Be Your Own Health Detective

Invited Talk

Personalized Life Extension Conference

San Francisco, CA

March 31, 2012

Dr. Larry Smarr

Director, California Institute for Telecommunications and Information Technology

Harry E. Gruber Professor,

Dept. of Computer Science and Engineering

Jacobs School of Engineering, UCSD

Follow me at http://lsmarr.calit2.net

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I am the Digitally-Enabled "Patient of the Future": Measuring the State of Your Body and "Tuning" It

Age 51





Age 61

I Arrived in La Jolla in 2000 After 20 Years in the Midwest and Discovered I was Pre-Diabetic

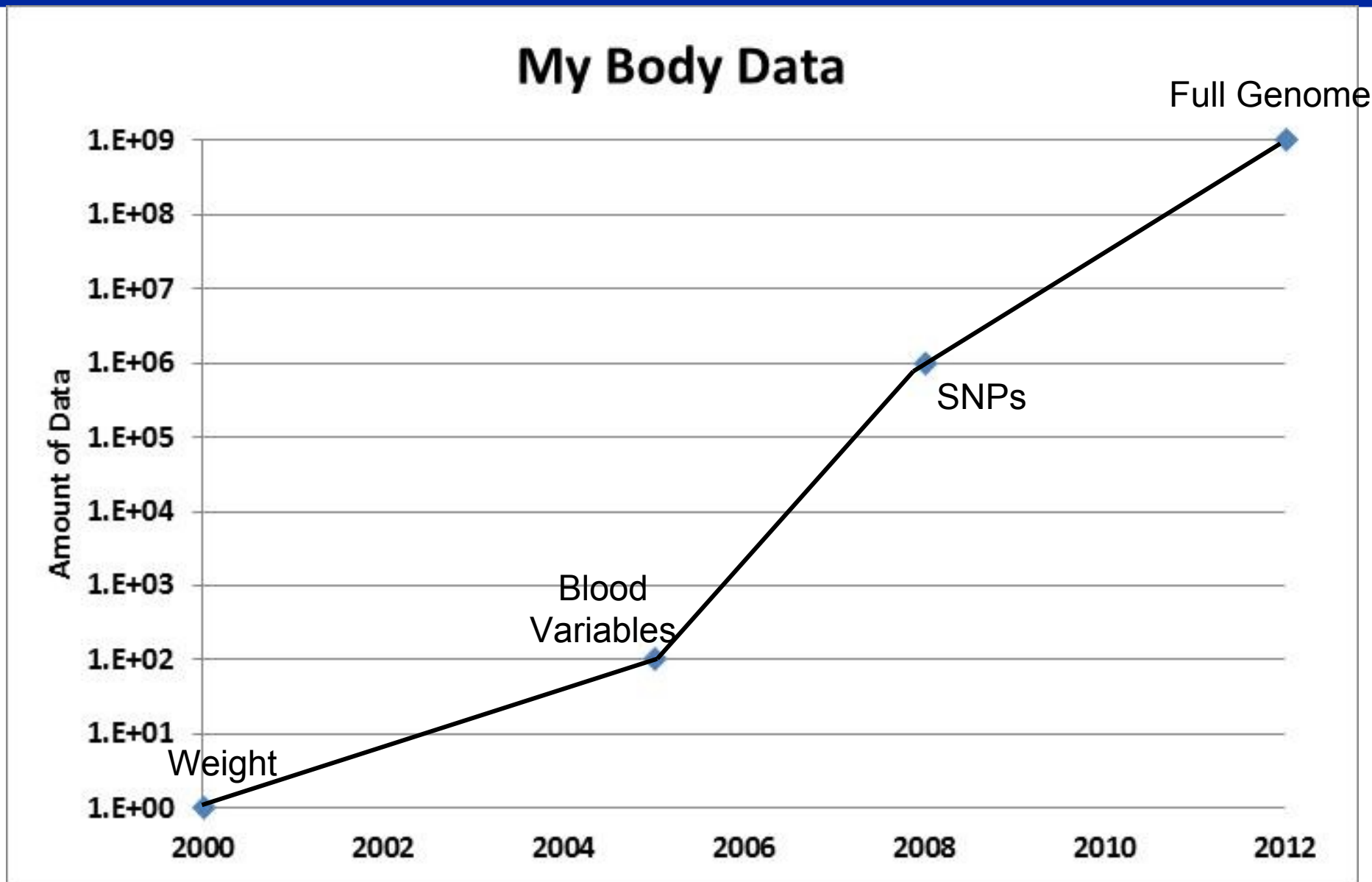
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From Measuring Macro-Variables to Measuring Your Internal Variables



www.technologyreview.com/biomedicine/39636

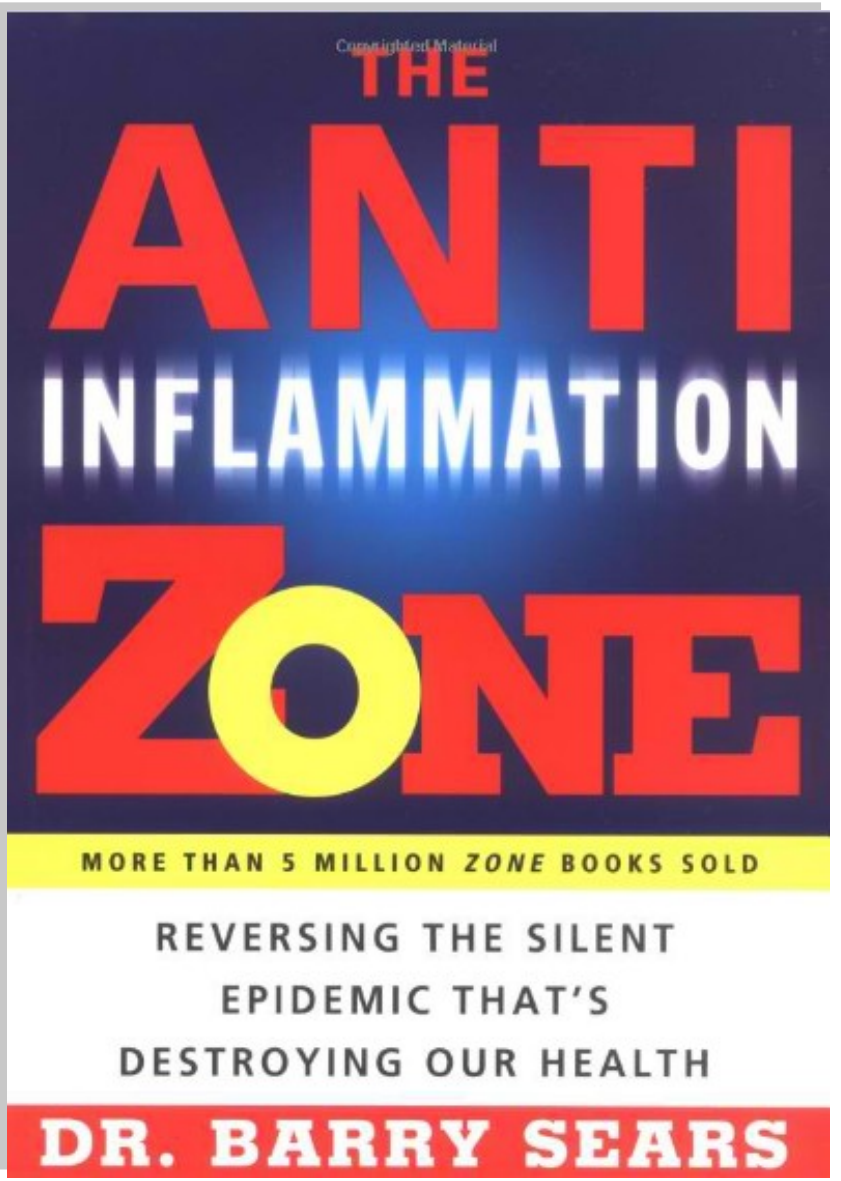
From One to a Billion Data Points Defining Me: The Exponential Rise in Body Data in Just One Decade!



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Tracking and Reducing Inflammation is Critical to Your Health



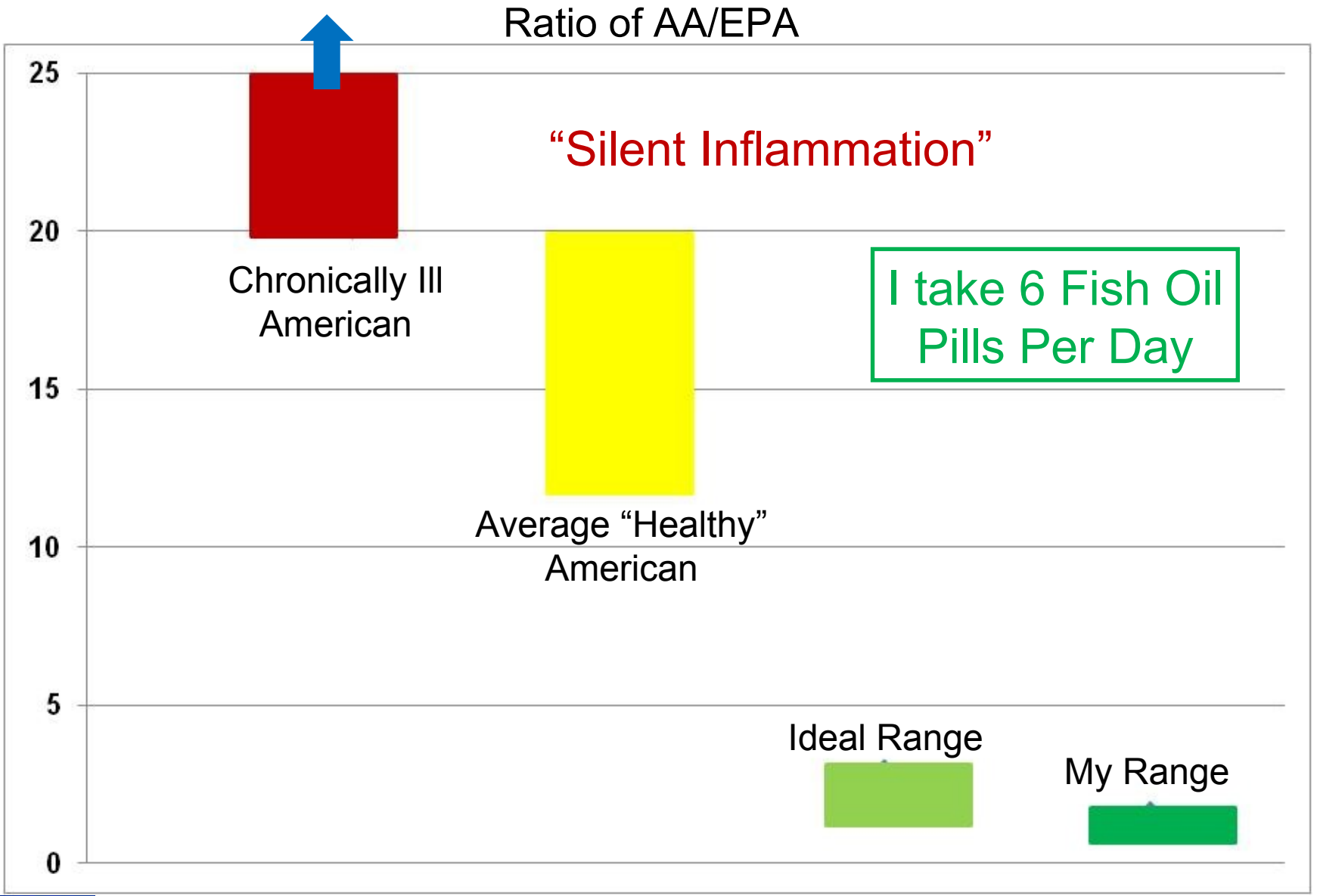


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2004

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I Have Greatly Lowered My Body's Inflammation From Food By Increasing Omega-3s



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Range Source: Barry Sears
My Tests by www.yourfuturehealth.com

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Blood Tests I Do Quarterly to Annually In Addition to Lipids

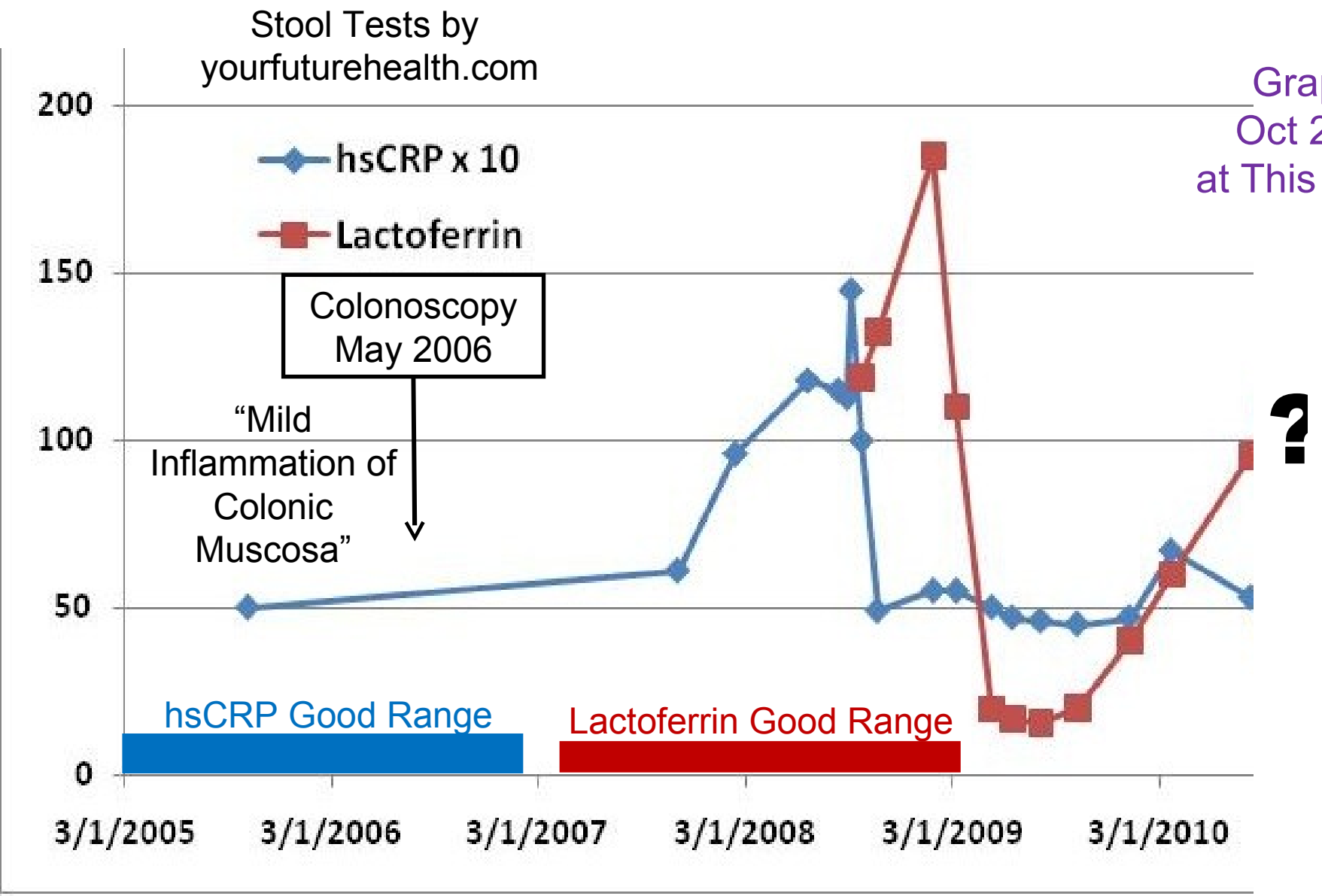
- **Electrolytes**
  - Sodium, Potassium, Calcium, Magnesium, Phosphorus, Boron, Chlorine, CO_2
- **Micronutrients**
  - Arsenic, Chromium, Cobalt, Copper, Iron, Manganese, Molybdenum, Selenium, Zinc
- **Blood Sugar Cycle**
  - Glucose, Insulin, A1C Hemoglobin
- **Cardio Risk**
  - Complex Reactive Protein
  - Homocysteine
- **Kidneys**
  - Bun, Creatinine, Uric Acid
- **Protein**
  - Total Protein, Albumin, Globulin
- **Liver**
  - GGTP, SGOT, SGPT, LDH, Total Direct Bilirubin, Alkaline Phosphatase
- **Thyroid**
  - T3 Uptake, T4, Free Thyroxine Index, FT4, 2nd Gen TSH
- **Blood Cells**
  - Complete Blood Cell Count
  - Red Blood Cell Subtypes
  - White Blood Cell Subtypes
- **Cancer Screen**
  - CEA, Total PSA, % Free PSA
  - CA-19-9
- **Vitamins & Antioxidant Screen**
  - Vit D, E; Selenium, ALA, coQ10, Glutathione, Total Antioxidant Fn.

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I Track Over 100 Blood Variables Over Time

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But, In Spite of My High Levels of Omega-3s, Blood & Stool Measurement Show Chronic Inflammation



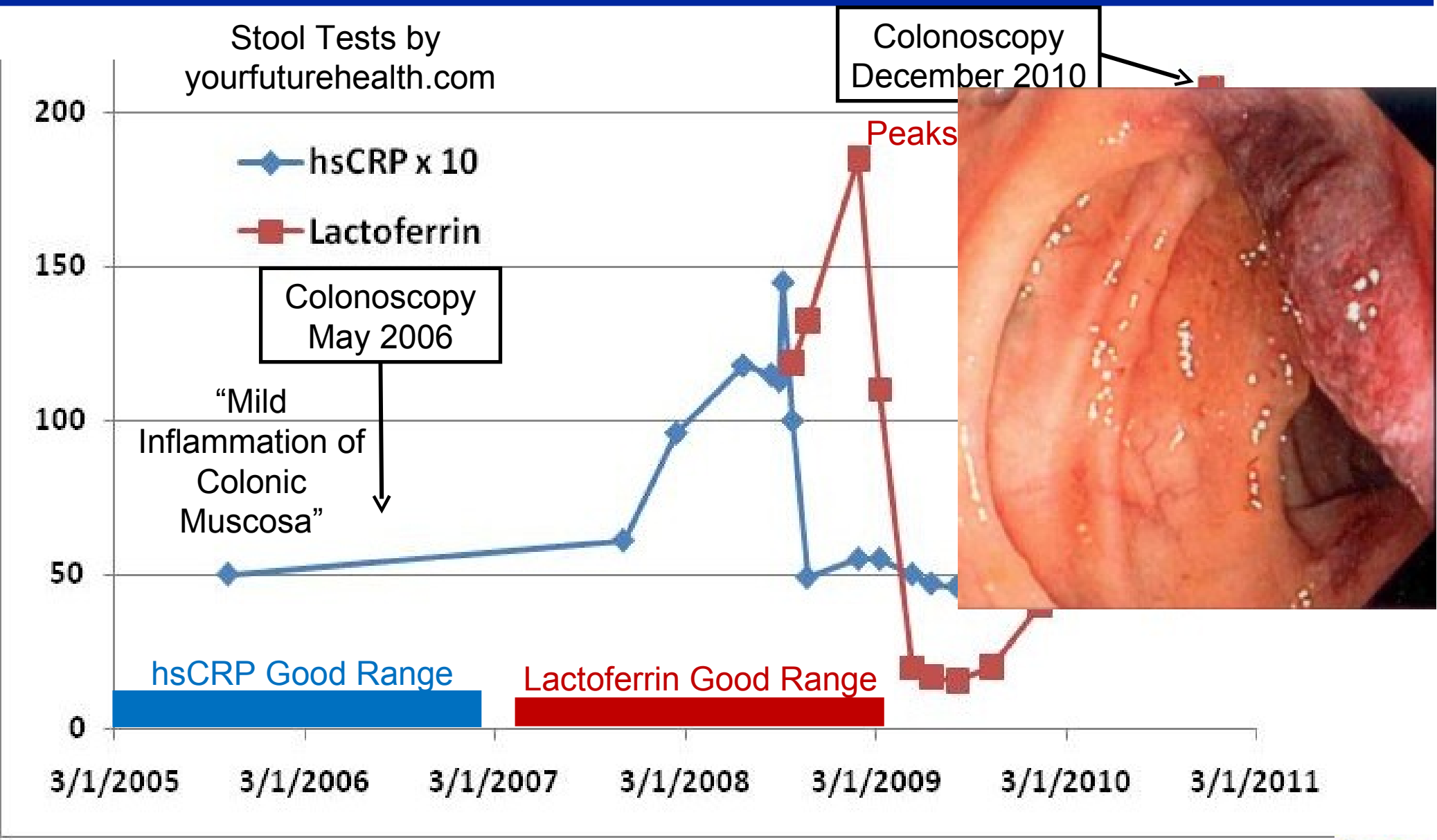
Graph From Oct 2010 Talk at This Conference

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High CRP Drives Arterial Plaque Formation

it²

Measuring Stool and Blood Markers Revealed Episodic Inflammation Peaks of CRP and Lactoferrin



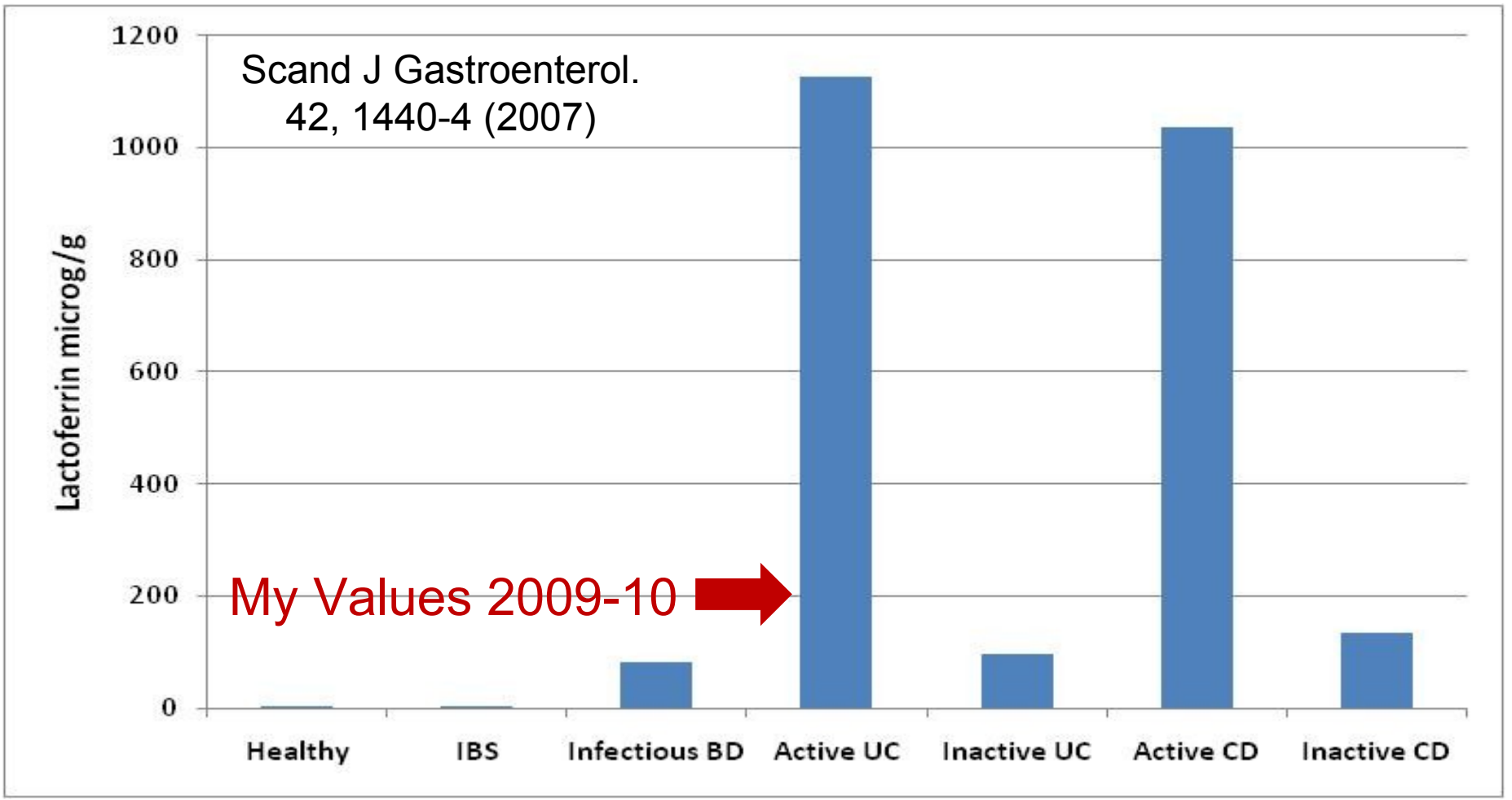
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Colonoscopy Revealed Inflamed Pseudopolyp
In Sigmoid Colon, Colon Otherwise Fine

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High Lactoferrin Biomarker Led Me to Hypothesis I Had Inflammatory Bowel Disease (IBD)

IBD is an Autoimmune Disease Which Comes in Two Subtypes: Crohn's and Ulcerative Colitis

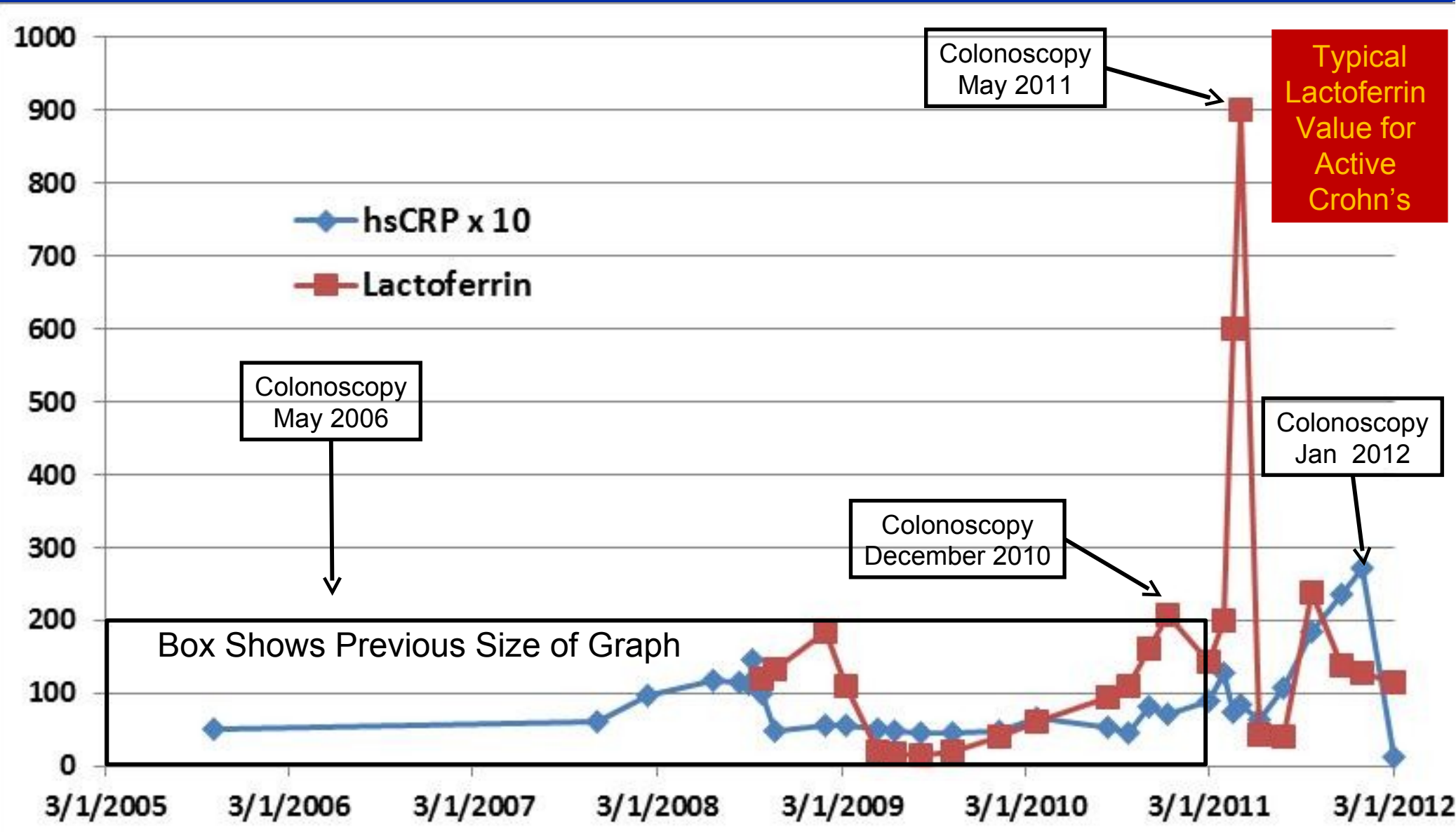


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Inflammatory Bowel Disease
Affects Over One Million Americans

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Latest Data Point Reveals Lactoferrin Spike to Active Crohn's Disease (CD) Level

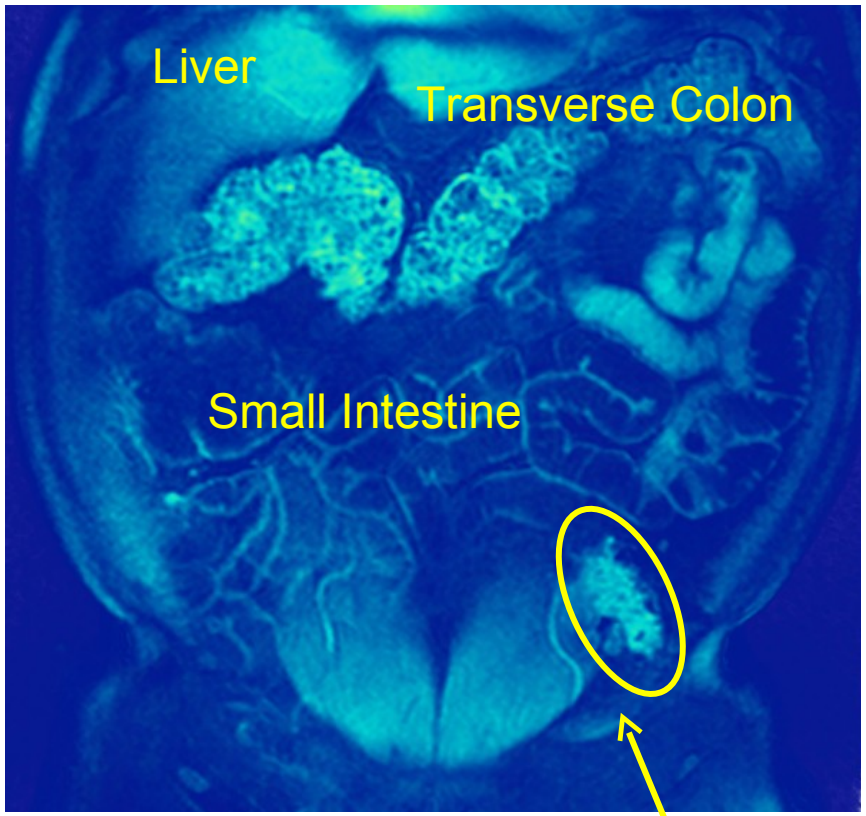


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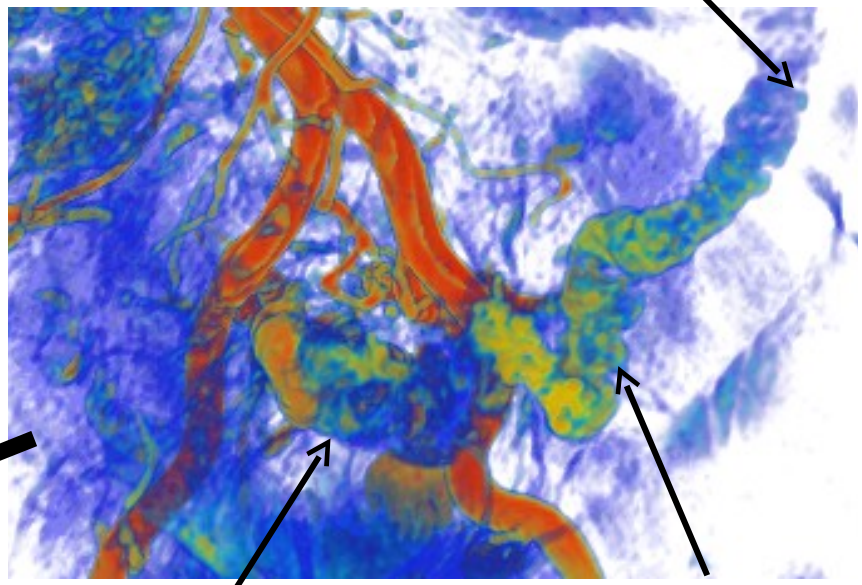
Colonoscopy and Biopsies Support CD Diagnosis

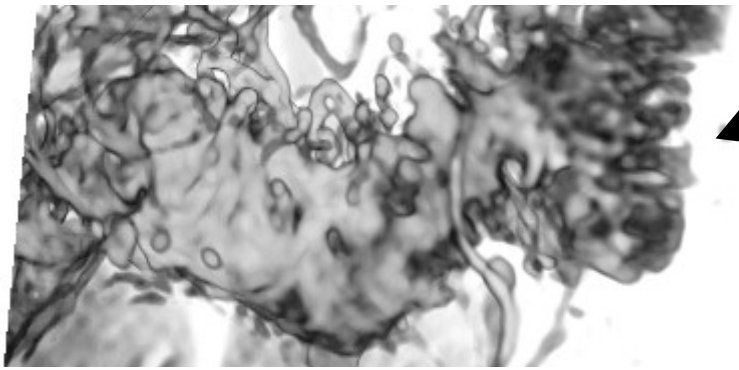
it²

Confirming the Crohn's Hypothesis: Finding the "Smoking Gun" with MRI Imaging



I Obtained the MRI Slices
From UCSD Medical Services
and Converted to Interactive 3D
Working With Calit2 Staff and Software

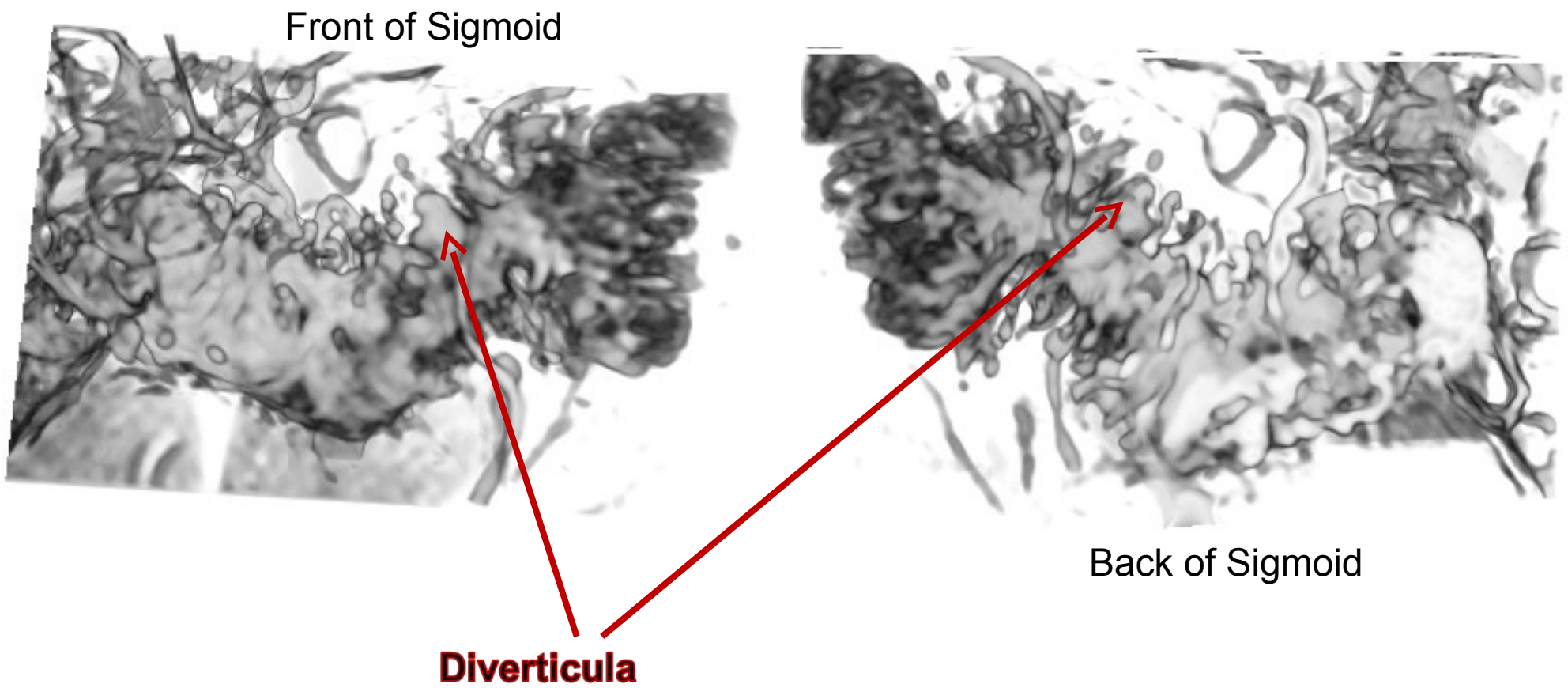




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Front and Back View of LS Diseased Sigmoid Colon

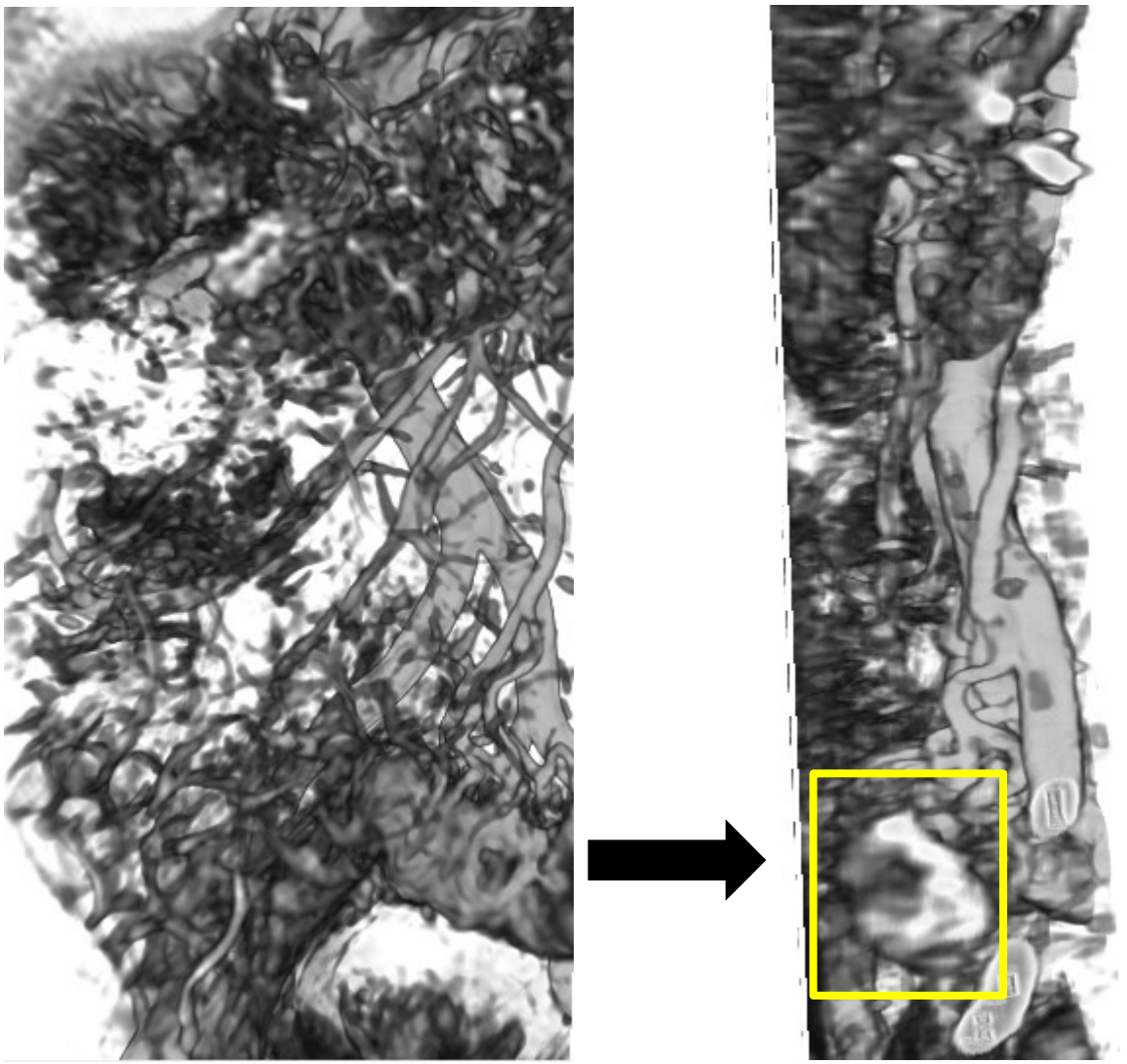


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mri-series14.dots on colon.xvf: 1 frame, 512 x 512 x 38 voxels, 2 bytes per channel, 1 channel

LS Sigmoid Colon Cross Sections Showing Inflamed Wall

Ulcerative Colitis is Restricted to the Mucosa, while Crohn's Disease Affects the Whole Bowel Wall

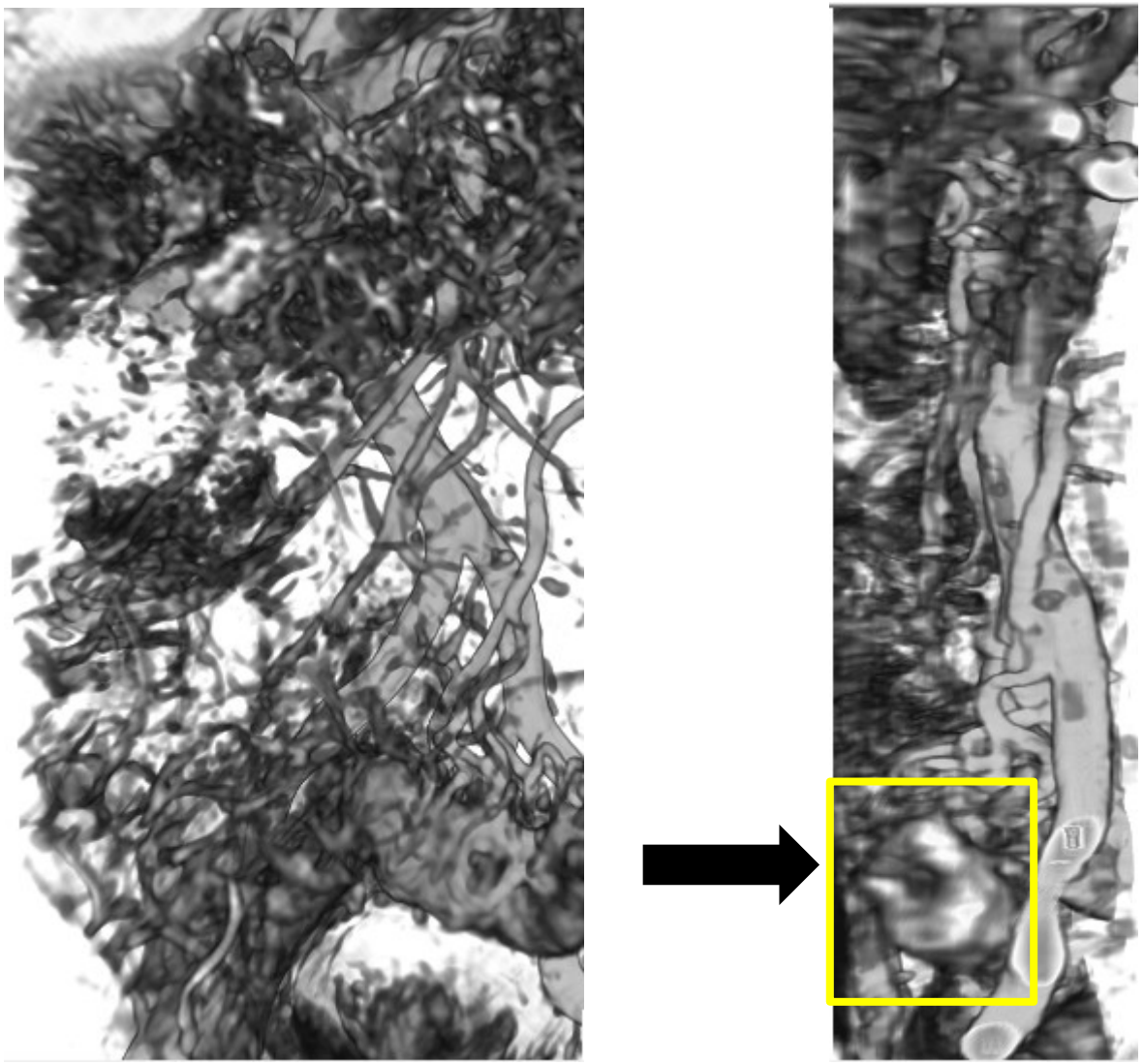


Note Thickness of Wall - Normal is 3mm (like a Balloon)

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LS Sigmoid Colon Cross Sections Showing Inflamed Wall

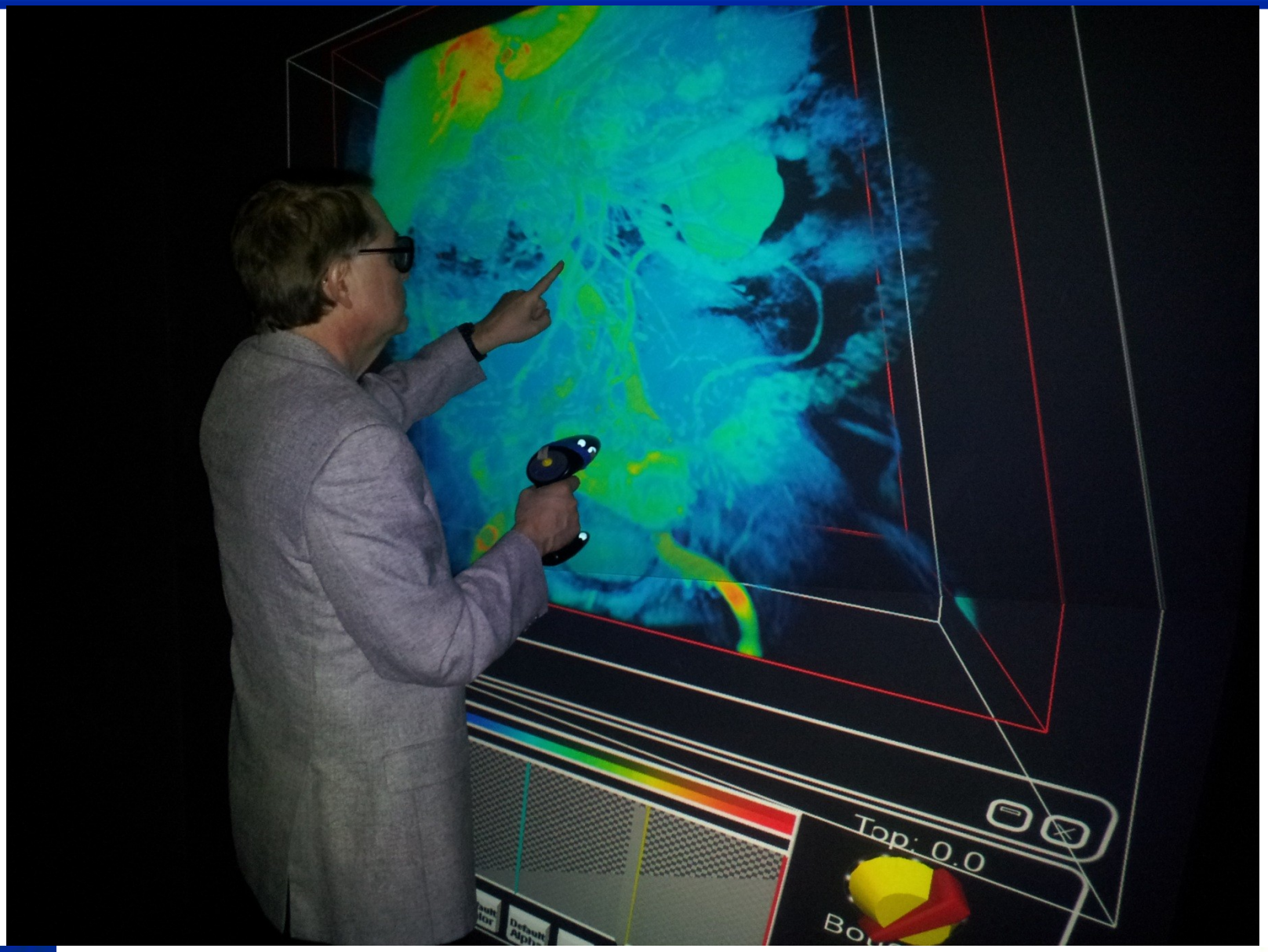


Note Small Opening In Colon

mri-series14.xvf: 1 frame, 512 x 512 x 40 voxels, 2 bytes per channel, 1 channel

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Exploring My Internal Organs in the Calit2 Virtual Reality CAVE Using DeskVOX Software



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Photo & DeskVOX Software Courtesy of Jurgen Schulze, Calit2

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Autoimmune Diseases
Effect 5-8% of Americans

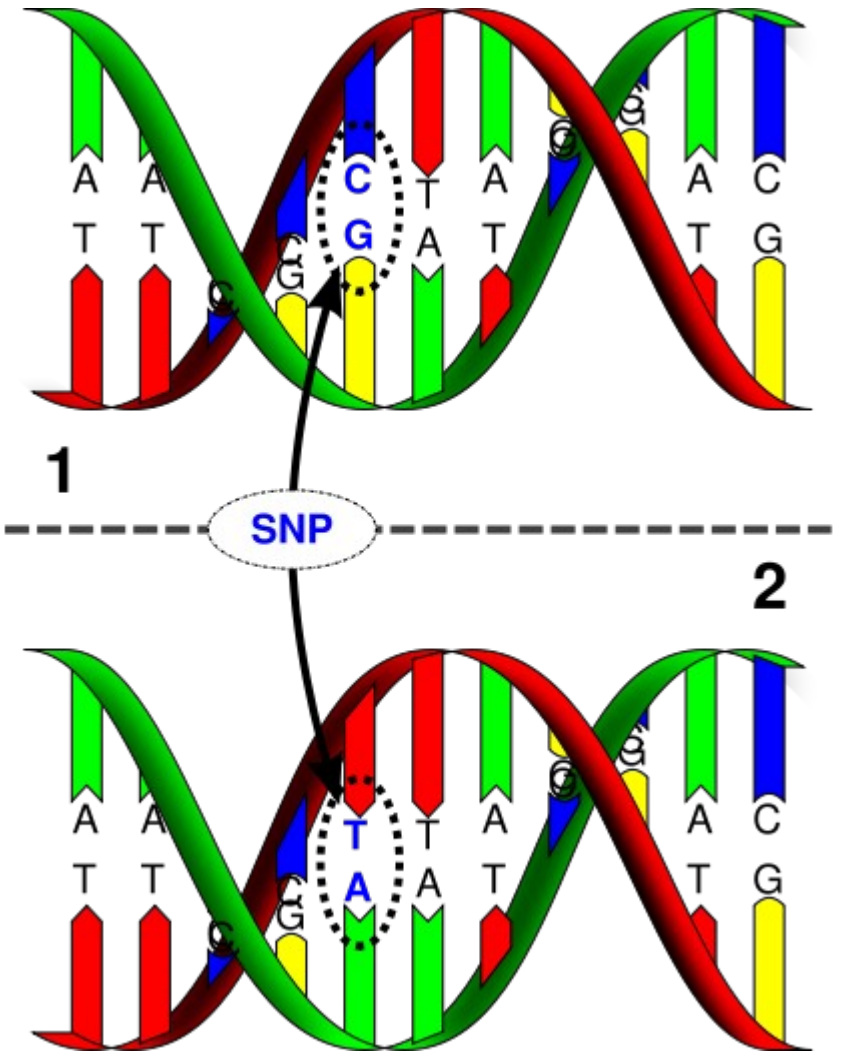
- **Crohn's Disease**
- **Ulcerative Colitis**
- **Rheumatoid Arthritis**
- **Multiple Sclerosis**
- **Psoriasis**
- **Type 1 Diabetes,**
- **Ankylosing Spondylitis**
- **Lupus Erythematosus**
- **Plus Over 70 Others**

Despite decades of research, the etiology of Crohn's disease remains unknown.
Its pathogenesis may involve a complex interplay between host genetics, immune dysfunction, and microbial or environmental factors.

--*The Role of Microbes in Crohn's Disease*
Paul B. Eckburg & David A. Relman
Clin Infect Dis. 44:256-262 (2007)

Single Nucleotide Polymorphisms (SNPs) Make Up About 90% of All Human Genetic Variation

Person A



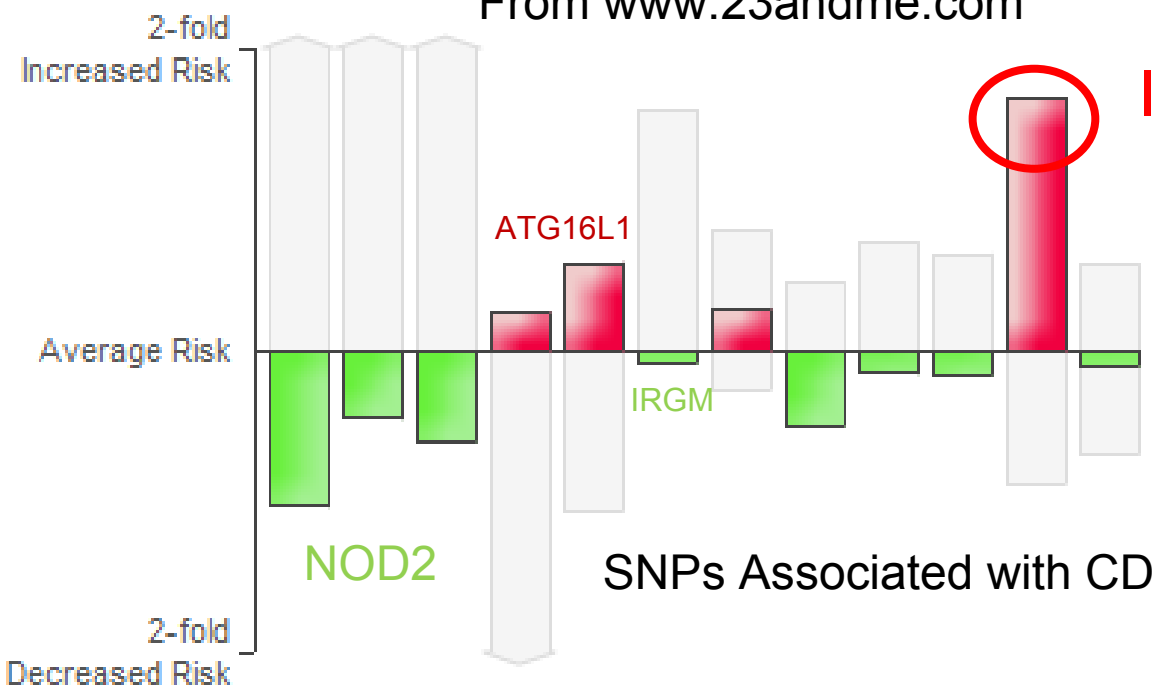
Person B

SNPs Occur Every 100 to 300 Bases Along Human DNA

www.23andme.com Tracks One Million SNPs

I Wondered if Crohn's is an Autoimmune Disease, Did I Have a Personal Genomic Polymorphism?

From www.23andme.com



Polymorphism in Interleukin-23 Receptor Gene — 80% Higher Risk of Pro-inflammatory Immune Response

News and Views

Nature Medicine **13**, 26 - 28 (2007)
doi:10.1038/nm0107-26

IL-23: a master regulator in Crohn disease

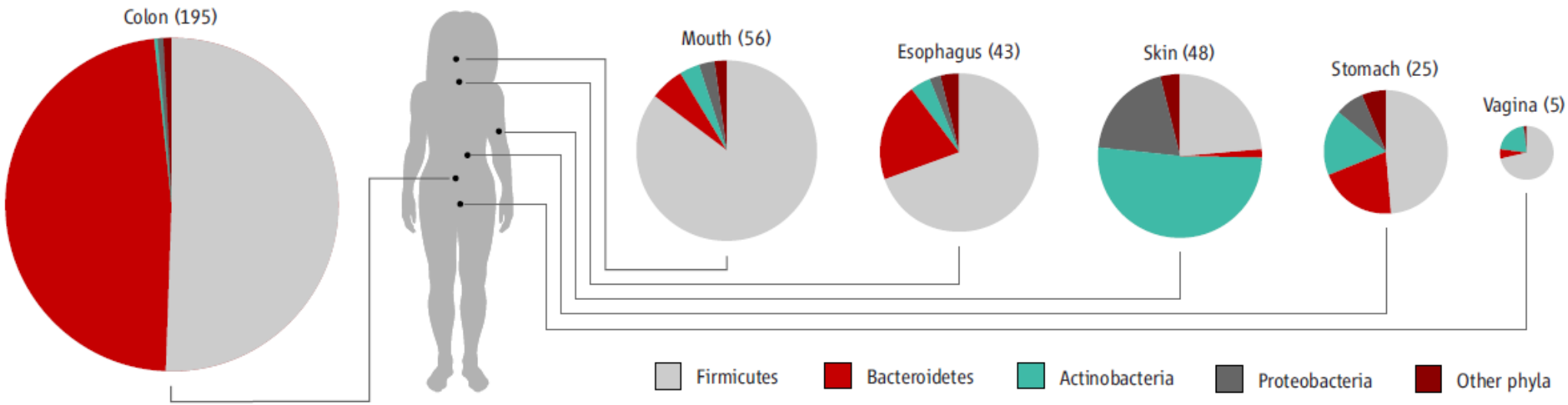
Markus F Neurath[1]

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You are a Superorganism:
Your Body Has Ten Microbes for Every Human Cell!

Human Microbiome Project

The NIH Common Fund
WE ACCELERATE DISCOVERY.



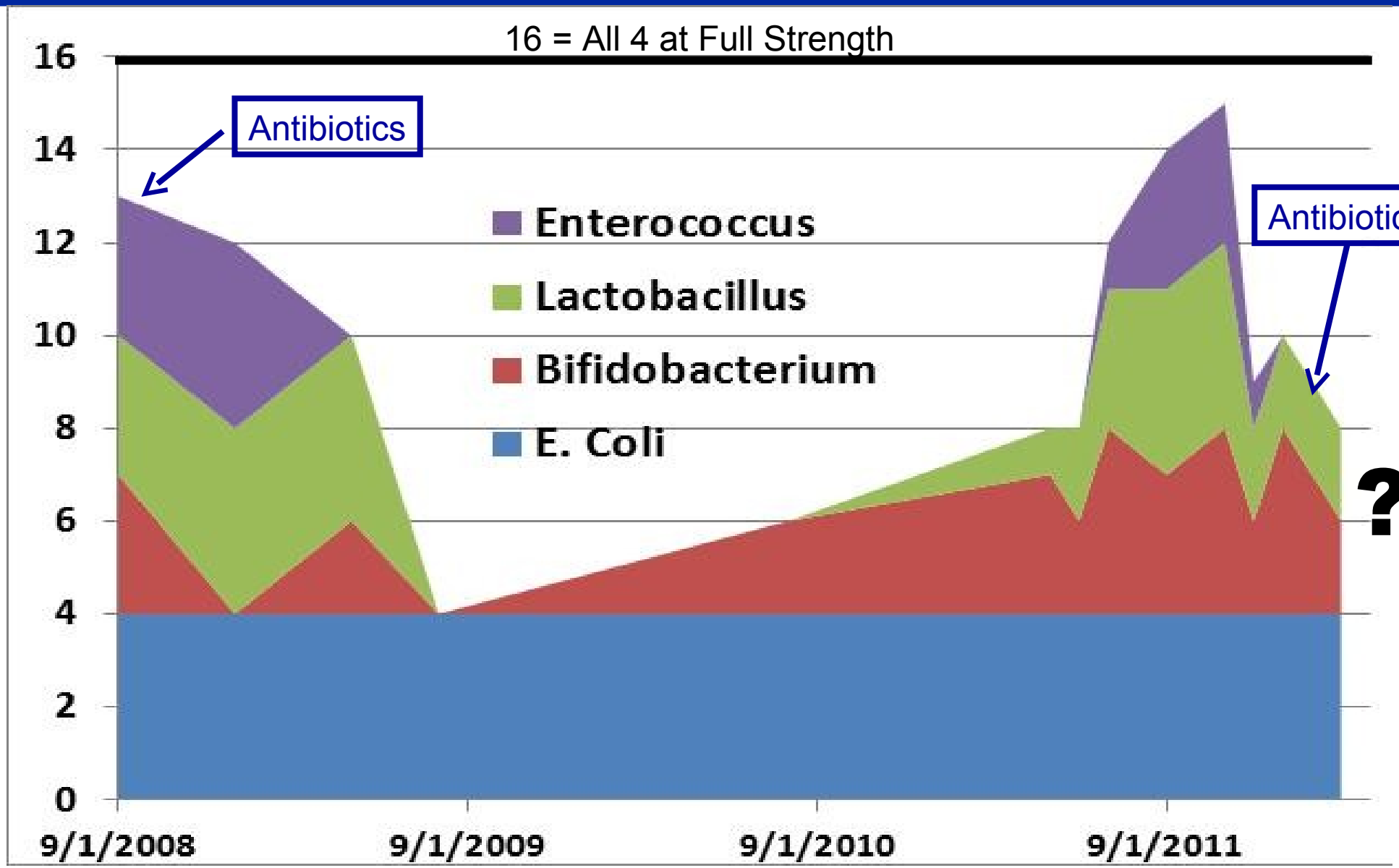
Firmicutes Are the Dominant Phyla
in the Human Microbiome

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Science v.330, p. 1619 (2010)

it²

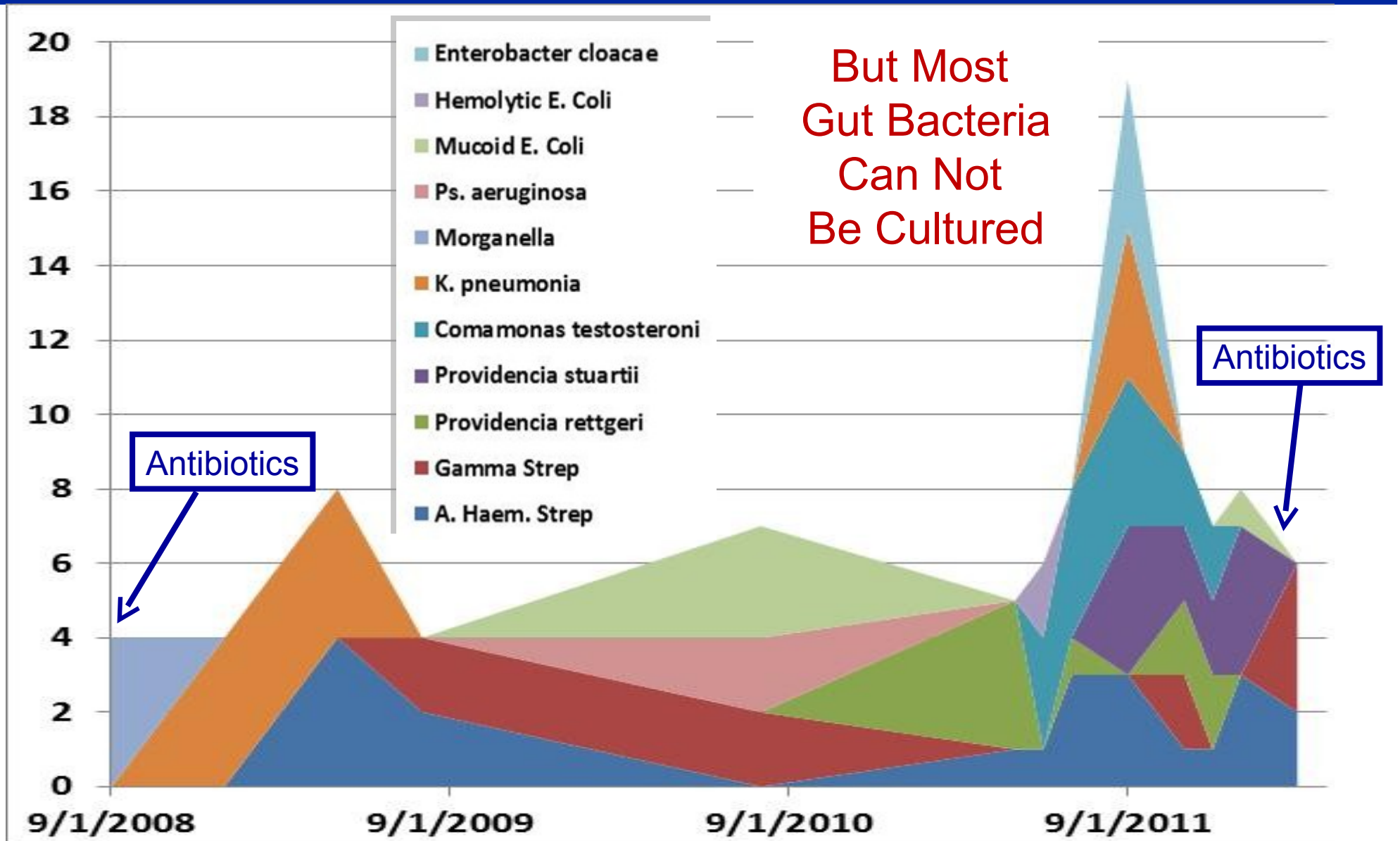
Except for E. Coli, My "Good" Cultured Gut Bacteria Collapsed After Antibiotics



Antibiotics: Levaquin & Metronidaloze

Values From www.yourfuturehealth.com stool test

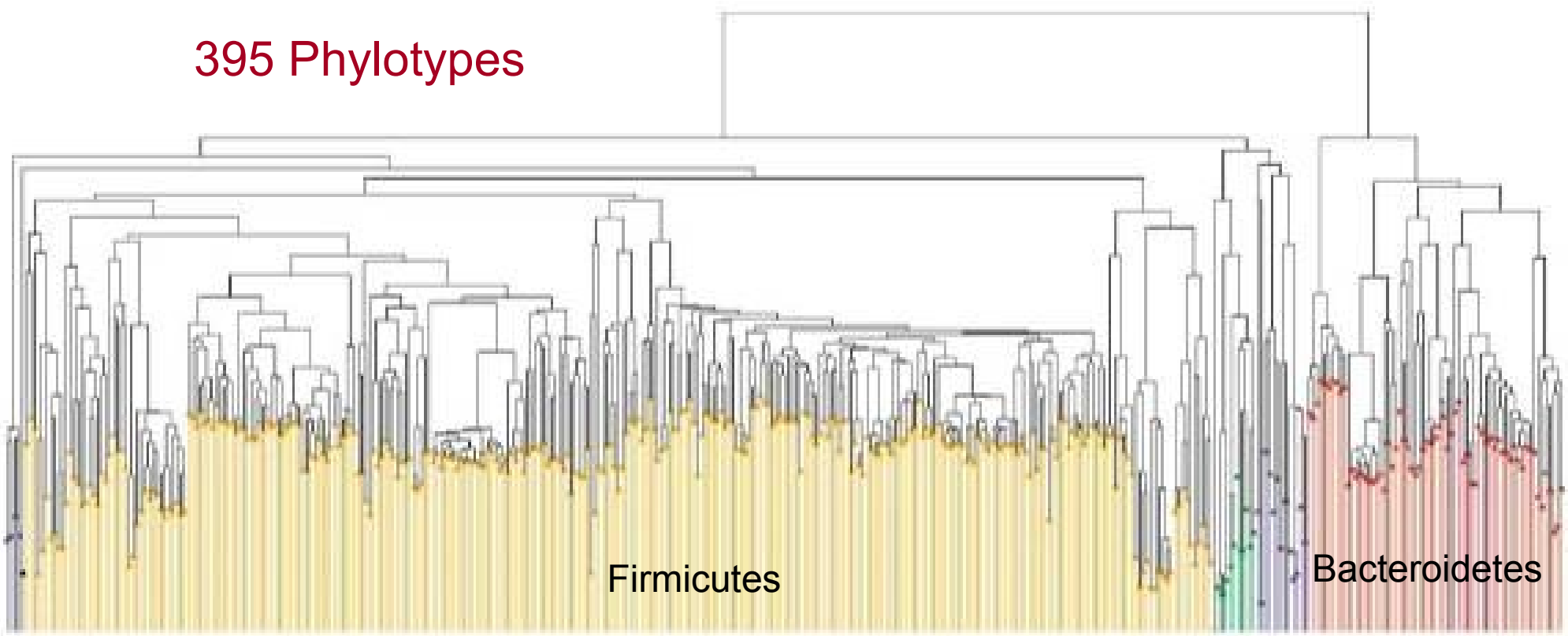
My Cultured "Bad" Dysbiotic Bacteria Have Been Flourishing



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The Gut Microbiome Has Been Mapped in the Last Five Years Using Genome Sequencing

"A majority of the bacterial sequences corresponded to uncultivated species and novel microorganisms."

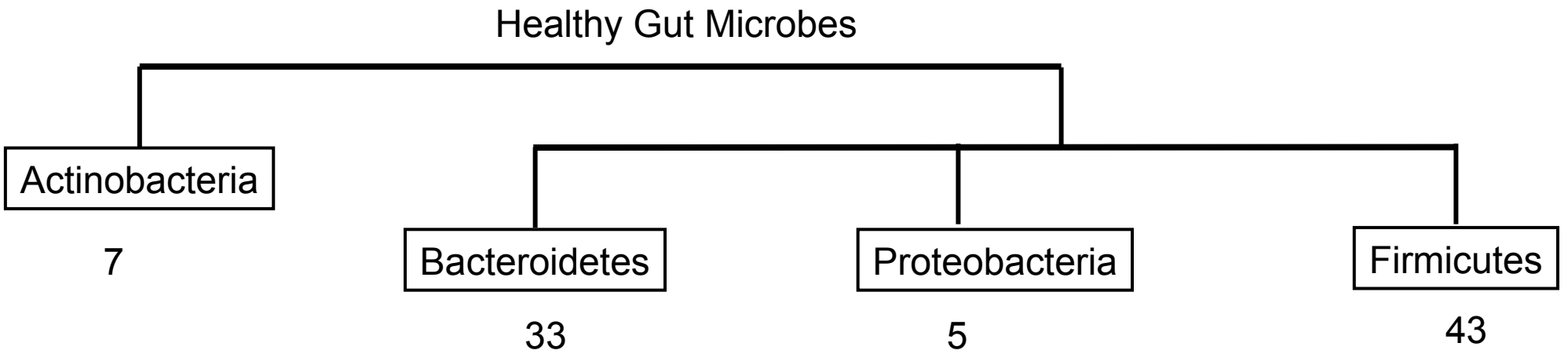


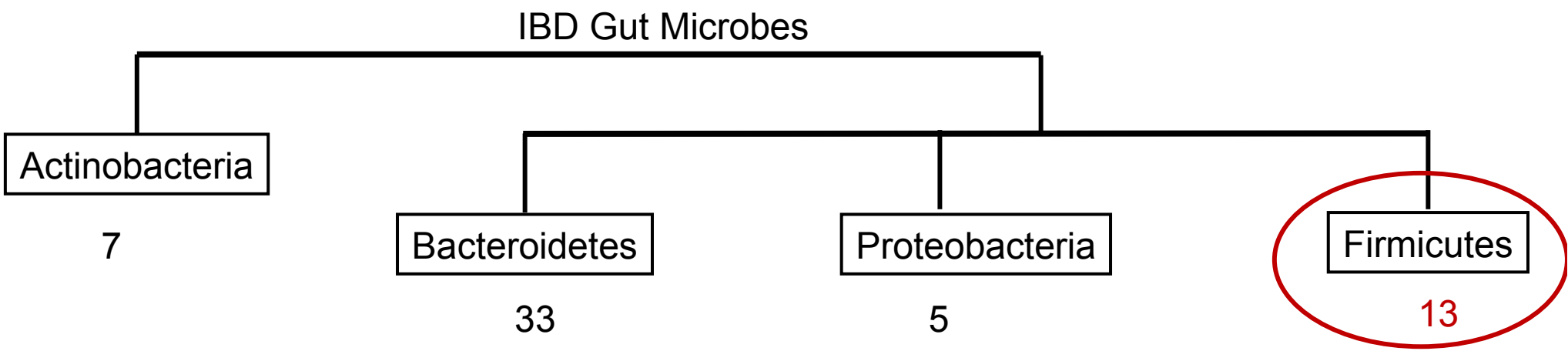
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"Diversity of the Human Intestinal Microbial Flora"
Paul B. Eckburg, et al *Science* 308, 1635-8 (2005)

it²

Crohn's Disease Patients Have Number of Firmicute Gut Microbe Species Reduced by Over 2/3!





The Missing Firmicutes Inhibit Pro-Inflammation

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Manichanh, et al, *Gut* 2006;55:205–211

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Can Increasing Use of Antibiotics and Western Diet Be Causing Increase in IBD?

"Importantly, changes in diet, use of antibiotics, … have likely modified intestinal microbial communities and contributed to the increased prevalence of IBD during the past century."

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Nature Reviews Immunology 9, 313-323 (2009)

it²

Next Step: Use Microarray to Measure Time Series of Microbial Diversity

www.secondgenome.com

SECOND GENOME
THE MICROBIOME COMPANY



LBL's Gary Andersen and his PhyloChip

"Second Genome has developed a sensitive, flexible and robust platform for the identification of microbiome-based signatures for the rapid identification of microbial gut health biomarkers."

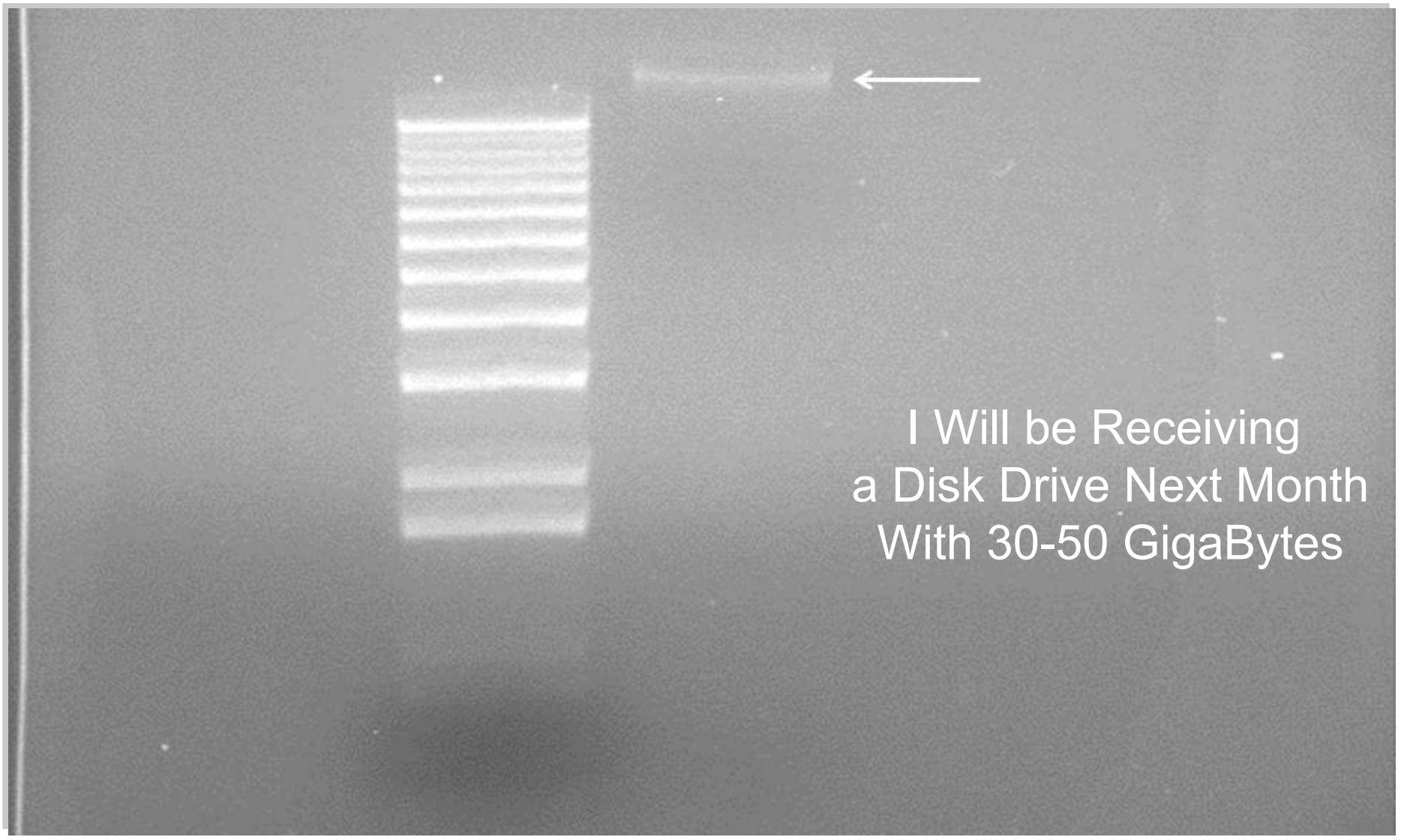
DNA microarray that can identify, within hours, over 50,000 different microbes



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First Stage of Metagenomic Sequencing of My Gut Microbiome at J. Craig Venter Institute



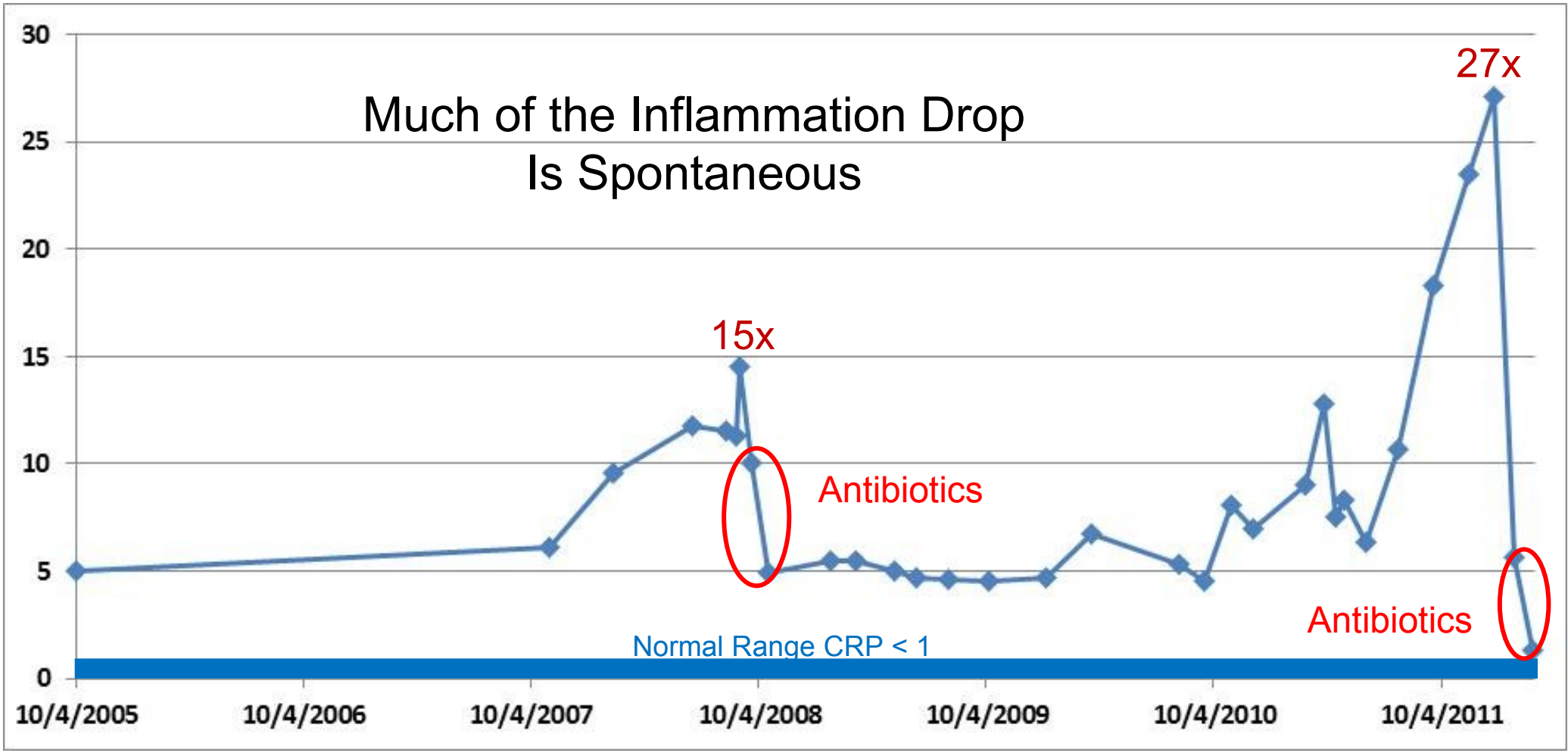
Gel Image of Extract from Smarr Sample-Next is Library Construction

Manny Torralba, Project Lead - Human Genomic Medicine
J Craig Venter Institute

January 25, 2012

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Sadly, Because of the Colon Wall Inflammation I Have Taken 1 Month Antibiotics & 2 Months Prednisone



However, Stool Calprotectin Inflammation Biomarker Doubled During the Last Month!

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Evidence for the Efficacy of Probiotics is IBD is Mixed - More Clinical Research Needed

VSL#3 Probiotic-Mixture Induces Remission in Patients with Active Ulcerative Colitis Am J Gastroenterol 2005;100:1–8

Probiotics for Inflammatory Bowel Disease: A Critical Appraisal Dig Dis 2009;27(suppl 1):111–114

"...there is virtually no evidence of probiotic efficacy in Crohn's disease."



Butyric acid-producing anaerobic bacteria as a novel probiotic treatment approach for inflammatory bowel disease

J Med Microbiol **February 2010**
vol. 59 no. 2 **141–143**

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I Take a Probiotic "Cocktail" to Enhance Microbial Diversity-48 Species of Bacteria

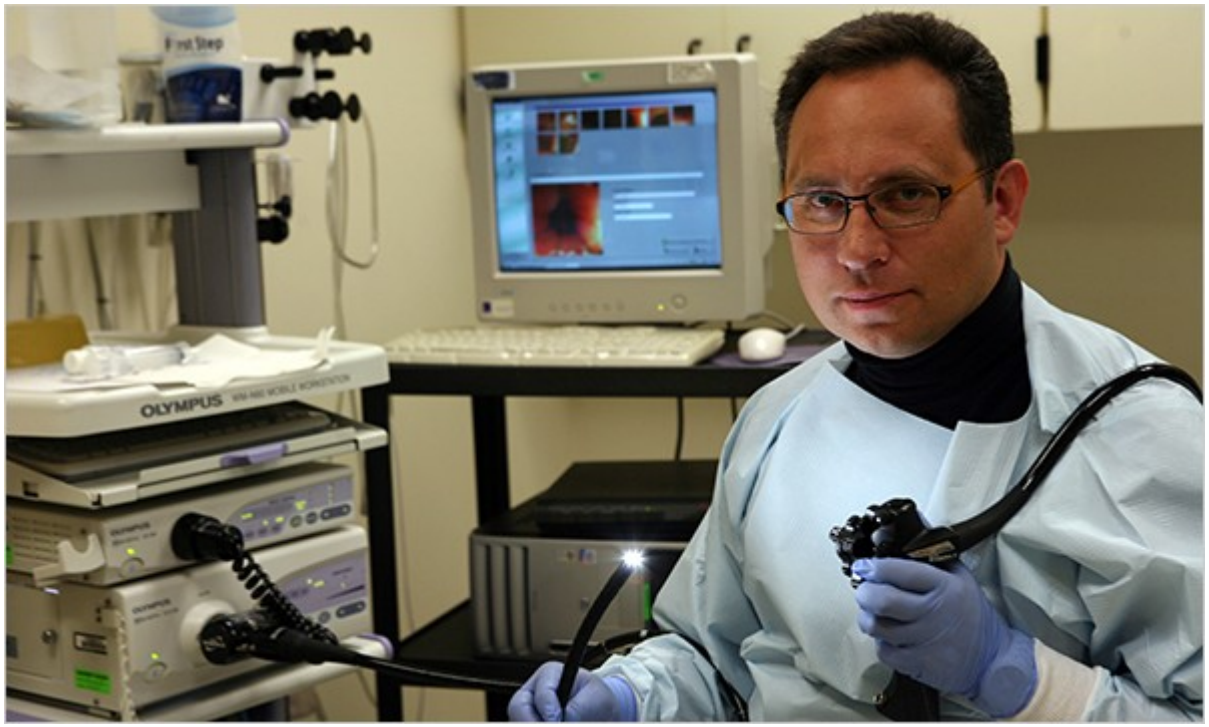
Jarro	Jarro	VSL#3	HLC	Flora V	Prescript	Keefer
Dophilus	Dophilus		Intensive		Assist	
EPS	FOS					

- Genera Covered:
  - Azospirillum
  - Azotobacter
  - Bacillus
  - Bacteriodes
  - Bifidobacteria
  - Brevibacterium
  - Kurtha
  - Lactobacillus

- **Genera Covered:**
  - **Lactococcus**
  - **Leuconostoc**
  - **Myrothecium**
  - **Pediococcus**
  - **Phanerochaete**
  - **Pseudomonas**
  - **Streptococcus**
  - **Streptomyces**

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Fecal Transplants
May Be a Radical New Treatment for IBD



Dr. Alexander Khoruts, NY Times
www.nytimes.com/2010/07/13/science/13micro.html

The Advantage:

A Mature Biochemically-Integrated Microbial Ecology is Transferred, In Contrast to a Collection of Individual Microbial Species as in Probiotics

Not FDA Approved;
Very Few Doctors Performing Procedure;
Essential No Clinical Trials So Far;
But, Encouraging Results…

www.gihealthfoundation.org/reuters/articles.cfm?article=20111102drgd011

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Publically Sharing Your Genome and Medical Records: Is it Crazy or the Future?

World DNA Day: April 25, 2012

GET Genomes Environments Traits CONFERENCE

I Have Been Accepted by PGP and Will Speak at GET 2012:
My Full Genome (6 Billion Bases) Will Be Sequenced This Year

Personal Genome Project

Posted 06.01.08 | NOVA scienceNOW

The Personal Genome Project, spearheaded by George Church of Harvard's Center for Computational Genetics, aims to recruit 100,000 people willing to offer up their DNA and personal life histories. It's all in an effort to further knowledge of human genetics and why we get—or don't get—diseases.

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www.personalgenomes.org

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From “How Do You Feel?”, to “What Are Your Numbers?”

Where’s There’s Data
There’s Hope

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