# Harnessing the Power of Data From Our Bodies – What I Have Learned by Measuring Myself

**Invited Talk**

**Diamond Management & Technology Consultants Meeting**

**"Taming the Torrent: Harnessing the Power of Data"**

**Kohler, WI**

**October 5, 2010**


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 on Twitter: lsmarr


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# Calit2 Has Been Had a Vision of "the Digital Transformation of Health" for a Decade

- **Next Step—Putting You On-Line!**
  - Wireless Internet Transmission
  - Key Metabolic and Physical Variables
  - Model -- Dozens of Processors and 60 Sensors / Actuators Inside of our Cars

www.bodymedia.com



- **Post-Genomic Individualized Medicine**
  - Combine
    - Genetic Code
    - Body Data Flow
  - Use Powerful AI Data Mining Techniques

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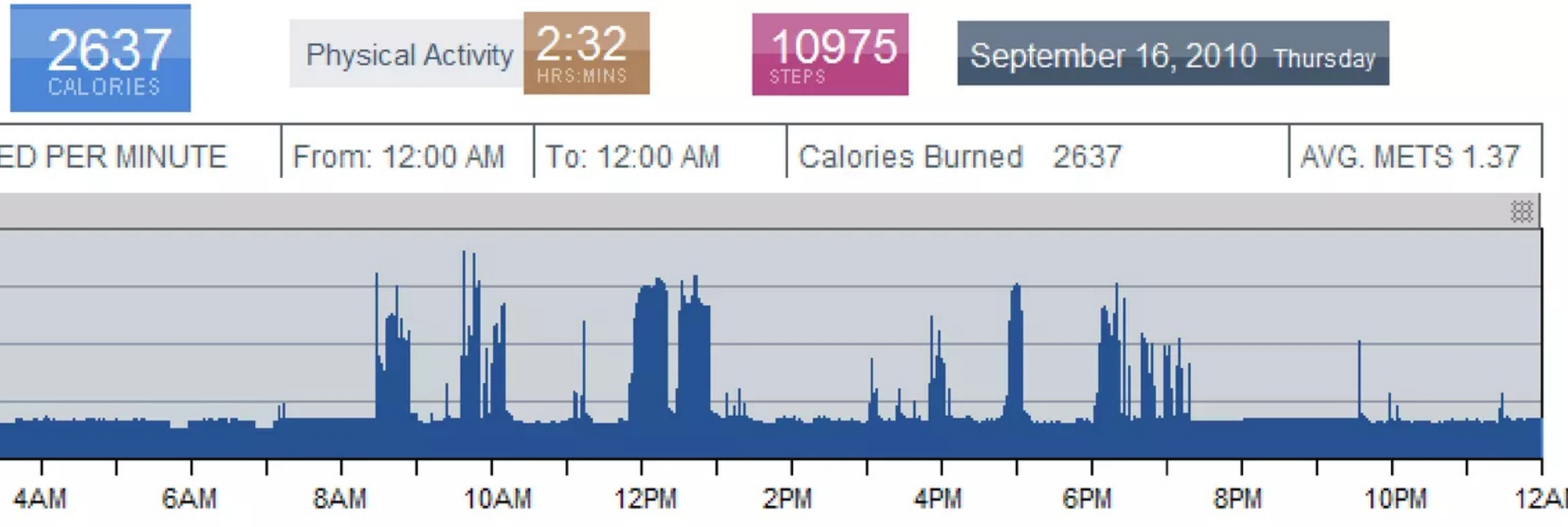
The Content of This Slide from 2001 Larry Smarr Calit2 Talk on Digitally Enabled Genomic Medicine

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# Nine Years Later I Am Recording My Metabolic Self

BODYMEDIA®
Know your Body. Change your life

www.bodymedia.com



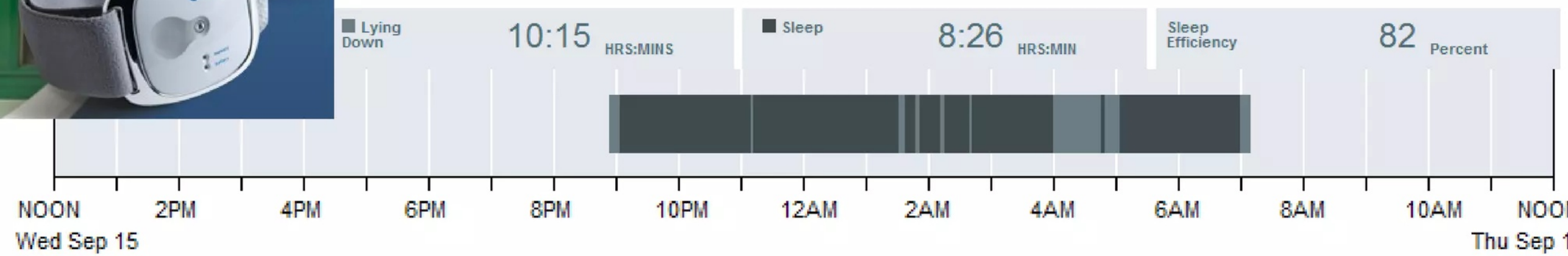



## 7 Week Ave:

2550 Calories Burned/Day

1:31 hr Physical Activity/Day (>3 METs)

7755 Steps/Day (~3.9 Miles)




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## Measure Quantity and Quality of Sleep--

7 Week Ave: 6:55 hrs with 81% Efficiency

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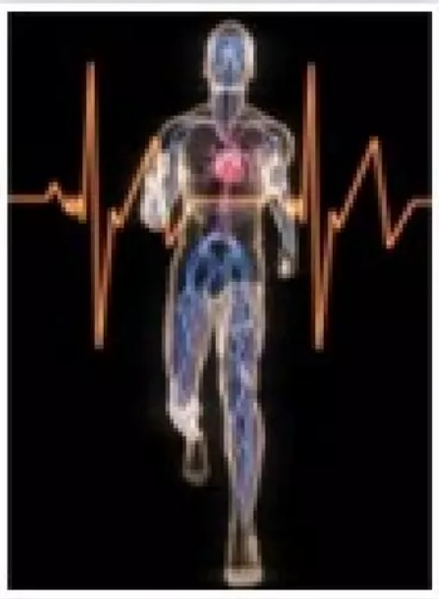
# There Are a Rapidly Growing Set of Tests and Strategies for Improving Health and Living Longer

I am Actively Engaged in All These

Personalized
Life Extension Conference

October 9-10, 2010
San Francisco Airport Marriott

## Strategies and Tactics for a Long Healthy Life



- ✓ Supplements
- ✓ DNA Testing
- ✓ Telomere Protection
- ✓ Blood Testing
- ✓ Finding a Life Extension Doctor
- ✓ Gadgets
- ✓ Inflammation
- ✓ Calorie Restriction & Intermittent Fasting
- ✓ Sleep
- ✓ Stress reduction
- ✓ Self-experimentation
- ✓ Exercise
- ✓ Enhancement & Brain Function
- ✓ Eating
- ✓ Standards of Information Quality
- ✓ Mood

READ MORE

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http://lifeextensionconference.com/

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# Leading Causes of Preventable Deaths in the United States in the Year 2000




| Cause | Number of deaths resulting |
|---|---|
| Tobacco Smoking | 435,000 deaths or 18.1% of the total deaths |
| Overweight and Obesity | 365,000 deaths or 15.2% of the total deaths. |
| Alcohol consumption | 85,000 deaths or 3.5% of the total deaths. |
| Infectious diseases | 75,000 deaths or 3.1% of the total deaths. |
| Toxicants | 55,000 deaths or 2.3% of the total deaths. |
| Traffic collisions | 43,000 deaths or 1.8% of the total deaths. |
| Incidents involving firearms | 29,000 deaths or 1.2% of the total deaths. |
| Sexually transmitted diseases | 20,000 deaths or 0.8% of the total deaths. |
| Drug abuse | 17,000 deaths or 0.7% of the total deaths. |

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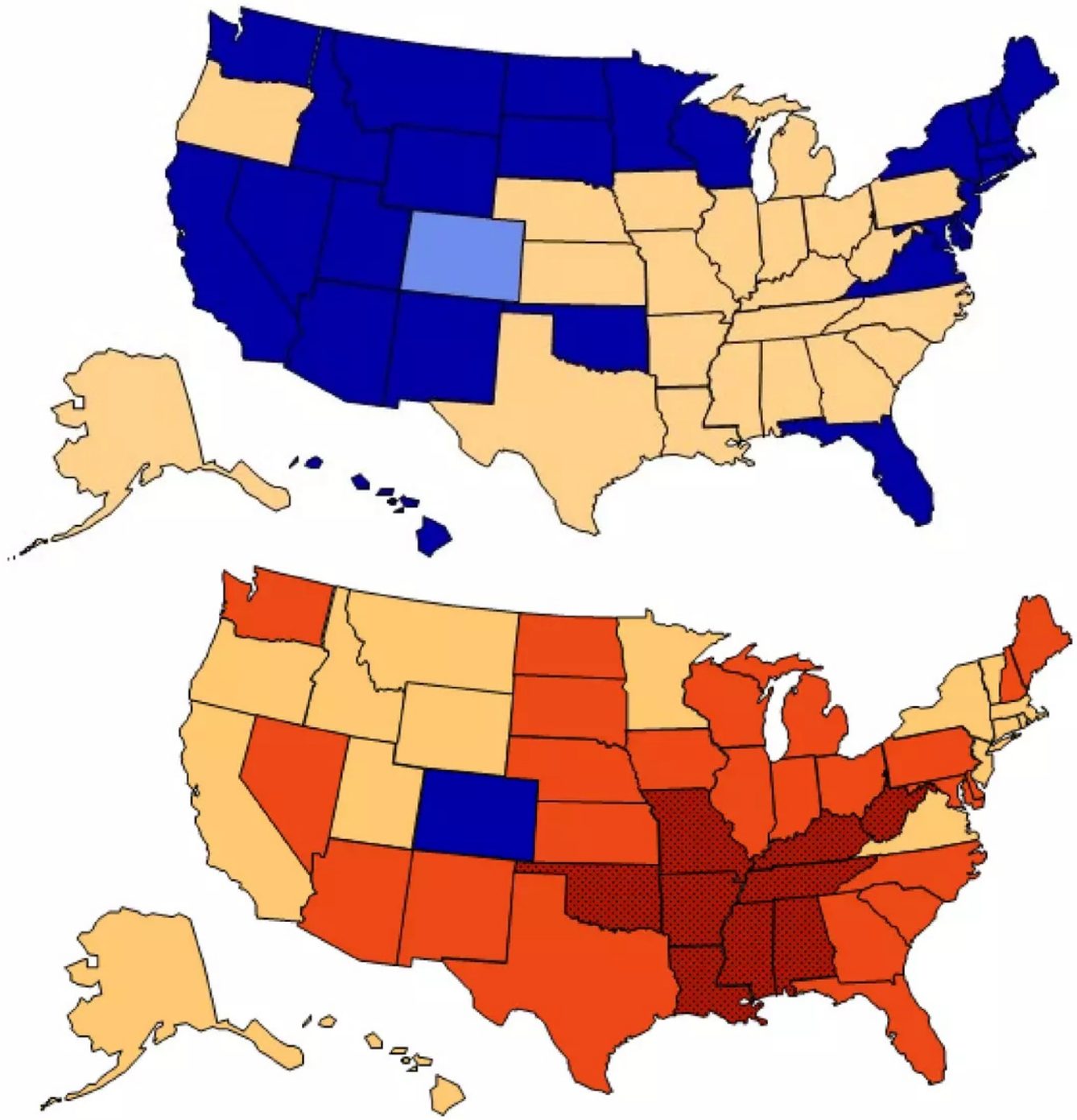
Mokdad AH, Marks JS, Stroup DF, Gerberding JL (March 2004).
"Actual causes of death in the United States, 2000". JAMA 291 (10): 1238–45.
doi:10.1001/jama.291.10.1238. PMID 15010446. www.csdp.org/research/1238.pdf.

# During the 2000s, The Fraction of the Population That is Overweight or Obese Has Greatly Increased

Source: Behavioral Risk Factor Surveillance System, CDC

2000

2009






(*BMI ≥30, or ~ 30 lbs. overweight for 5’ 4” person)

# There are a Growing Number of People Who are Measuring and "Tuning" the State of Their Bodies

www.xconomy.com/san-diego/2010/05/12/how-internet-pioneer-larry-smarr-lost-20-pounds-by-becoming-a-quantified-self/

HEALTH IT, PEOPLE, WIRELESS

## How Internet Pioneer Larry Smarr Lost 20 Pounds by Becoming a "Quantified Self"

Luke Timmerman 5/12/10



2000



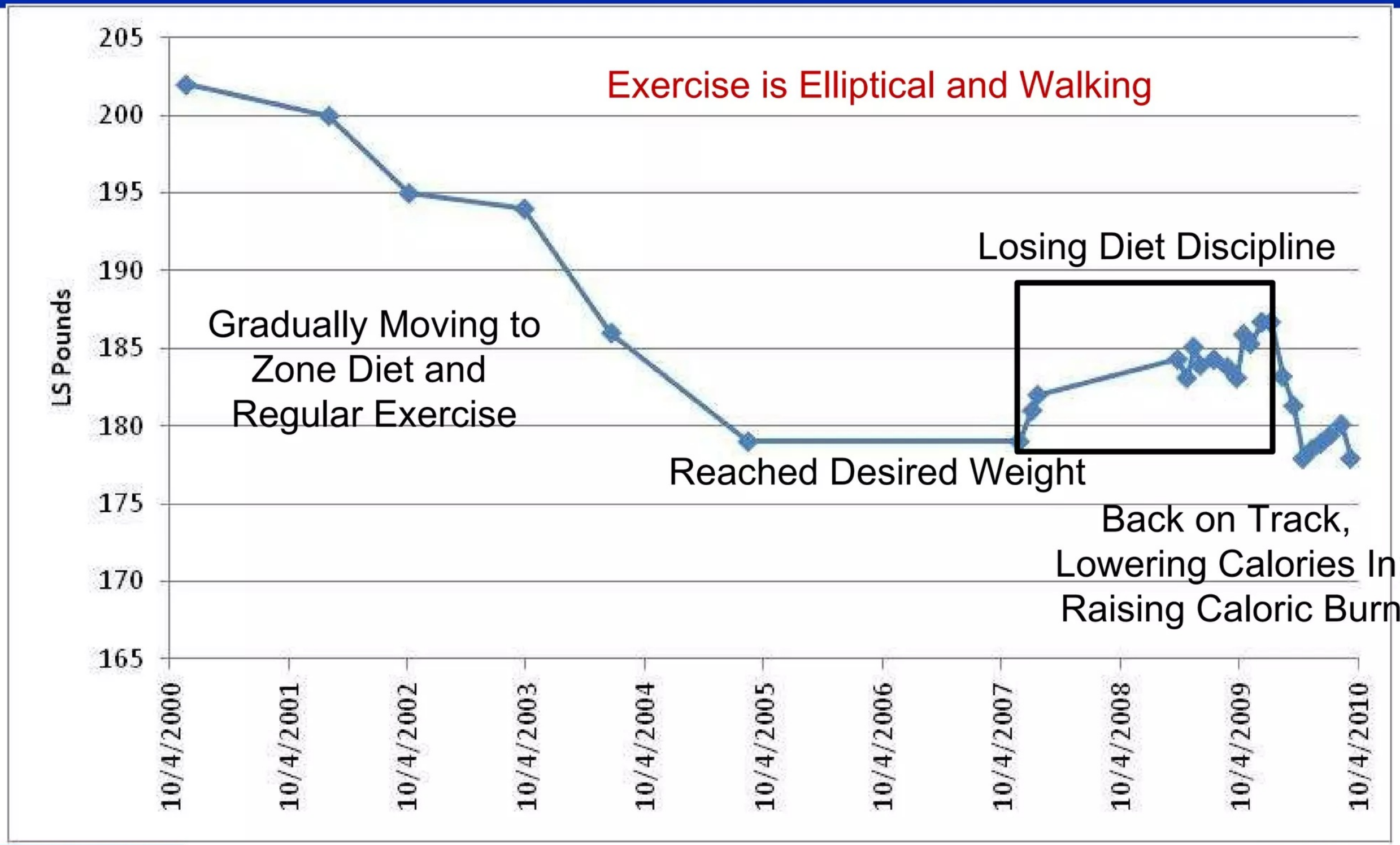
2010

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I Arrived from 20 Years in the Midwest in 2000 and Decided to Move Against the Trend

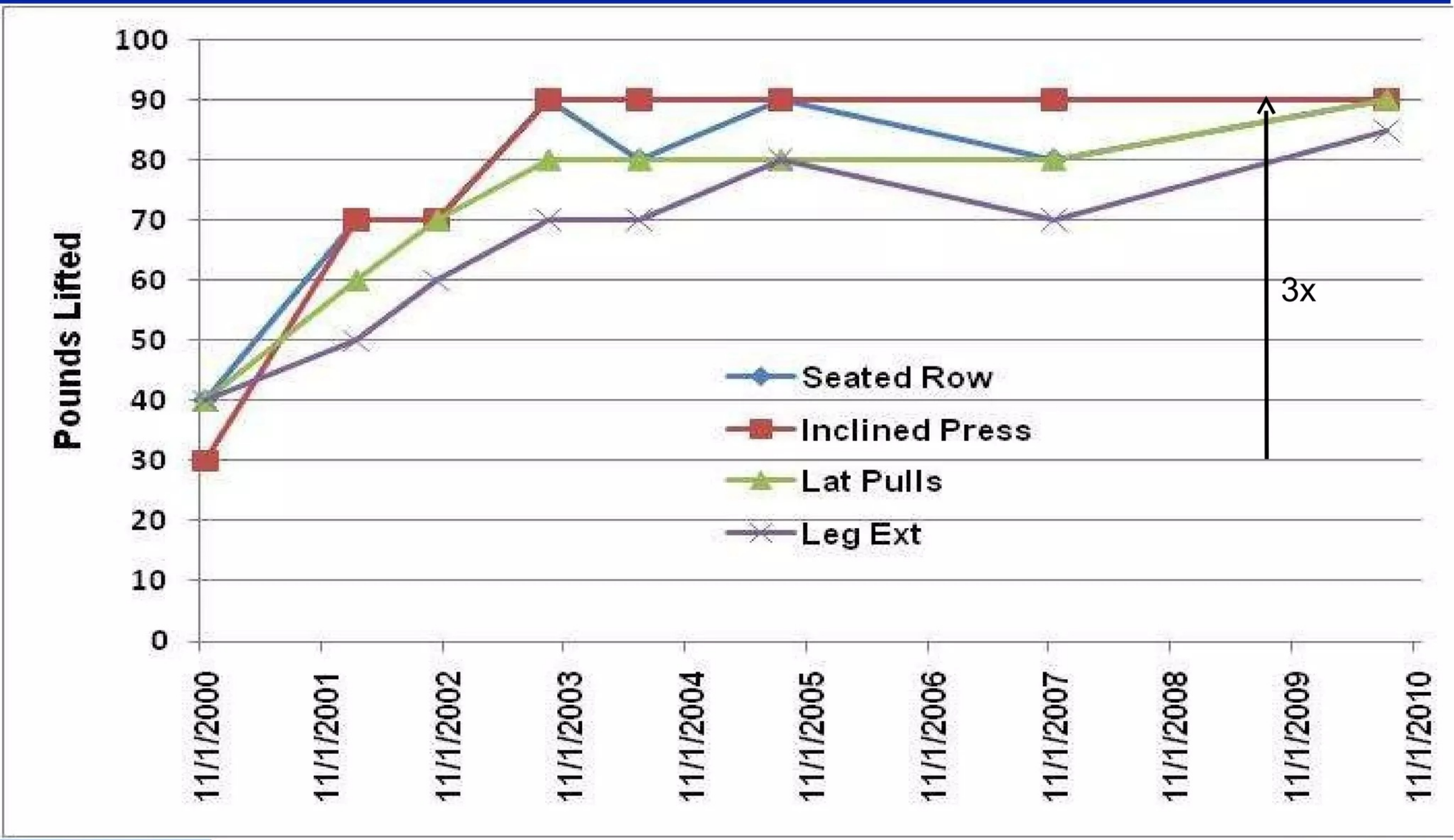
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# Goal: Lose Weight by Changing What &How Much I Ate, While Increasing Aerobic Exercise




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# Goal: Use Strength Training to Raise My Rest Metabolic Rate

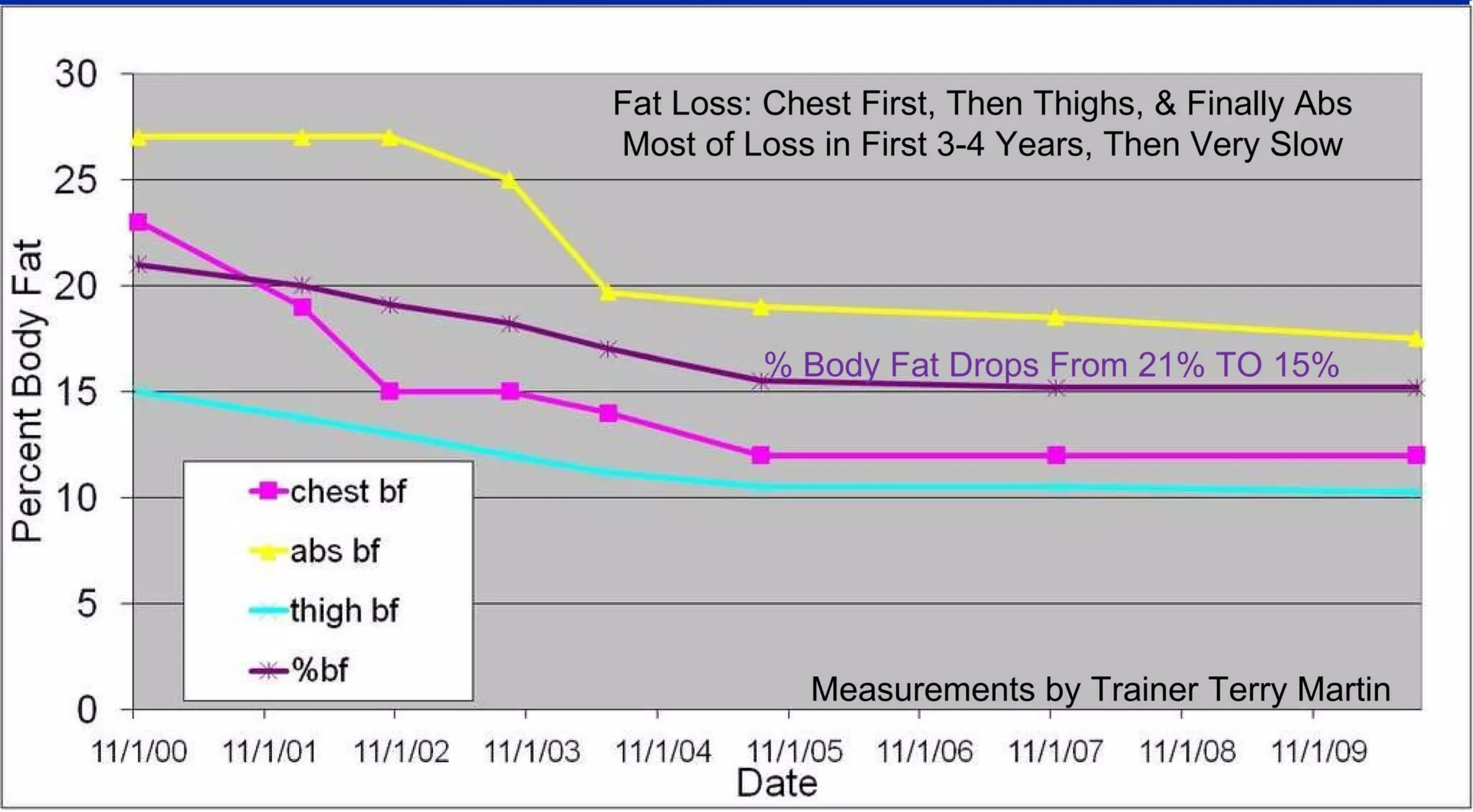



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Source: Terry Martin, LS Personal Trainer

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# Goal: Reduce My Body Fat Through Nutrition and Exercise



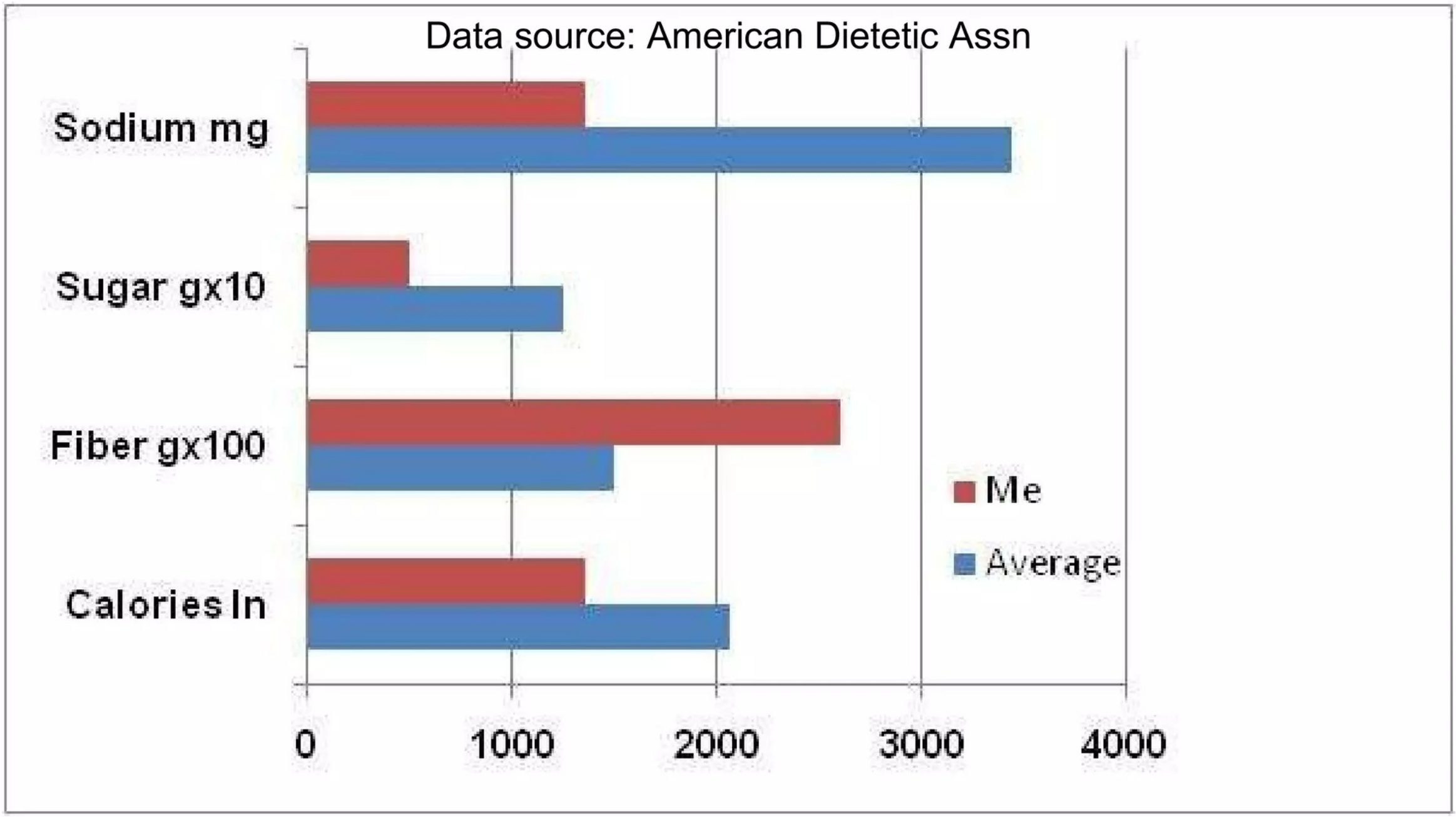

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I Lost More Than 1/3 of My Original Body Fat!

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# Goals: Reduce Calories, Sugar, and Sodium Intake, While Increasing Fiber

Also, Average American Drinks 526 12-oz Sodas per Year--Me Zero




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Me Compared to Average American Male Over 60

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# Goal: Quantify Your Food Intake So You Can "Tune" Your Glucose/Insulin System and Lower Inflammation

Computed Average Over 12 Days When at Home for Maximum Accuracy
Measure All Food and Drink Components,
Then Use USDA Lookup to Compute Each Item

| calories | fat | carb | protein | | fiber | sugar | sodium |
|---|---|---|---|---|---|---|---|
| kcal | g | g | g | | g | g | mg |
| 1441 | 46 | 122 | 80 | 0 | 26 | 53 | 1358 |

Still Need to Lower Sugar &
Increase Protein and Decrease Fat by 15%

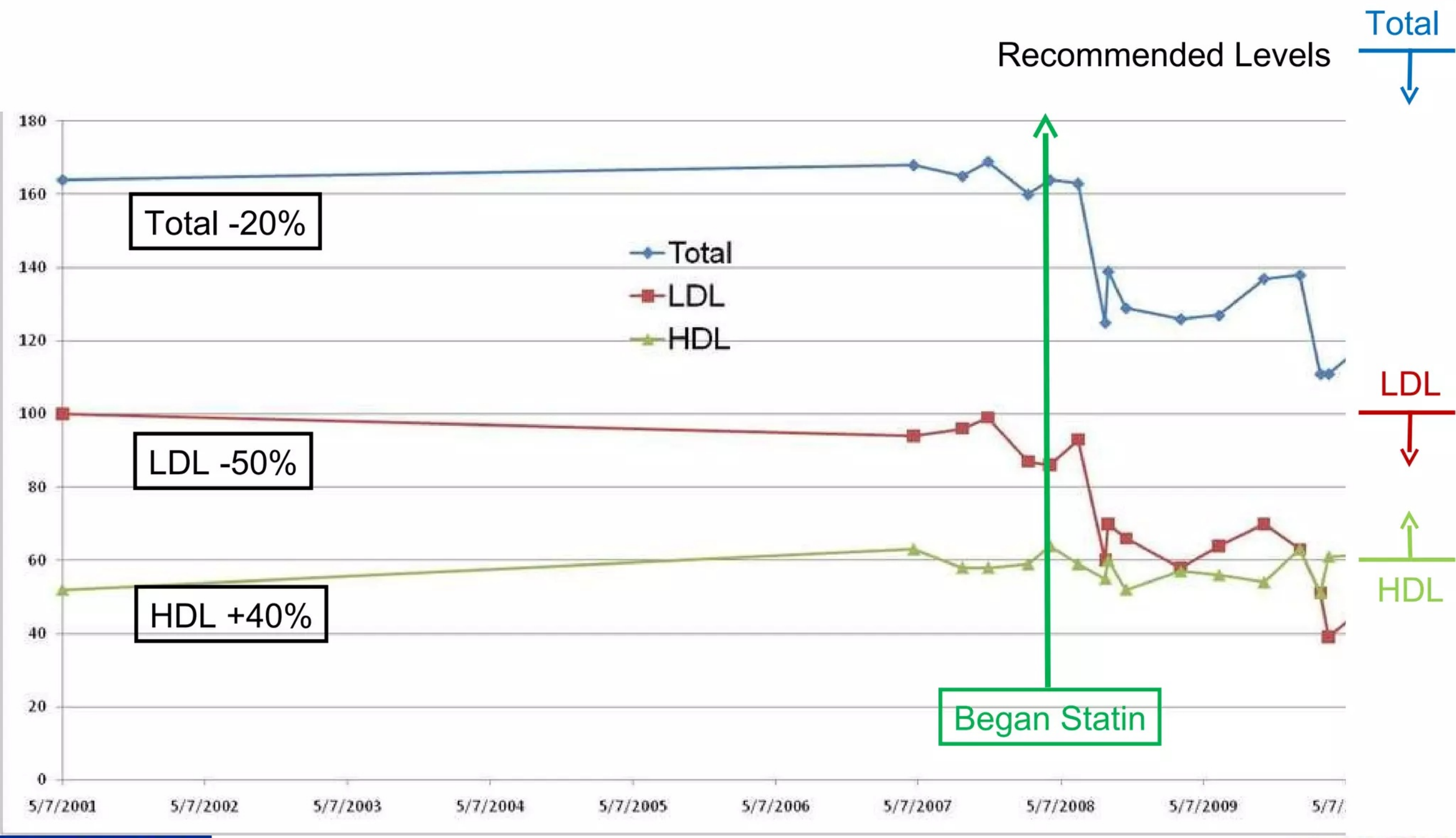
- **Quality of Food**
  - **All Organic and Mostly Locally Grown**
  - **Carbs are Low Glycemic Index**
    - **No Added Sugar or Refined Flour – Mostly Fruits and Vegetables**
  - **Proteins are Lean**
    - **Meat is Grass Fed – No Corn or Antibiotics**
    - **Fish is Wild, Often Locally Caught**
  - **Fats are Omega-3 Rich**
    - **Supplemented by 7g Daily Pharmaceutically Purified Fish Oil Pills**



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# Goal: Change Your Cholesterol Levels to Lower LDL, Raise HDL, While Lowering Total

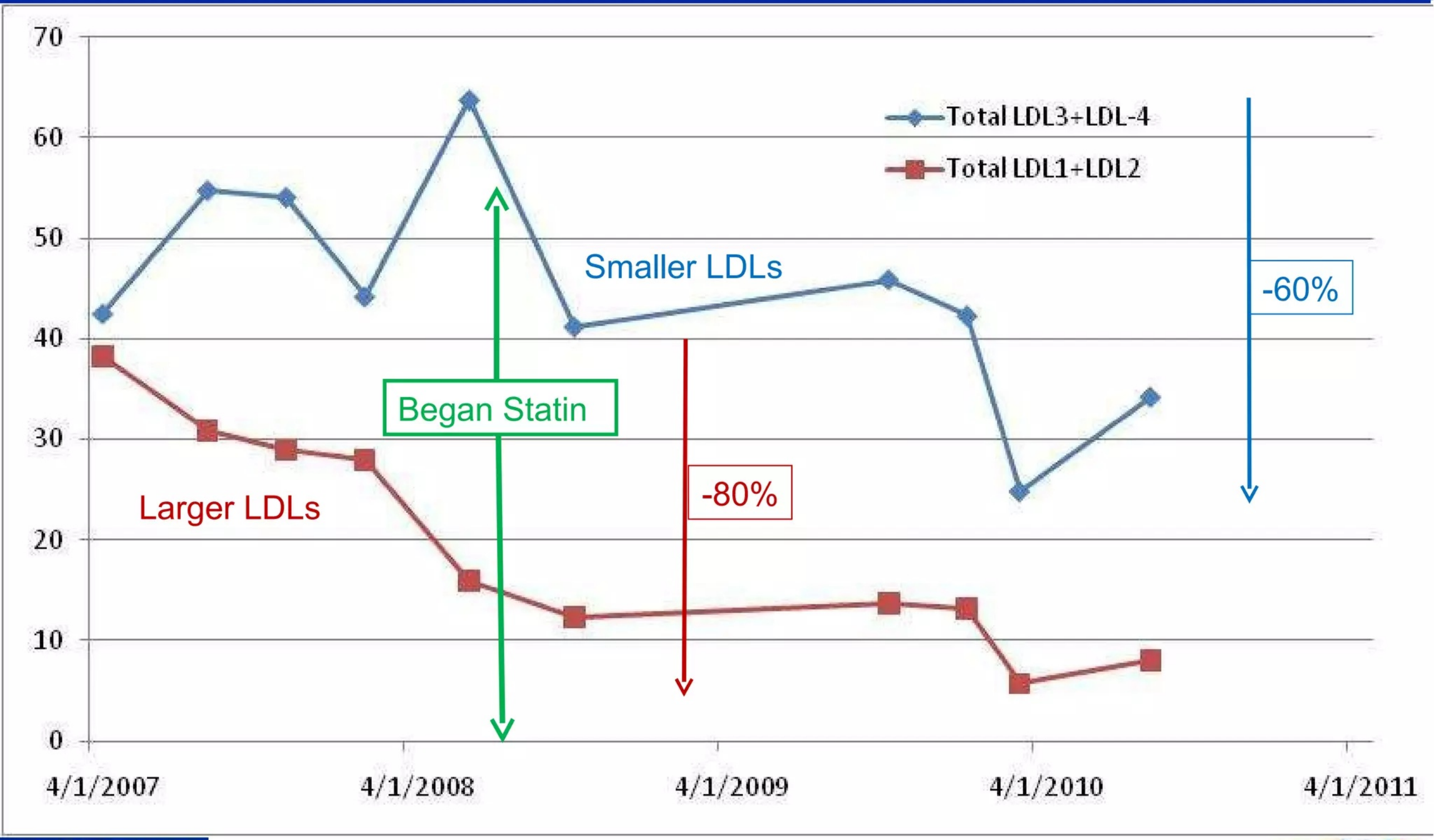



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Raising “Good” HDL Seems Most Difficult

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# Goal: Make Major Reductions in LDL Subfractions to Avoid Future Plaque Deposits




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Data Source: Scripps Clinic of Integrative Medicine

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# Goal: Lower Triglycerides and Cholesterol Ratios to Reduce Future Risk of Diabetes and Heart Disease

- **TG**
  - **High Risk 200-500**
  - **Best <150**
  - **My TG ~35**
- **TG/HDL**
  - **Ratio>4 Are Pre-Diabetic or Have Type 2 Diabetes**
  - **Average American Has a Ratio of ~3.3**
  - **My Ratio 0.5**
- **Total Cholesterol/HDL**
  - **Ratio Should be <4.6**
  - **My Ratio 1.75**

"The Ratio of Triglycerides to HDL Cholesterol (TG/HDL-C) is the Single Most Powerful Lipid Predictor of Extensive Coronary Disease."
[Clinics 2008; v.64: 427-432]

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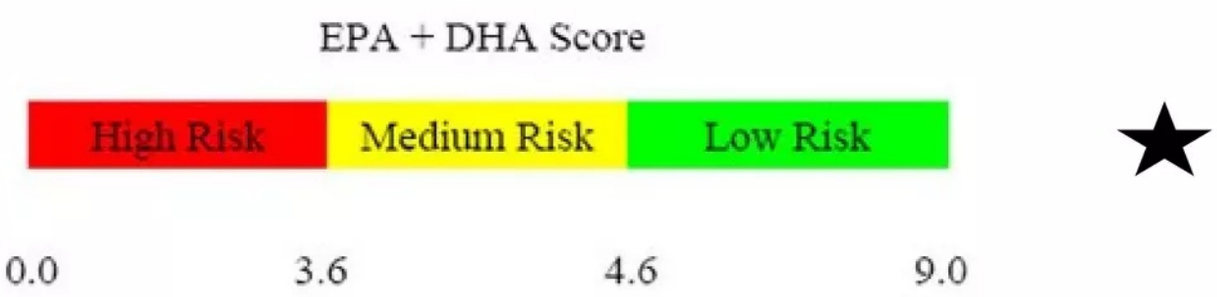
# Goal: Improve My Omega-3 Scores To Protect Against Future Heart Disease

If your Omega-3 Score is at least 7.2 and your DHA Score is at least 4.5, you are 32% less likely to develop heart disease

Graphics from www.anne-marie.ca/ratiokits/



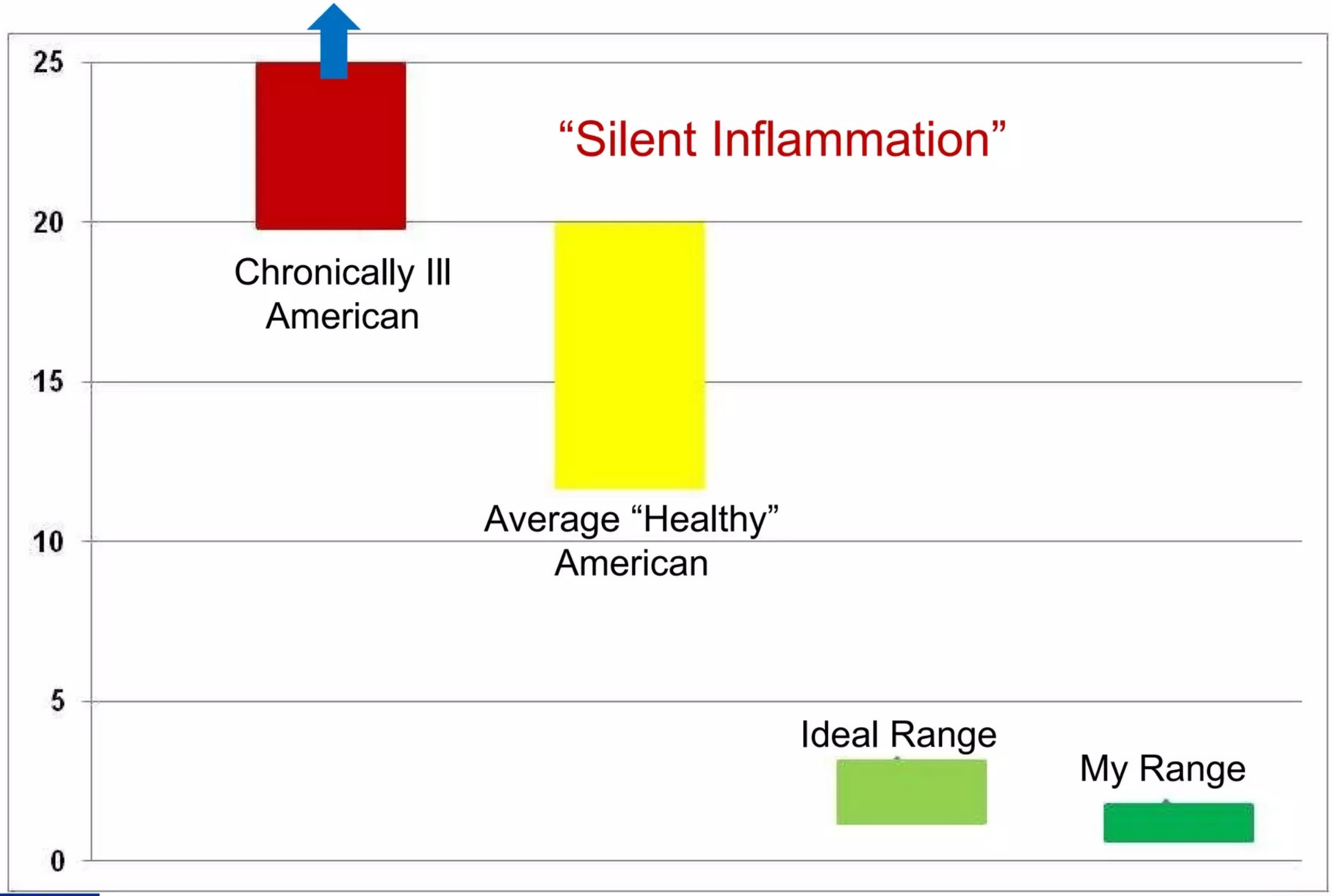

If your EPA+DHA Score is at least 4.6, you are 70% less likely of dying from a heart attack.




★ = My Values Tested by yourfuturehealth.com

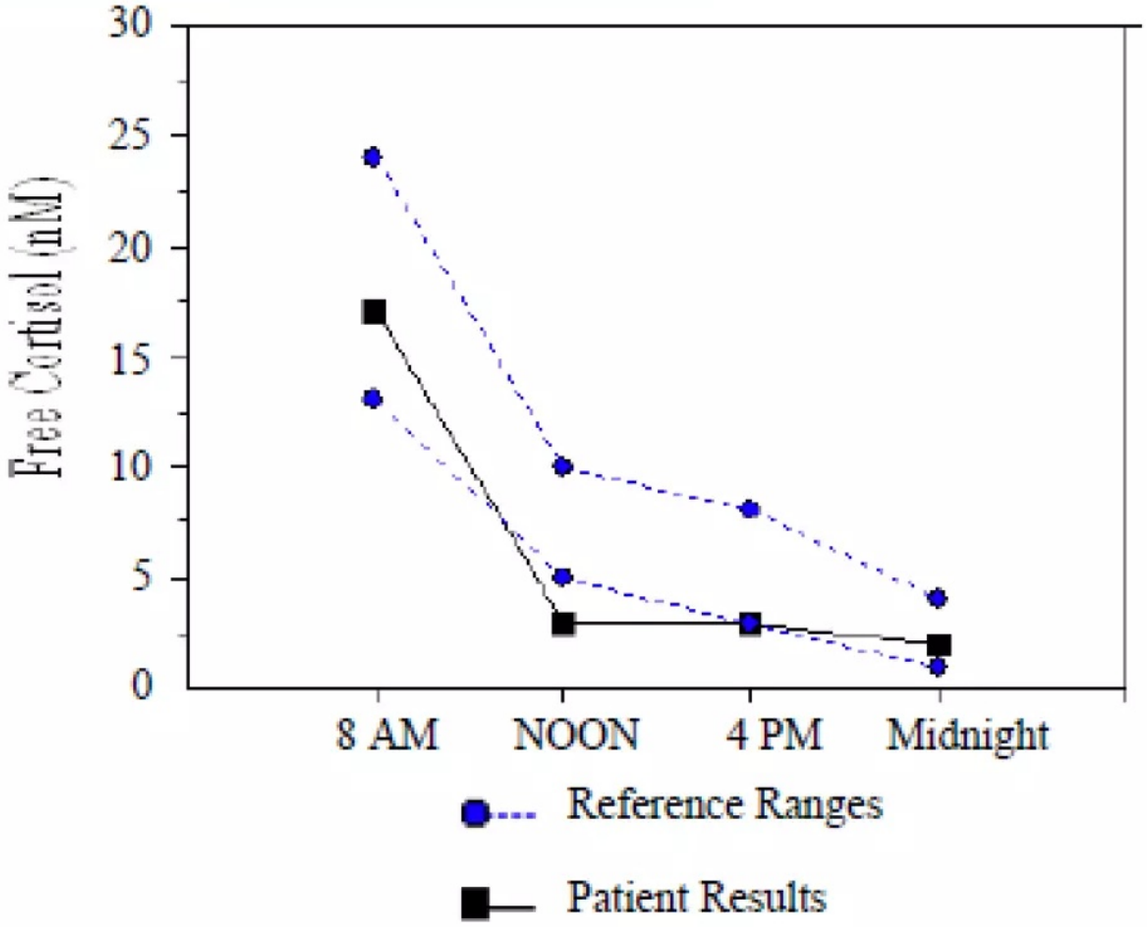
Ref: Based on Lemaitre et al., n-3 Polyunsaturated fatty acids, fatal ischemic heart disease, and nonfatal myocardial infarction in older adults: the Cardiovascular Health Study. Am. J. Clin. Nutr. 77:319-325 (2003).

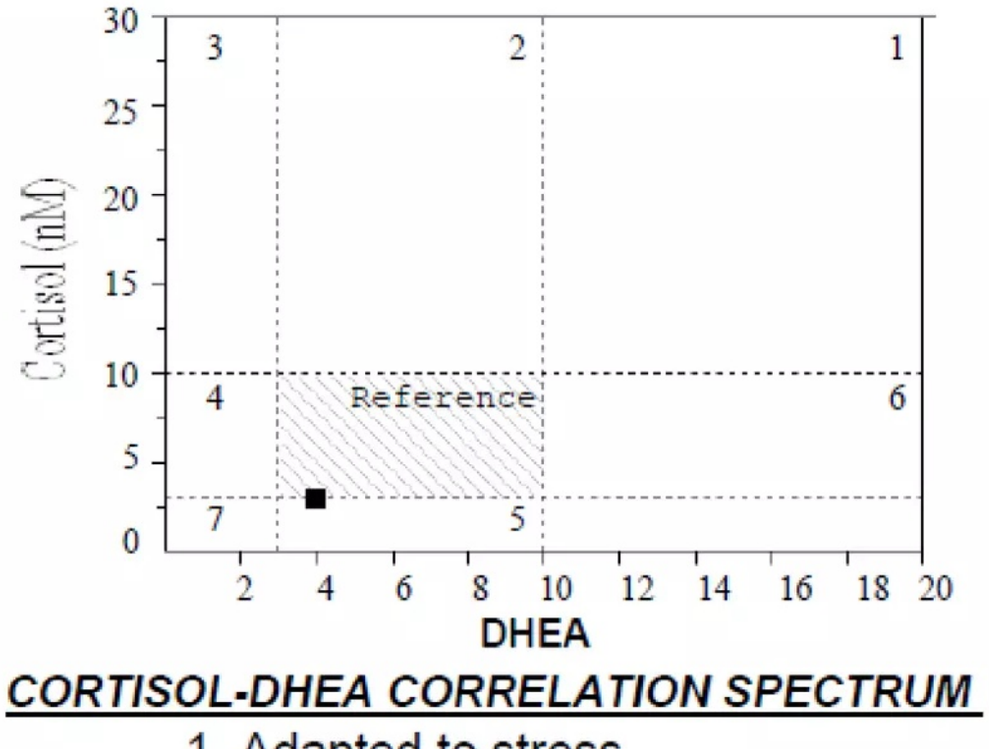
# Goal: Lower Ratio of Arachidonic Acid to EPA to Reduce Pro-Inflammatory Potential of Your Cells




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

# Goal—Lower Stress and Cortisol Levels: Use Saliva Tests to Quantify




***CORTISOL-DHEA CORRELATION SPECTRUM***

1. Adapted to stress.
2. Adapted with DHEA slump.
3. Maladapted Phase I.
4. Maladapted Phase II.
5. **Non-adapted, Low Reserves.**
6. High DHEA.
7. Adrenal Fatigue.

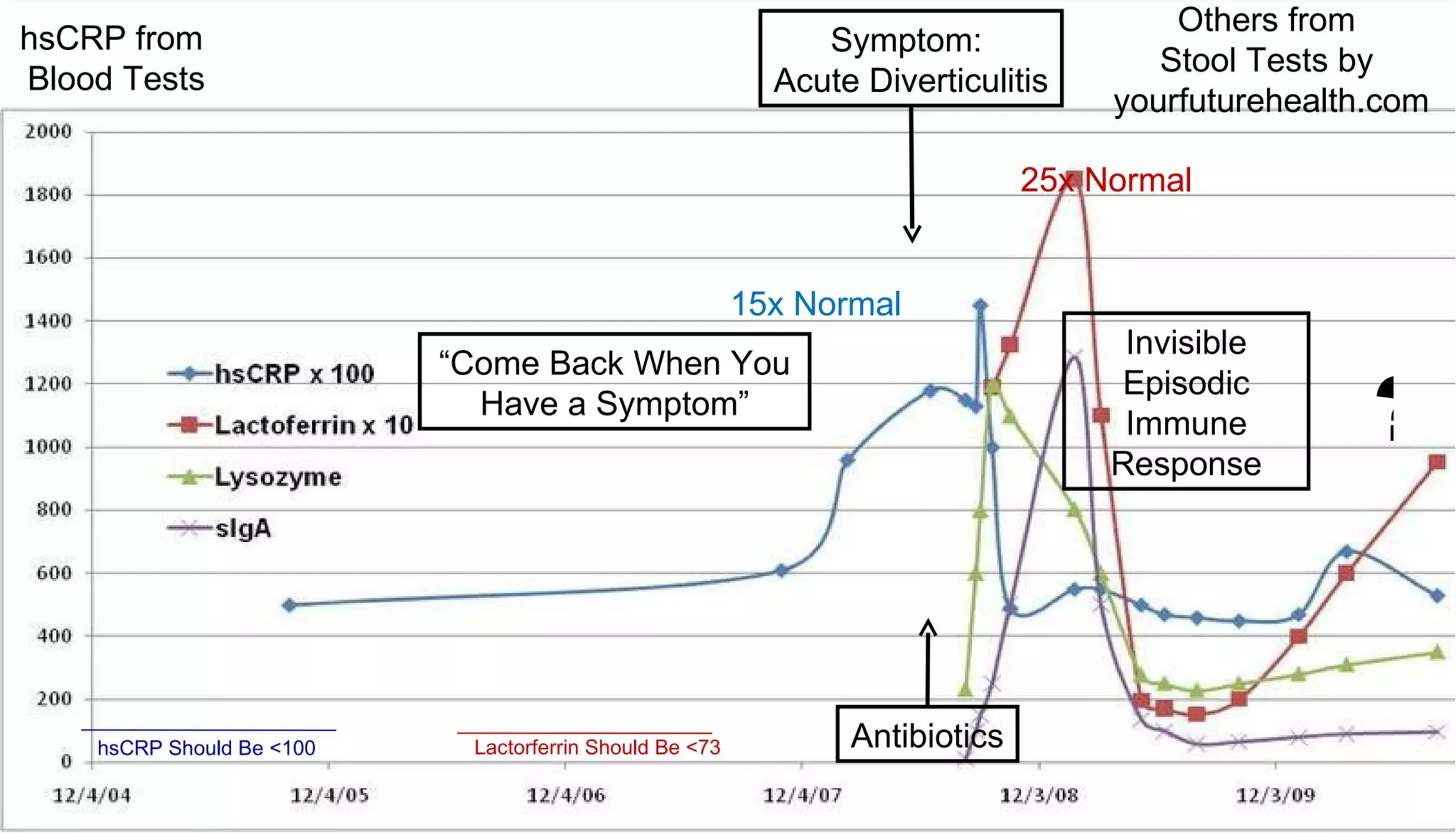
- **Surprising Result—Low Cortisol In Spite of My Stressful Life Style**
- **Hypothesis: Suboptimal Cortisol Output Reflects an Adrenal Decline or a Depleted Reserve Caused by Chronic and Protracted Exposure to Stressors**

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Adrenal Glands Produce Cortisol, DHEA, and Adrenaline Coupled to Cholesterol Cycle

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# Goal: Quantitatively Monitor the State of Your Inflammation and Immune System



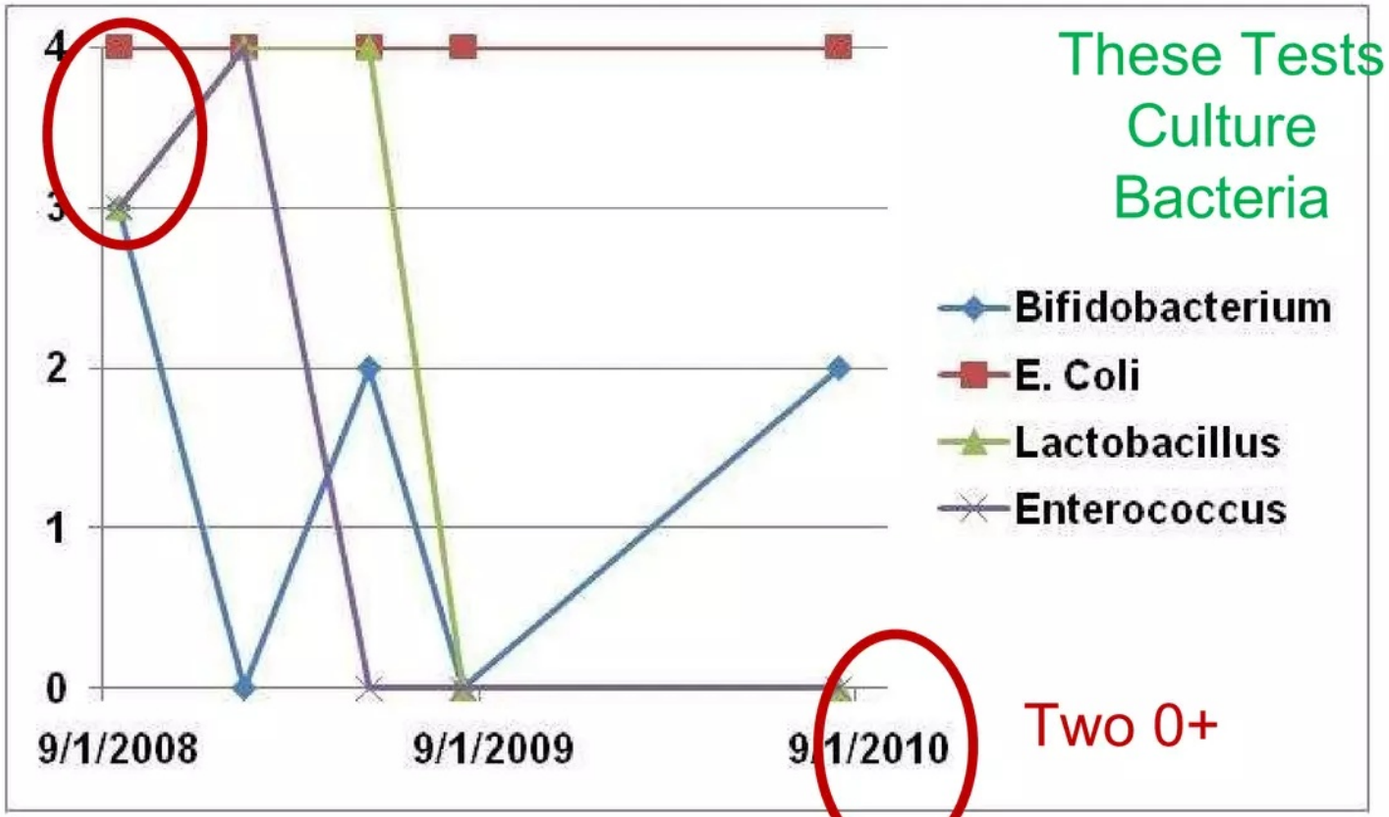

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Future Challenge: Danger of Persistent hsCRP Inflammation and Destabilized Microbiome

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# Goal: Monitor the Colon Microbiome- an Ecological Battle Between Beneficial and Harmful Bacteria

All 3+ or 4+

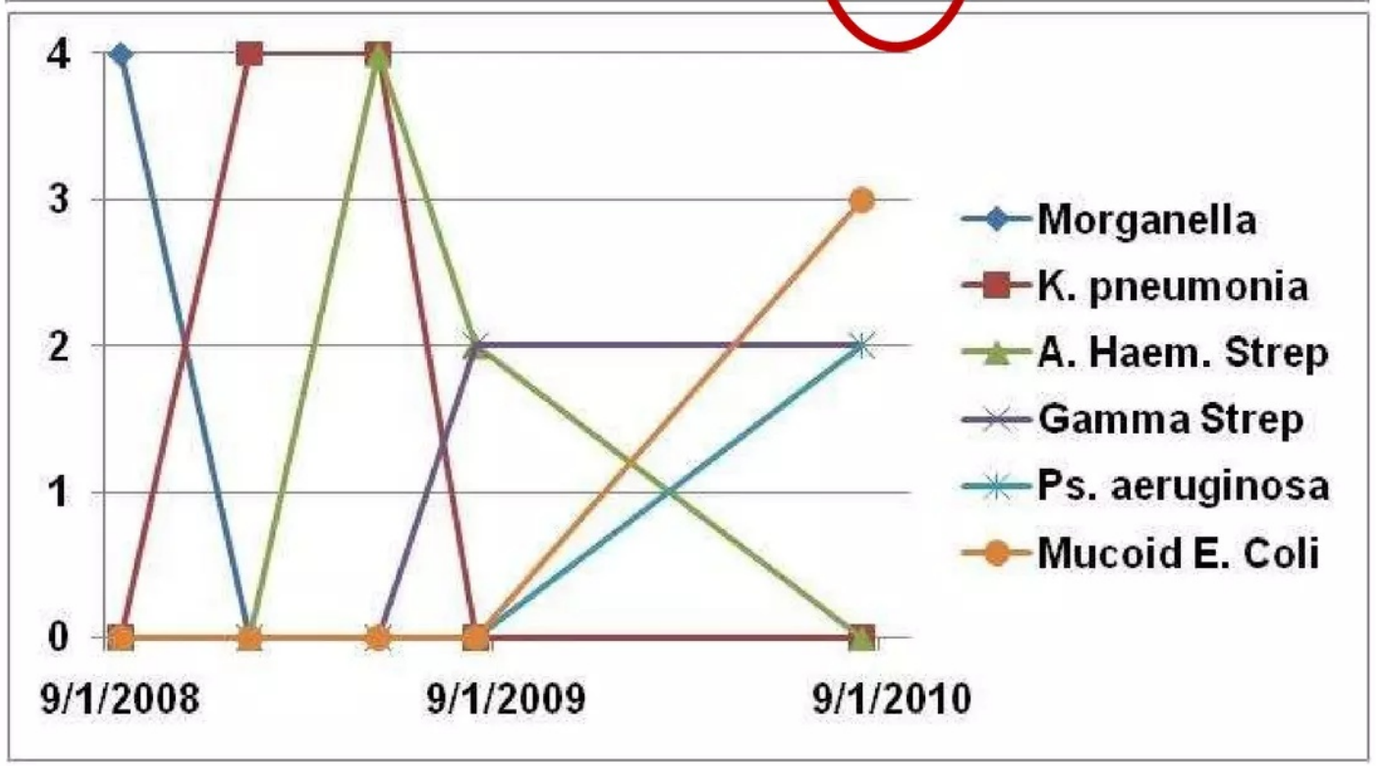



These Tests Culture Bacteria

Two 0+

Bacterial Cells Are 90% of the Cells in Your Body!

TheTwo Years Following 10 Days of Antibiotics (Levaquin & Metronidaloze)




Next Step Get DNA Microbe, Parasite, Yeast Test

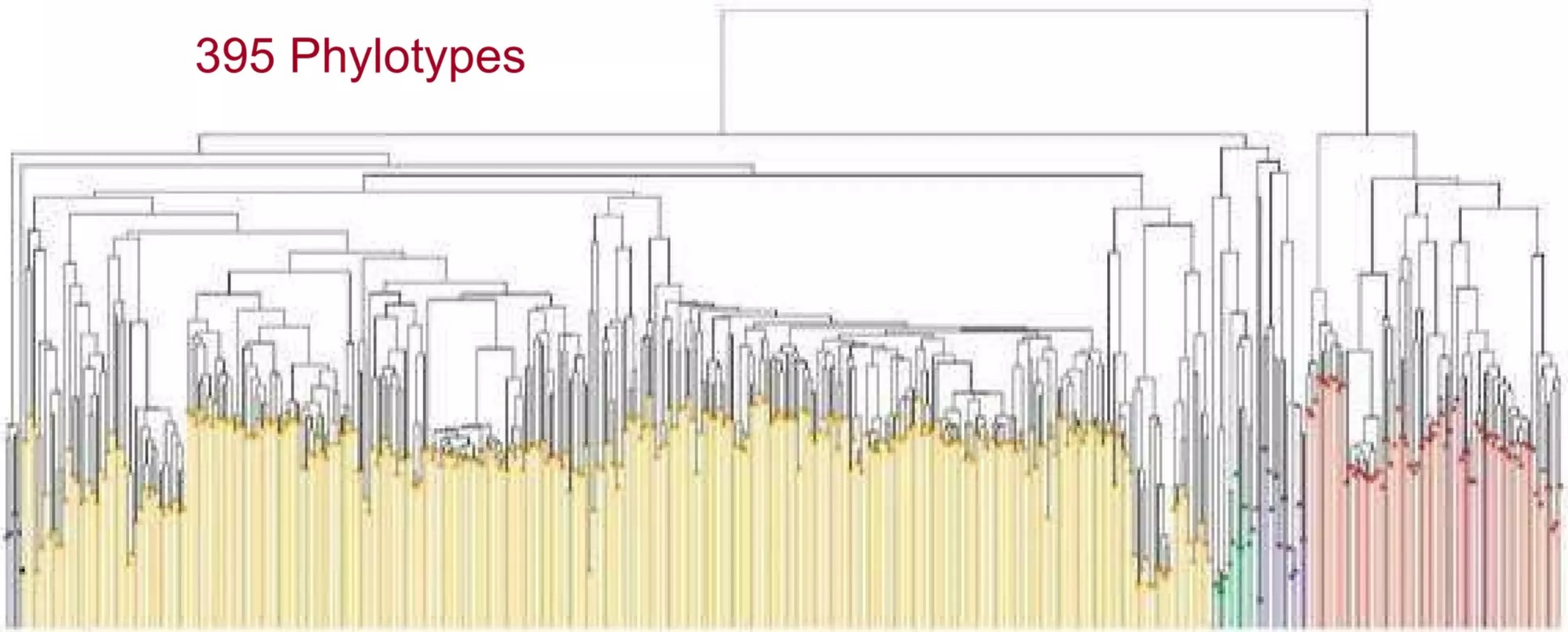
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Stool tests by www.yourfuturehealth.com

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# The Human Microbiome is the Next Large NIH Drive to Understand Human Health and Disease

- **"A majority of the bacterial sequences corresponded to uncultivated species and novel microorganisms."**
- **"We discovered significant inter-subject variability."**
- **"Characterization of this immensely diverse ecosystem is the first step in elucidating its role in health and disease."**




"Diversity of the Human Intestinal Microbial Flora"
Paul B. Eckburg, et al *Science* (10 June 2005)

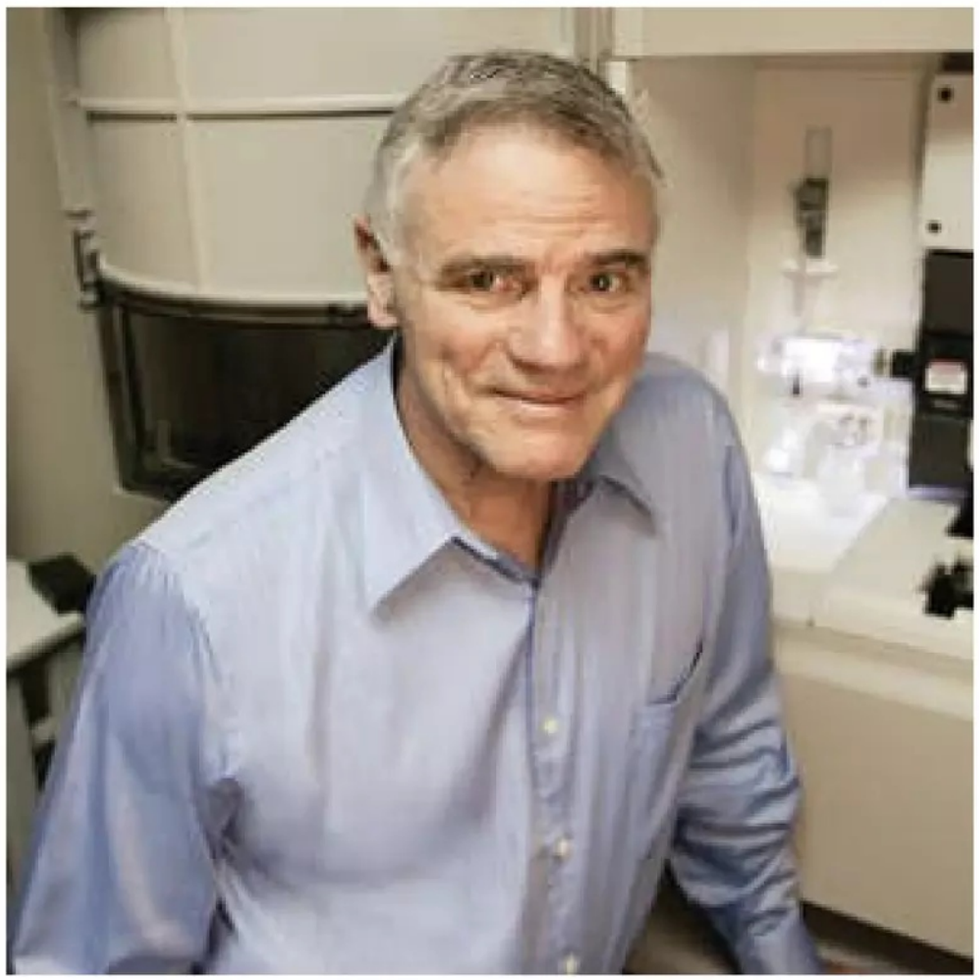
The Vision of Predictive, Personalized, Preventive, & Participatory Medicine

Newsweek

# A Doctor's Vision of the Future of Medicine

Leroy Hood
NEWSWEEK

From the magazine issue dated Jul 13, 2009



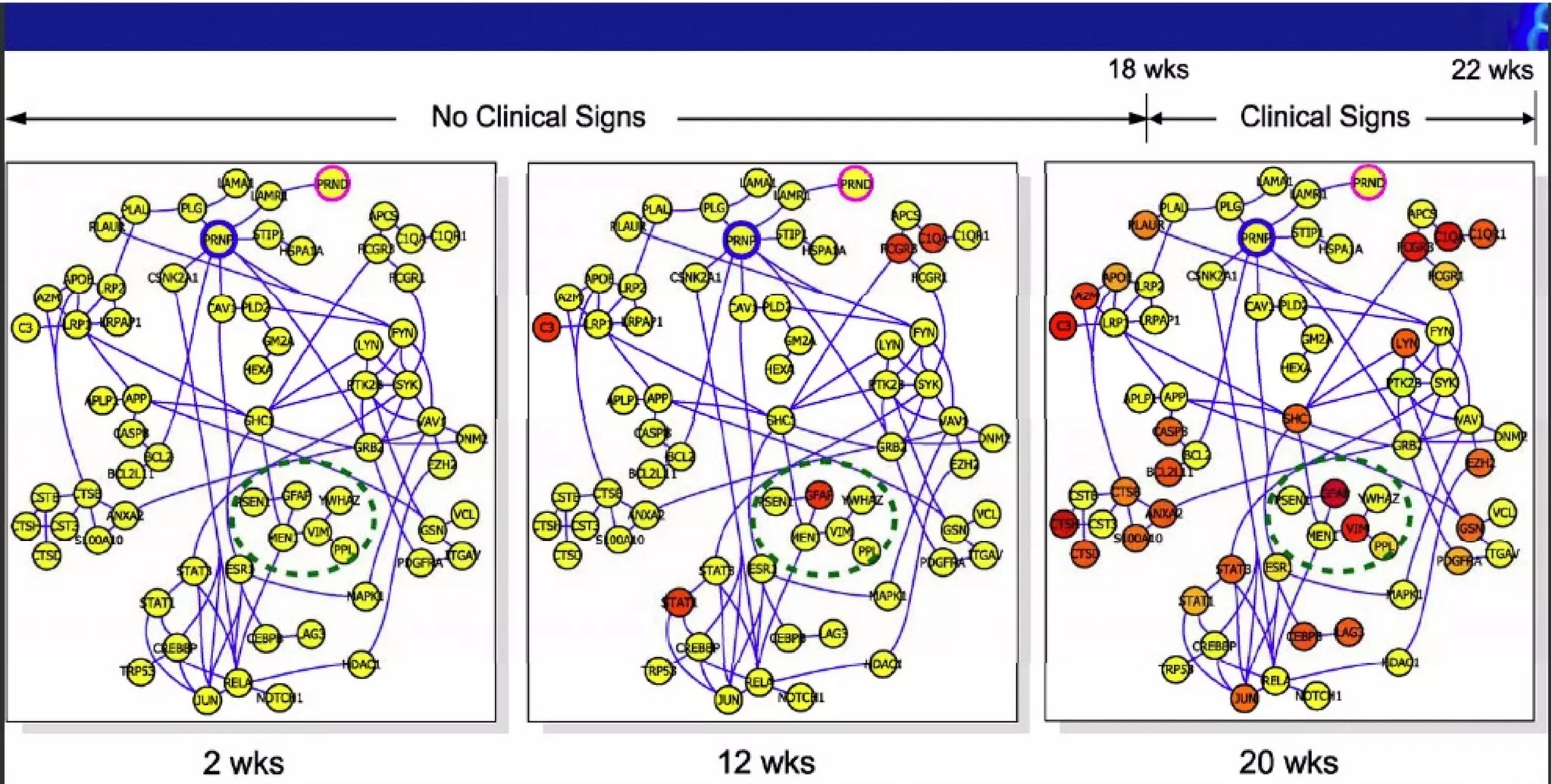
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www.newsweek.com/2009/06/26/a-doctor-s-vision-of-the-future-of-medicine.html

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# Disease Arises from Perturbed Cellular Networks: Dynamics of a Prion Perturbed Network in Mice





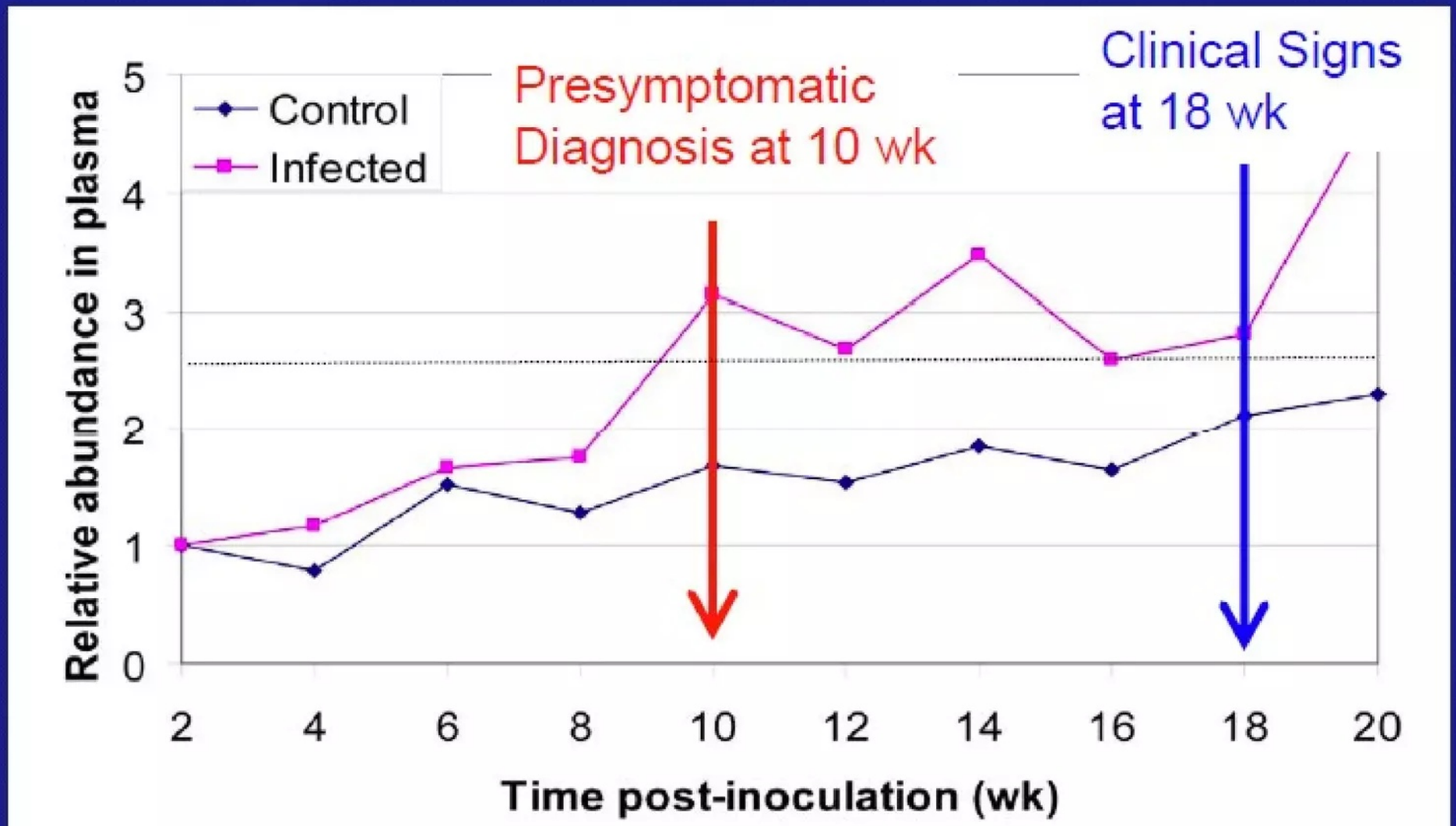

Source: Lee Hood, ISB

INSTITUTE FOR Systems Biology

# Increasing Abundance of Protein A for Prion-Infected Blood Samples



## Dynamic change in relative abundance of "Protein A"




Source: Lee Hood, ISB

INSTITUTE FOR Systems Biology

# Organ-Specific Blood Proteins Will Make the Blood a Window into Health and Disease

Source: Lee Hood, ISB

- **Perhaps 50 Major Organs or Cell Types**
  - **Each Secreting Protein Blood Molecular Fingerprint**

- **The Levels of Each Protein in a Particular Blood Fingerprint Will Report the Status of that Organ**
  - **Probably Need Perhaps 50 Organ-Specific Proteins Per Organ**

- **Will Need to Quantify 2500 Blood Proteins from a Drop of Blood**
  - **Use Microfluidic/Nanotechnology Approaches**

Key Point: Changes in The Levels Of Organ-Specific Markers Can Assess Virtually All Disease Challenges for a Particular Organ

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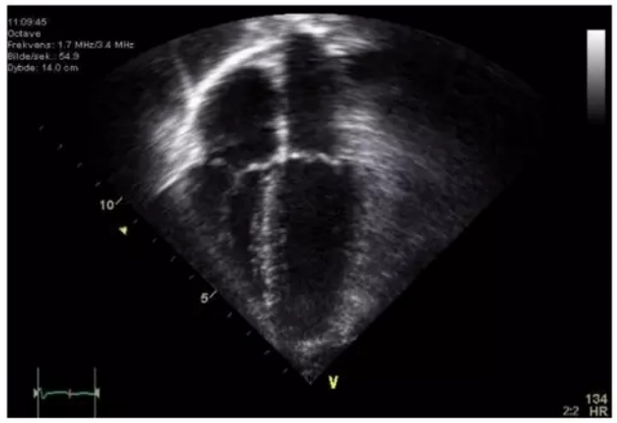
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# Goal: Determine the Structural State of Each Internal Organ and Major Body Subsystems




Carotid Ultrasound Imaging

Plaque Thickness



Stress Test with Echocariogram

Heart Fitness

Structural Weakness

Physical Colonoscopy

Detect Polyps

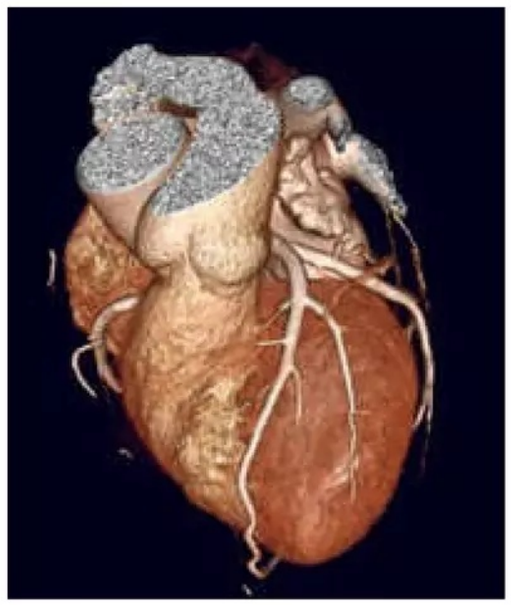
Colon Disease



64 Slice Heart CT Scan

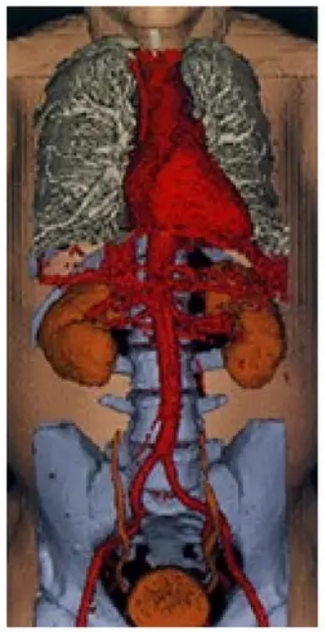
Plaque Sites

Valve Anomalies



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3D Full Body Scan

mm Accuracy

Small Tumors

Organ Damage

Plaque Sites

Virtual Colonoscopy



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# What I Learned From Spending 3 Hours Inside of My Body

- **Awesome Experience Getting to Know Your Internal Body**
  - Dr. Harvey Eisenberg Body Scan Inventor on 9/11/08
  - 3D Full Body X-Ray at Millimeter Scale
  - Has Performed 80,000 Scans
- **Highlights of Fly Through of Organs and Systems:**
  - No Cancer in 20 Different Organs-Can Detect at 0.5mm
  - Circulatory System Clear Except Small Plaques-Carotid, Femoral, & LAD
  - Lungs Perfect--Little Scar Tissue From Pneumonia 30 Years Ago
  - Need to Lose More Fat Around Heart and Under Diaphragm
    - Can Cause Sleep Apnea (Which Sleep Tests Show I Have Slightly)
  - Pancreas Has Slightly Lower Volume From Pre-Diabetes Degradation
  - Liver, Kidney, Adrenal Glands, Spleen, Sperm Creation All Normal
  - Prostate Slightly Enlarged-Take Saw Palmetto to Shrink Prostate
  - Colon Free of Polyps, Have Diverticula
    - Could Develop Diverticulitis (2 Weeks Before I Did!)

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# The Rise of Individual and Societal Genomic Testing- Promise and Concerns

Technology
PUBLISHED BY MIT Review

# How Personal Genomics Could Change Health Care

The select few who have had their genomes sequenced learn to use that information for health care.

By Emily Singer

FRIDAY, APRIL 30, 2010

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www.technologyreview.com/biomedicine/25218/

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# Goal: Measure Your Individual Genetic Predispositions to Future Health Risks

Navigenics®

| 0 - 1% | >1 - 10% | >10 - 25% | >25 - 50% | >50 - 100% |
|---|---|---|---|---|
| Graves' disease<br>You: 0.93%<br>Avg: 0.55% | Lung cancer<br>You: 8%<br>Avg: 8% | Prostate cancer<br>You: 17%<br>Avg: 17% | Osteoarthritis<br>You: 44%<br>Avg: 40% | You have no results in this range |
| Glaucoma<br>You: 0.78%<br>Avg: 1.1% | Colon cancer<br>You: 6%<br>Avg: 6% | Diabetes, type 2<br>You: 12%<br>Avg: 25% | Heart attack<br>You: 38%<br>Avg: 42% | |
| Macular degeneration<br>You: 0.74%<br>Avg: 3.1% | Psoriasis<br>You: 6%<br>Avg: 4.0% | | Obesity<br>You: 32%<br>Avg: 34% | |

You: 1.7%
Avg. 3.0%

You: 22.4%
Avg. 11.4%

You: 14.7%
Avg. 23.7%

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# However, SNP Indications of Adverse Drug Side Effects May Be Quite Useful

Navigenics®

23andMe

Side Effects

| Drug | Your Risk | Side Effect | |
|---|---|---|---|
| Abacavir (Ziagen®)<br>Used to treat HIV infection | High Risk | Severe allergic reaction, including fever, rash, and nausea | Increased Risk |
| Floxacillin (Floxapen®)<br>Used to treat infections | High Risk | Severe liver toxicity, leading to liver damage | Greatly Increased Risk |

I Would Definitely Not Take Either!

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# The Cost for Full Human Genome Sequencing is Exponentially Decreasing

Forbes



**Science Business**

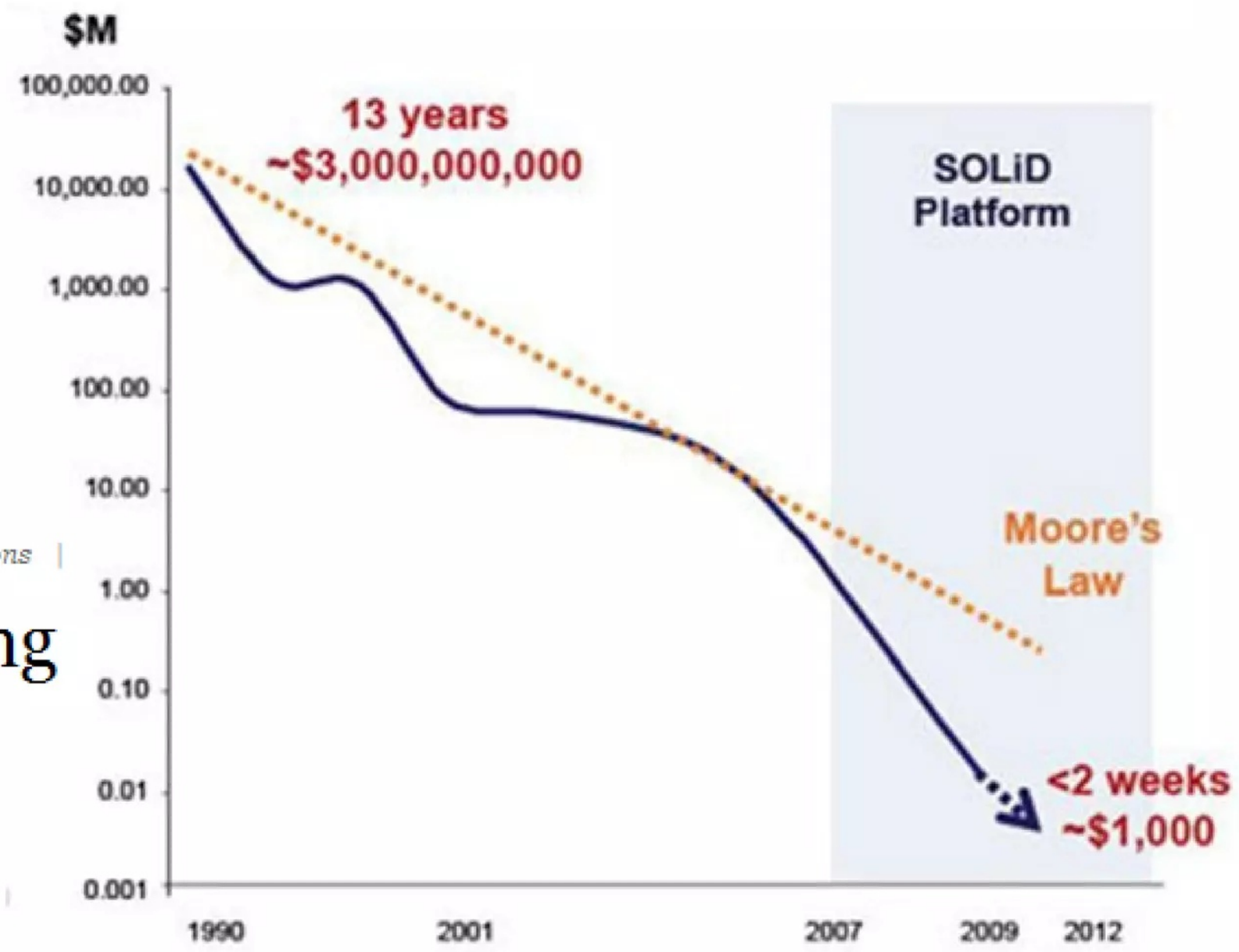
RESEARCH, INNOVATION & POLICY

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Jun. 3 2010 - 5:32 pm | *30 views* | *0 recommendations* |

## Your Genome Is Coming

*posted by* **MATTHEW HERPER**




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http://blogs.forbes.com/sciencebiz/2010/06/03/your-genome-is-coming/

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# Should You Keep Your Health Data Private or Share to Gain the Most Knowledge?

U.S. Department of Health & Human Services
HHS.gov *Improving the health, safety, and well-being of America*

**The Health Insurance Portability and Accountability Act of 1996 (HIPAA) Privacy and Security Rules**

trusera

Trusera is an online health network platform where you can find and share real-world experiences. Share your story and experience the Power of Been There™.

patientslikeme®

**Share Your Health Profile**

By openly sharing your health profile with the community, you can learn more about yourself while helping other patients like you.

Social Networks and Health NEXT

Medicine 2.0 #10 – Medicine and the Second Generation of Internet-based Services

by Walter Jessen

Quantified Self
tools for knowing your own body and mind

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# You Can Download This Presentation at lsmarr.calit2.net



Videos



Larry Smarr Sizzle of Science for NSF Facebook
2010.09.21

+ more videos

Presentations



Sustainable Computing and Telecom Can Contribute to Limiting Global Climatic Disruption
2010.07.28

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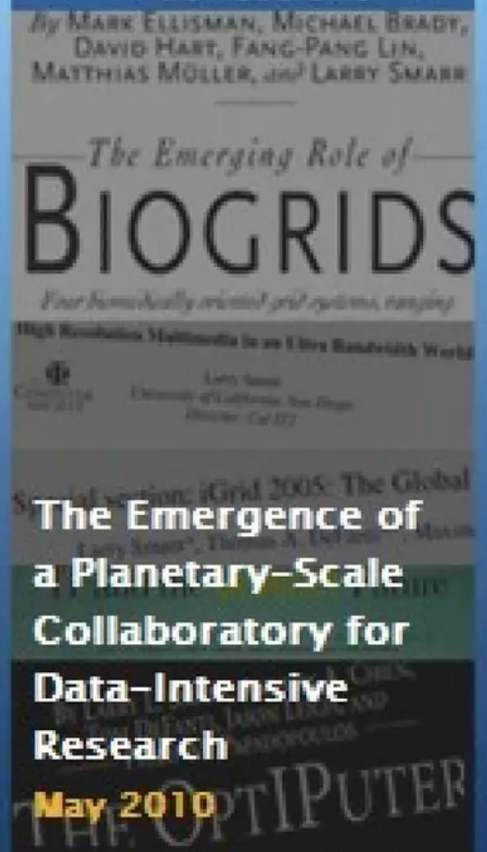
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Calit2 : Michael L. Norman Named Director of the San Diego ...
2010.08.29

+ more news

Publications




The Emergence of a Planetary-Scale Collaboratory for Data-Intensive Research
May 2010

+ more publications

Photos



+ more photos

## ABOUT LARRY SMARR

Larry Smarr is the founding Director of the California Institute for Telecommunications and Information Technology (Calit2), a UC San Diego/UC Irvine

## WHAT I'M READING

**Complete List of Larry's Recommendations**

## RECENT TWITTER POSTS

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