Ready or Not
AI Nutrition is Coming

Richard A. Williams, Ph.D.
Senior Affiliated Scholar, Mercatus Center at George Mason University
MarginalRegulation.Com
RichardAWilliams.com

International Life Sciences Institute
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Predictions.....

Rock n’ roll? It will be gone by June
Fruit and Vegetable Consumption
Per Capita Intake 2003 to 2015

Down 7%

Down 5%
Prevalence of Obesity Among U.S. Adults Aged 20-74

Derived from NHANES data (http://www.cdc.gov/nchs/data/hestat/obesity_adult_09_10/obesity_adult_09_10.html#table1)
Confused Consumers

• New food related disease findings regularly announced (then reversed, possibly because of poor studies)
• Food labels depend on tracking and math
• Innumerable diets, none of which appear to work long term
• Dietary Guidelines not based on consumer acceptance
• Restaurants – little information to confusing information?
Here it Comes!

Healthy Dining Finder

[Image of a 3D food printer and a diagram of a body with medical sensors and information flow]
Convergence

Intakes
- Food
- Dietary Supplements
- Medical Foods
- Drugs
- Illegal Drugs
- Packaged food profiles
- Restaurant foods

Big Data/AI
- Diet/Disease
- Exercise/Disease
- Enhancements

Activity
- Exercise
- Sleep
- Stress
- Sunlight
- Smoking

Location
- Restaurants
- Hospitals
- Parks

Advice
- Eating
- Exercise
- Sleep
- Leisure
- Medical care

Medical Condition
- Illness
- Injury
- Biomonitoring
- Vitals
- Weight
- Genetics
- Allergies
- Hunger
- Family history

Preferences
- Taste
- Price
- Social Setting
- Available time
- Culture
Personalized Advice

There is a restaurant near you that serves food you like, can afford, and fits your nutritional needs right now. It will be ready in the appropriate proportions when you arrive. You may also use the kiosk, instead.

Your personalized dinner will be ready in 30 seconds from your 3D printer. It will also contain your medicines.

I have chosen your foods at your supermarket and they can be picked up or delivered.
Why It Will Work
“Many of us would be happy to transfer much of our decision-making processes into the hands of such a system....”

“Eventually we may reach a point when it will be impossible to disconnect from this all-knowing network even for a moment.”

“Algorithms won’t revolt and enslave us. Rather they will be so good at making decisions “for us that it would be madness not to follow their advice.”

“The data is overwhelmingly clear that it is really easy to make better decisions than even an experienced expert will make by following the data and not applying any judgment on top of it.”

Homo Deus
by Yuval Noah Harari

Andrew McAfee MIT
21st Century Augmented Humans

<table>
<thead>
<tr>
<th>20th Century Medicine</th>
<th>21st Century Health</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age</strong></td>
<td><strong>Age</strong></td>
</tr>
<tr>
<td>Average Age</td>
<td>Methuselah</td>
</tr>
<tr>
<td>Death</td>
<td>Constant Happiness</td>
</tr>
<tr>
<td><strong>Mental</strong></td>
<td><strong>Mental</strong></td>
</tr>
<tr>
<td>Not Depressed</td>
<td>Superwoman</td>
</tr>
<tr>
<td><strong>Health</strong></td>
<td><strong>Health</strong></td>
</tr>
<tr>
<td>Absence of Disease/Injury</td>
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</tbody>
</table>
CONSUMPTION SPREADS FASTER TODAY

PERCENT OF U.S. HOUSEHOLDS

100%


SOURCE MICHAEL FELTON, THE NEW YORK TIMES
We are already behind

Technologies

Persuasion Technology

Science, Governance

Time
What Science is Needed?

- Learning Algorithms
- Monitoring and Feedback (Outcomes)
- Diet and Health recommendations
- Individual and Population Data
- Research

Statistics Ready for a Revolution
1 September 2010 8,054
Next Generation of Statisticians Must Build Tools for Massive Data Sets
Research Quality

Why is that woman scowling at me? Do I know her?

If she loves you more each and every day, by linear regression she hated you before you met.
Good/Bad Competition
## Policy Tools for AI

<table>
<thead>
<tr>
<th>Hard Law</th>
<th>Soft Law</th>
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<tbody>
<tr>
<td>Prohibitions</td>
<td>Private Standards</td>
</tr>
<tr>
<td>Pre-market approval (products, companies)</td>
<td>Codes of Conduct</td>
</tr>
<tr>
<td>User Fees</td>
<td>Monitoring with triggering</td>
</tr>
<tr>
<td>Regulation/Adaptive management</td>
<td>Principles</td>
</tr>
<tr>
<td>Performance/Design Standards</td>
<td>Voluntary Programs</td>
</tr>
<tr>
<td>Mandated Transparency/Disclosure (access to data)</td>
<td>Notification</td>
</tr>
<tr>
<td>Ex post liability with sanctions</td>
<td>Monitoring algorithms</td>
</tr>
<tr>
<td>Licensing</td>
<td></td>
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<tr>
<td>Planned Review</td>
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</tbody>
</table>
Premarket Approval Cost/Time to Market

$1.3 billion/12 years

$24 million/1 year

$830,000/5.5 years

$0/0
Definition of Benefit-Cost Analysis

Cost-benefit analysis is an analytical tool used to evaluate policy options by estimating the dollar value of benefits and costs associated with each option.
Costs and Benefits - Options

Problem → Baselines → Requirements → Change in Practices → Costs, Benefits

Requirements → Change in Practices → Costs, Benefits

Requirements → Change in Practices → Costs, Benefits
Benefit-Cost Analysis (and Risk Assessment):

• Organizes facts and different kinds of science
• Reveal need for more information
• Contain uncertainty and variability
• Are decision aids
## Levels of Societal Changes
### Dietary/Health Technologies

<table>
<thead>
<tr>
<th>Level One</th>
<th>Will the technology perform as designed?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1. Probability of a good outcome versus a bad outcome?</td>
</tr>
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<td></td>
<td>2. Benefits of a good outcome versus costs of a bad outcome</td>
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<tr>
<th>Level Two</th>
<th>What are the unintended effects?</th>
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<tbody>
<tr>
<td></td>
<td>1. How will medical care be affected?</td>
</tr>
<tr>
<td></td>
<td>2. How will industries be restructured?</td>
</tr>
<tr>
<td></td>
<td>3. What will be the social inequalities?</td>
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<table>
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<tr>
<th>Level Three</th>
<th>How will these technologies change cultures, governments, longevity?</th>
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<tbody>
<tr>
<td></td>
<td>1. Where will human design go?</td>
</tr>
<tr>
<td></td>
<td>2. How will this affect societies – religion, geopolitics?</td>
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Key Takeaways

• Food Technologies are currently moving faster than science and governance but are likely to drive consumer choice.
• Emerging food technologies include health and food intake monitoring, additive printing, interactive GPS restaurant advice, and may interact with enhanced humans.
• Benefit-Cost analysis can help decide between pre-market approval versus post market soft law to strike the right balance between progress and risk.