Public Health Research in the Post-Genomic Era (PH ver. 3.0)

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Figure 1. Richard Doll at the age of 91 years, after the *British Medical Journal* press conference in 2004, where he presented the 50-year results of his study of British doctors (15) on the hazards of smoking and the benefits of stopping. He himself had stopped smoking at the age of 37 years, as his first results began to emerge; he may well have prevented his own premature death by doing so, and his work helped prevent millions of other premature deaths. (Photograph courtesy of Troika Photos.) (Online version in colour.)
113,597 DOCTORS FROM COAST TO COAST WERE ASKED:

More doctors smoke Camels than any other cigarette!

This is no casual claim. It's an actual fact. Based on the statements of doctors themselves to three nationally known independent research organizations.

The question was very simple. One that you... any smoker... might ask a doctor: "What cigarette do you smoke, Doctor?"

After all, doctors are human too. Like you, they smoke for pleasure. Their tastes, like yours, enjoy the pleasing flavor of costlier tobaccos. Their throats too appreciate a cool mildness.

And more doctors named Camels than any other cigarette.

If you are a Camel smoker, this preference for Camels among physicians and surgeons will not surprise you. But Camel—costlier tobaccos.
# Data inflation

<table>
<thead>
<tr>
<th>Unit</th>
<th>Size</th>
<th>What it means</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bit (b)</td>
<td>1 or 0</td>
<td>Short for “binary digit”, after the binary code (1 or 0) computers use to store and process data</td>
</tr>
<tr>
<td>Byte (B)</td>
<td>8 bits</td>
<td>Enough information to create an English letter or number in computer code. It is the basic unit of computing</td>
</tr>
<tr>
<td>Kilobyte (KB)</td>
<td>1,000, or $2^{10}$ bytes</td>
<td>From “thousand” in Greek. One page of typed text is 2KB</td>
</tr>
<tr>
<td>Megabyte (MB)</td>
<td>1,000KB; $2^{20}$ bytes</td>
<td>From “large” in Greek. The complete works of Shakespeare total 5MB. A typical pop song is about 4MB</td>
</tr>
<tr>
<td>Gigabyte (GB)</td>
<td>1,000MB; $2^{30}$ bytes</td>
<td>From “giant” in Greek. A two-hour film can be compressed into 1-2GB</td>
</tr>
<tr>
<td>Terabyte (TB)</td>
<td>1,000GB; $2^{40}$ bytes</td>
<td>From “monster” in Greek. All the catalogued books in America’s Library of Congress total 15TB</td>
</tr>
<tr>
<td>Petabyte (PB)</td>
<td>1,000TB; $2^{50}$ bytes</td>
<td>All letters delivered by America’s postal service this year will amount to around 5PB. Google processes around 1PB every hour</td>
</tr>
<tr>
<td>Exabyte (EB)</td>
<td>1,000PB; $2^{60}$ bytes</td>
<td>Equivalent to 10 billion copies of The Economist</td>
</tr>
<tr>
<td>Zettabyte (ZB)</td>
<td>1,000EB; $2^{70}$ bytes</td>
<td>The total amount of information in existence this year is forecast to be around 1.2ZB</td>
</tr>
<tr>
<td>Yottabyte (YB)</td>
<td>1,000ZB; $2^{80}$ bytes</td>
<td>Currently too big to imagine</td>
</tr>
</tbody>
</table>

Source: The Economist

The prefixes are set by an intergovernmental group, the International Bureau of Weights and Measures. Yotta and Zetta were added in 1991; terms for larger amounts have yet to be established.
The Human Genome Project: Benefiting All Humanity

“Later this year, researchers will complete the first draft of

The New York Times

September 5, 2012

Bits of Mystery DNA, Far From ‘Junk,’ Play Crucial Role

By GINA KOLATA

Among the many mysteries of human biology is why complex diseases like diabetes, high blood pressure and psychiatric disorders are so difficult to predict and, often, to treat. An equally perplexing puzzle is why one individual gets a disease like cancer or depression, while an identical twin remains perfectly healthy.

The New York Times

Genes Show Limited Value in Predicting Diseases

By NICHOLAS WADE
Published: April 15, 2009

The era of personal genomic medicine may have to wait. The genetic analysis of common diseases is turning out to be a lot more complex than imagined.

The New York Times

President Clinton

January 27, 2000

State of the Union Address

The New York Times

The New York Times

The New York Times

nature

The New York Times

The New York Times

The New York Times

The New York Times

The New York Times

The New York Times

The New York Times

The New York Times

The New York Times
Complexity: Major feature of the Post-Genomic Era

✓ Causation of disease is HIGHLY COMPLEX

✓ Complexity at
  - Biological level
  - Behavioural level
  - Healthcare System level
Does knowing our genetic predisposition to disease lead to a change in behavior?

✓ Genes, smoking cessation and lung cancer
  ▪ Knowledge of single genes association with lung cancer did not change smoking behavior.
  ▪ Knowledge of multiple genes with small effects did change smoking behavior

✓ Genes and Alzheimer's disease
  ▪ Family members carrying APOE gene (higher risk) is likely to adopt healthier lifestyle even though there are no effective prevention strategies.
HEALTH SYSTEMS FRAMEWORK

SYSTEM BUILDING BLOCKS

- SERVICE DELIVERY
- HEALTH WORKFORCE
- INFORMATION
- MEDICAL PRODUCTS/TECHNOLOGIES
- FINANCING
- LEADERSHIP/GOVERNANCE

OUTCOME

- IMPROVED HEALTH
- RESPONSIVENESS
- IMPROVED EFFICIENCY
- SOCIAL/FINANCIAL RISK PROTECTION

ACCESS

COVERAGE

SAFETY

QUALITY

ACCESS

COVERAGE

SAFETY

QUALITY
Figure 8.4: The full obesity system map, which highlights how agents outside conventional mechanisms are key enablers of and barriers to change.

Variables outside of coloured areas relate to social trends and interaction or human biology. Variables are represented by boxes, positive causal relationships are represented by solid arrows and negative relationships by dotted lines. The central engine is highlighted in orange at the centre of the map.
Public Health 3.0

Public Health 2.0
- Single factor interventions; vaccination, tobacco control

Public Health 1.0
- Environmental and economic improvements

- Multiple factors; complexity and implementation science
Moving Public Health 3.0 forward...

✔ Focus on translating etiology into programs and policies; from single to multiple interacting factors.

✔ Embrace the role of behavioral and implementation science; moving beyond biomedical disciplines.
Changing Human Behavior to Prevent Disease: The Importance of Targeting Automatic Processes

Theresa M. Marteau,†* Gareth J. Hollands,† Paul C. Fletcher

Much of the global burden of disease is associated with behaviors—overeating, smoking, excessive alcohol consumption, and physical inactivity—that people recognize as health-harming and yet continue to engage in, even when undesired consequences emerge. To date, interventions aimed at changing such behaviors have largely encouraged people to reflect on their behaviors. These approaches are often ineffectual, which is in keeping with the observation that much human behavior is automatic, cued by environmental stimuli, resulting in actions that are largely unaccompanied by conscious reflection. We propose that interventions targeting these automatic bases of behaviors may be more effective. We discuss specific interventions and suggest ways to determine whether and how interventions that target automatic processes can enhance global efforts to prevent disease.

Why a Macroeconomic Perspective Is Critical to the Prevention of Noncommunicable Disease

Richard Smith

Effective prevention of noncommunicable diseases will require changes in how we live, and thereby effect important economic changes across populations, sectors, and countries. What we do not know is which populations, sectors, or countries will be positively or negatively affected by such changes, nor by how much. Without this information we cannot know which policies will produce effects that are beneficial both for economies and for health.
SAFETY ISSUES

HEALTH ISSUES

GOVERNMENT

MANAGEMENT

WORKER

Management System
Policies, structure, processes

Multi-disciplinary Committee/Business Unit

Modular Health Protection and Health Promotion Programs

Health Protection Programs

Health Promotion Programs

Capacity Building and Sustainability

Vendors
In-house Providers

Awards
Funding Schemes

Culture
Audit

Total WSH System
Moving Public Health 3.0 forward...

✓ Focus on translating etiology into programs and policies; single to multiple interacting factors.

✓ Embrace the role of behavioral and implementation science; moving beyond biomedical disciplines.

✓ Employ complex simulation and modeling to aid in program and policy implementation.
Population Health Metrics and Analytics (PHMA)

- Modeling and Simulation Core (Agent-based)
- Aggregate Data Repository and meta-analyses platform
- Cohort of 50,000 Singaporeans
Projected prevalence of diabetes (18-69), Singapore, 2010-2050

- Ageing effect only: 11.3%
- Ageing, obesity & genes: 13%
- 15%
Prevalence (18-69): 11.3%
Lifetime risk (till 70): 1 in 3
Singapore Population and Persons with Diabetes by 5 year age group and sex 2050

1 million diabetics
Majority above 70
Public Health 3.0: Back to focusing on primary prevention

**PRIMARY PREVENTION**
Preventing the ONSET of diabetes.

**SECONDARY PREVENTION**
Early DETECTION of diabetics

**TERTIARY PREVENTION**
Preventing and DELAYING complications and death.

NORMAL → PRE-DIABETES → DIABETES → COMPLICATIONS DEATH
Turning Discovery into Healthier Communities