


Ethics and Personalized Medicine

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Personalized Medicine & Targeted Therapeutics
Professor of Pharmaceutical Sciences
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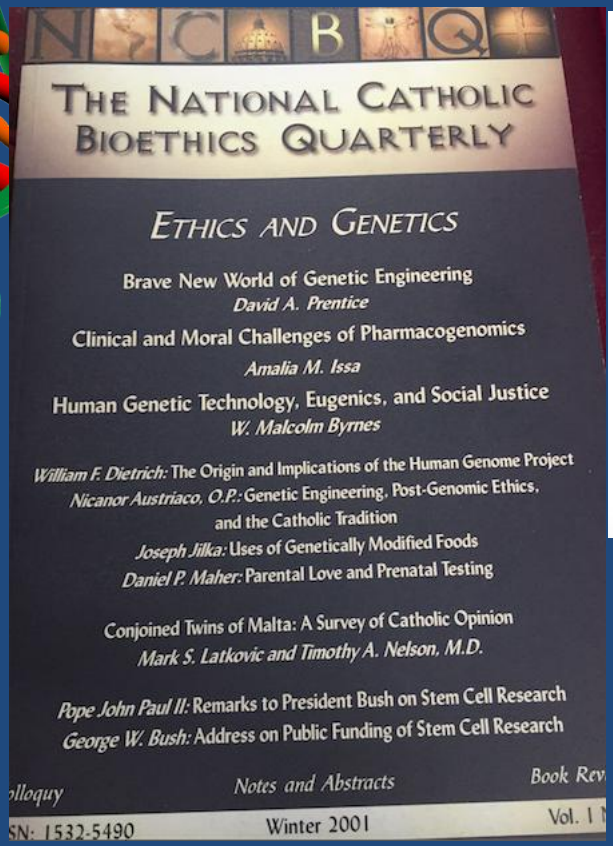
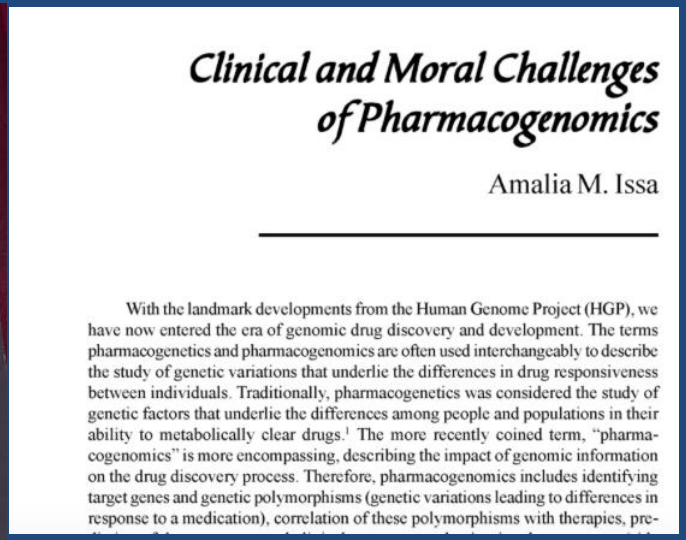




Clinical and Moral Challenges of Pharmacogenomics

Amalia M. Issa

With the landmark developments from the Human Genome Project (HGP), we have now entered the era of genomic drug discovery and development. The terms pharmacogenetics and pharmacogenomics are often used interchangeably to describe the study of genetic variations that underlie the differences in drug responsiveness between individuals. Traditionally, pharmacogenetics was considered the study of genetic factors that underlie the differences among people and populations in their ability to metabolically clear drugs.[1] The more recently coined term, "pharmacogenomics" is more encompassing, describing the impact of genomic information on the drug discovery process. Therefore, pharmacogenomics includes identifying target genes and genetic polymorphisms (genetic variations leading to differences in response to a medication), correlation of these polymorphisms with therapies, pre-

Ethical considerations in clinical pharmacogenomics research

Amalia M. Issa

In recent years there have been unprecedented advances in our understanding of the involvement of genetic polymorphisms in the response to drug therapies. Polymorphisms have been identified that lead to variable patient responses to several medications including cardiovascular, psychiatric, anti-infective and analgesic therapies. The potential for the development of customized, genotype-based therapies is scientifically and clinically attractive. However, these developments, although bearing scientific promise, raise ethical concerns for the conduct of research with human subjects, particularly with respect to confidentiality, risk–benefit analysis, DNA-banking and pharmacoeconomic issues. This article discusses some of the ethical considerations that are related to the use of pharmacogenomics in clinical research protocols.

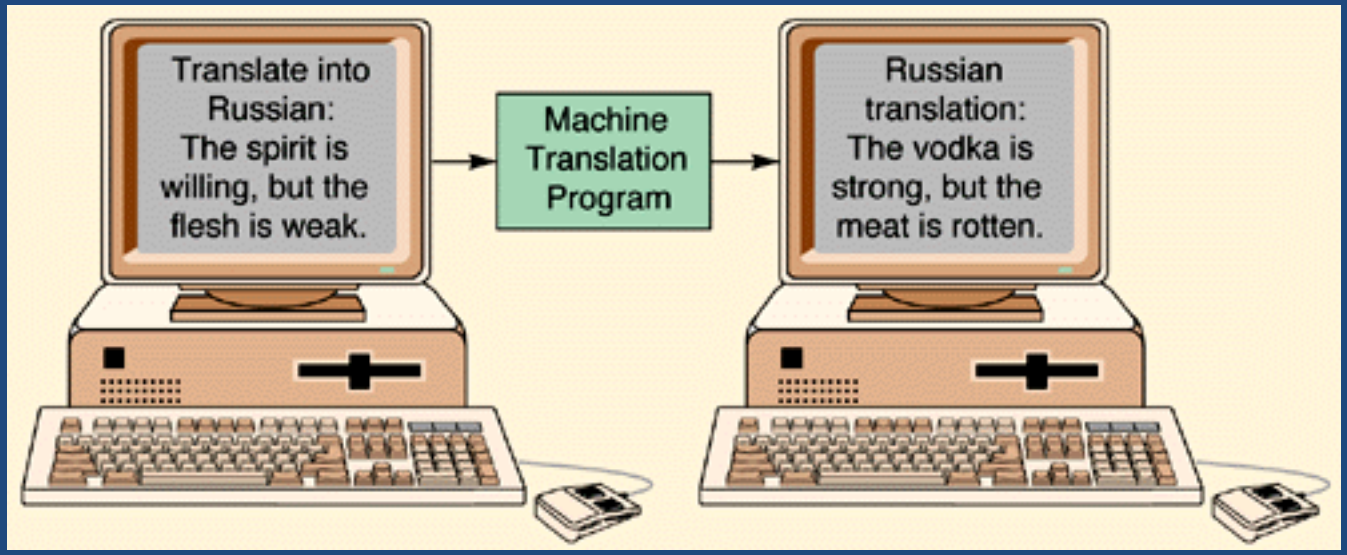
Trends in Pharmacol Sci. 2001

ETHICAL PERSPECTIVES ON PHARMACOGENOMIC PROFILING IN THE DRUG DEVELOPMENT PROCESS

Amalia M. Issa

Pharmacogenomics, which is a field that encompasses the study of genetic polymorphisms that underlie individual differences in drug response, is rapidly advancing. The potential for the widespread use of pharmacogenomics in the drug development process merits an examination of its fundamental impact on clinical-trial design and practice. This article provides a critical analysis of some of the issues that pertain to pharmacogenomics in the drug development process. In

Nature Rev Drug Discov 2002


Translate into Russian: The spirit is willing, but the flesh is weak.
Machine Translation Program
Russian translation: The vodka is strong, but the meat is rotten.

PhD in Neuroscience (neuropharm) from McGill University

MPH, UCLA SPH

Some theological and Catholic ethics training at Regis College, U of Toronto

Fellowships, Harvard Medical School




The Washington Post

Wonkblog

Hot dogs, bacon and other processed meats cause cancer, World Health Organization

Testicles Of Yogurt-Eating Mice Shown Bigger, And Researchers Credit Probiotics

Elle [illegible]in

Last summer a team of researchers from the Massachusetts Institute of [illegible]ology set out to better understand the effects of yogurt on

Tall women have higher cancer risk; are smoking, drinking to blame?

July 25, 2013 | By Monte Morin

Email Share Tweet Recommend 0

The taller a postmenopausal woman is, the greater risk she faces of developing cancer, according to a new study.

In a paper published Thursday in the journal Cancer Epidemiology, Biomarkers & Prevention, researchers concluded that a woman's cancer risk increased 13% with every 4 inches of height.

The study is the latest of several to report an association between women's height and cancer, according to lead study author Geoffrey Kabat, a cancer epidemiologist at

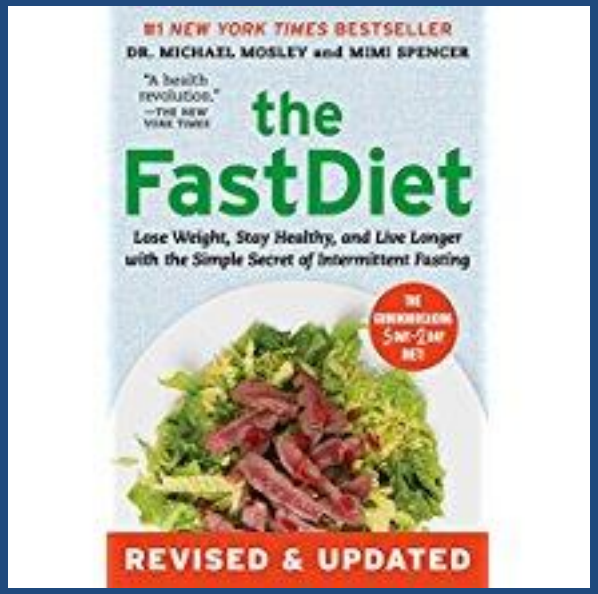
A new study has linked women's height to cancer risk. (Divyakant Solanki / European...)

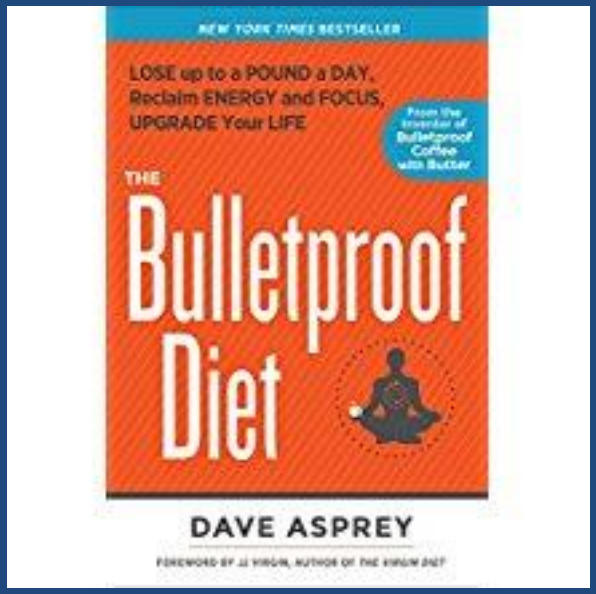


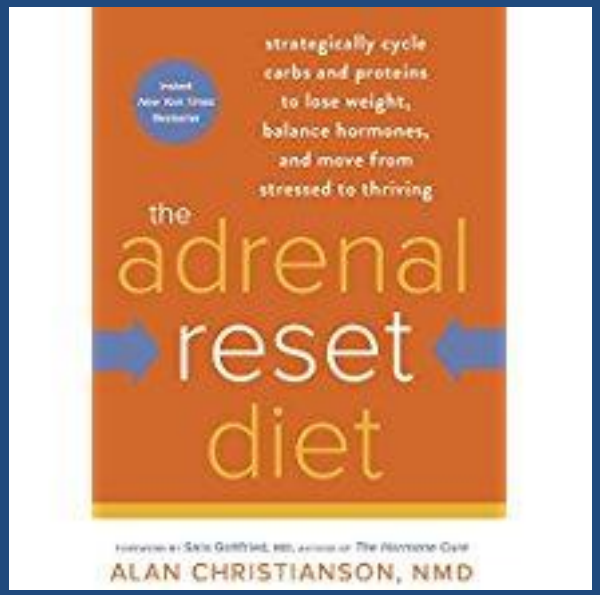


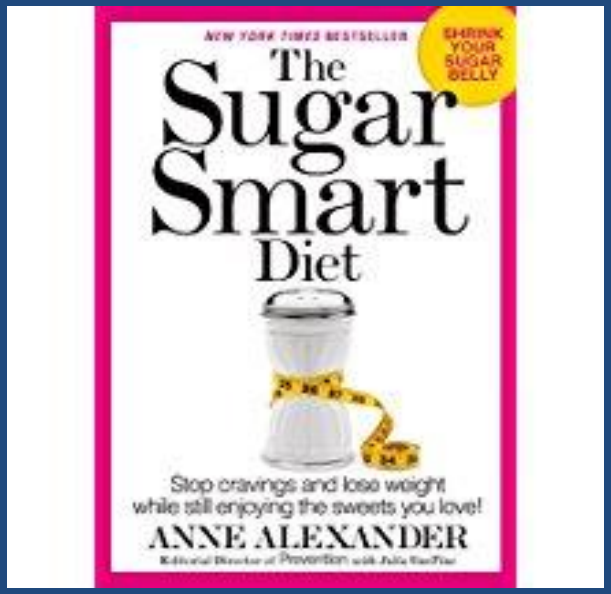

Museum Tour

- Good ethics begins with good science
- Autonomy & Privacy/Confidentiality
- Issues related to Big Data
- How the Church Can Contribute to the Dialogue

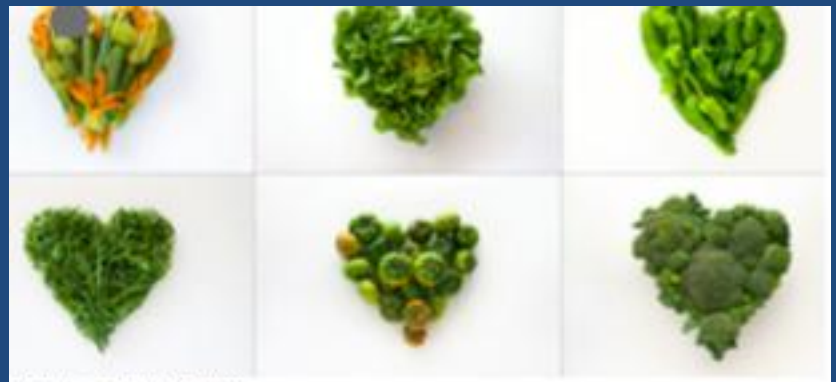

#1 NEW YORK TIMES BESTSELLER
DR. MICHAEL MOSLEY and MIMI SPENCER
"A health revolution." —THE NEW YORK TIMES
the FastDiet
Lose Weight, Stay Healthy, and Live Longer with the Simple Secret of Intermittent Fasting
REVISED & UPDATED


NEW YORK TIMES BESTSELLER
LOSE up to a POUND a DAY, Reclaim ENERGY and FOCUS, UPGRADE Your LIFE
From the Inventor of Bulletproof Coffee with Butter
THE Bulletproof Diet
DAVE ASPREY


strategically cycle carbs and proteins to lose weight, balance hormones, and move from stressed to thriving
the adrenal reset diet
ALAN CHRISTIANSON, NMD


NEW YORK TIMES BESTSELLER
SHRINK YOUR SUGAR BELLY
The Sugar Smart Diet
Stop cravings and lose weight while still enjoying the sweets you love!
ANNE ALEXANDER

Green Foods May Power Your Cells Like Plants



PATRIZIA SAVARESE VIA GETTY IMAGES

How many times have you heard the recommendation to eat your greens? Kale, bok choy, mustard greens, broccoli and other vegetables have been praised as superfoods and are often rated as the healthiest foods to eat. Although there are many components of these foods that contribute to health like the fiber, minerals, micronutrients and antioxidants, the green color itself may aid our health. Why are these vegetables green? And how does that help our health?

They are green because they contain large amounts of chlorophyll. Chlorophyll is from the Latin "green leaf" and is the green color leaves and plants. Chlorophyll is formed in the cells of the leaves and other parts of the plants exposed to light. Green plants take in sunlight and transform it into energy. This is called photosynthesis. Chlorophyll is

Huffington Post, 5/23/2016






Good ethics begins with good science.

THERE is no good science without good judgment

and no good judgment without good ethics

Era of Precision Medicine has Arrived

No commonly agreed upon definition of the term "Personalized Medicine"

Widely understood that *personalized medicine* refers to:

A medical model using characterization of individuals' ***phenotypes*** (observable physical and biochemical characteristics) and ***genotypes*** (e.g. molecular profiling) along with medical imaging, lifestyle data for tailoring the right therapeutic strategy and/or to deliver timely and targeted prevention.





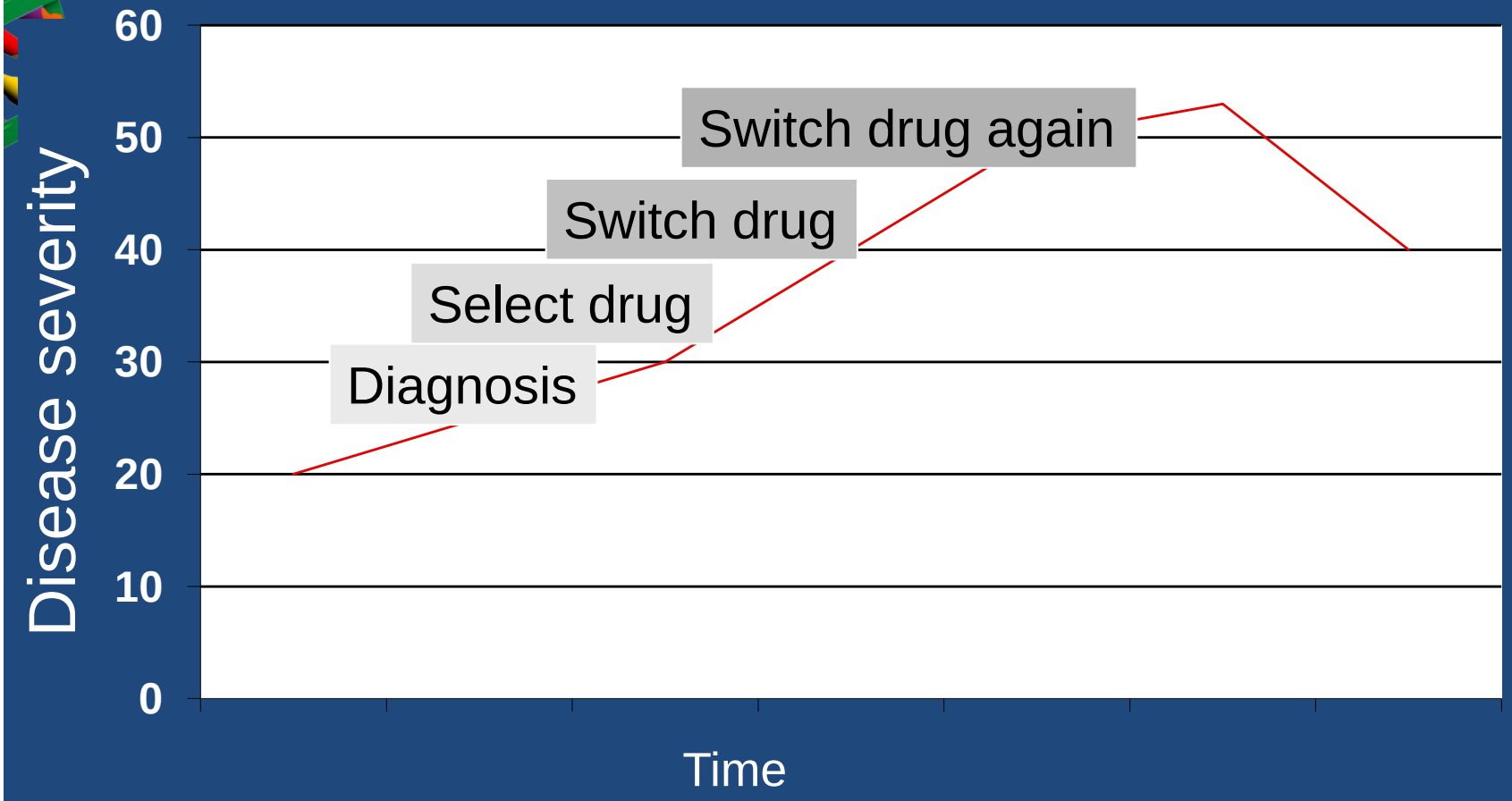

From personalized medicine to precision medicine

Precision medicine implies that diseases are defined by underlying molecular mechanisms rather than traditional signs and symptoms.

Lancet 378 : 1678, 2011

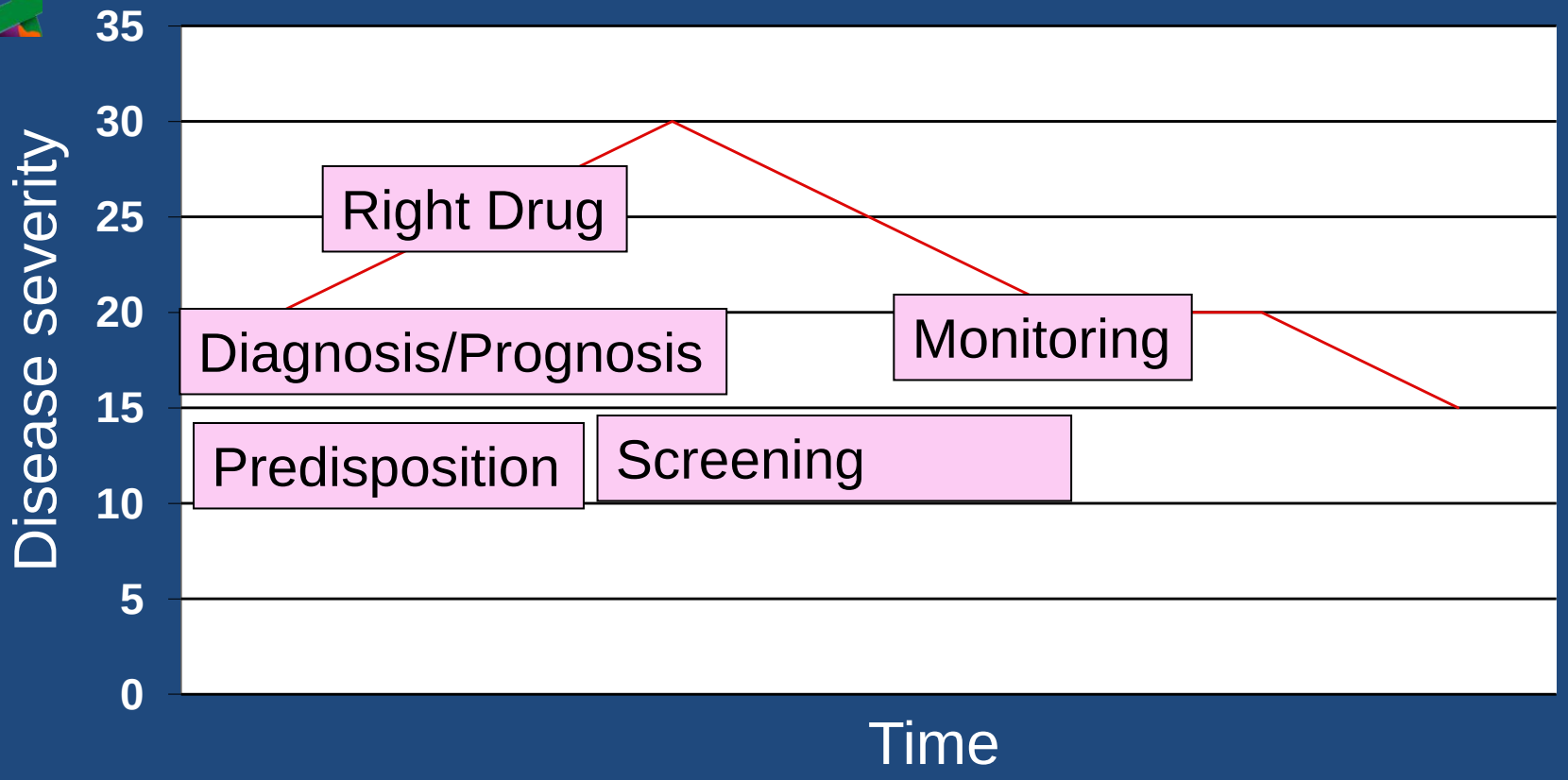
Toward precision medicine

The old paradigm: Treatment of the disease



Reactive medical care

More Effective Treatment Paradigm



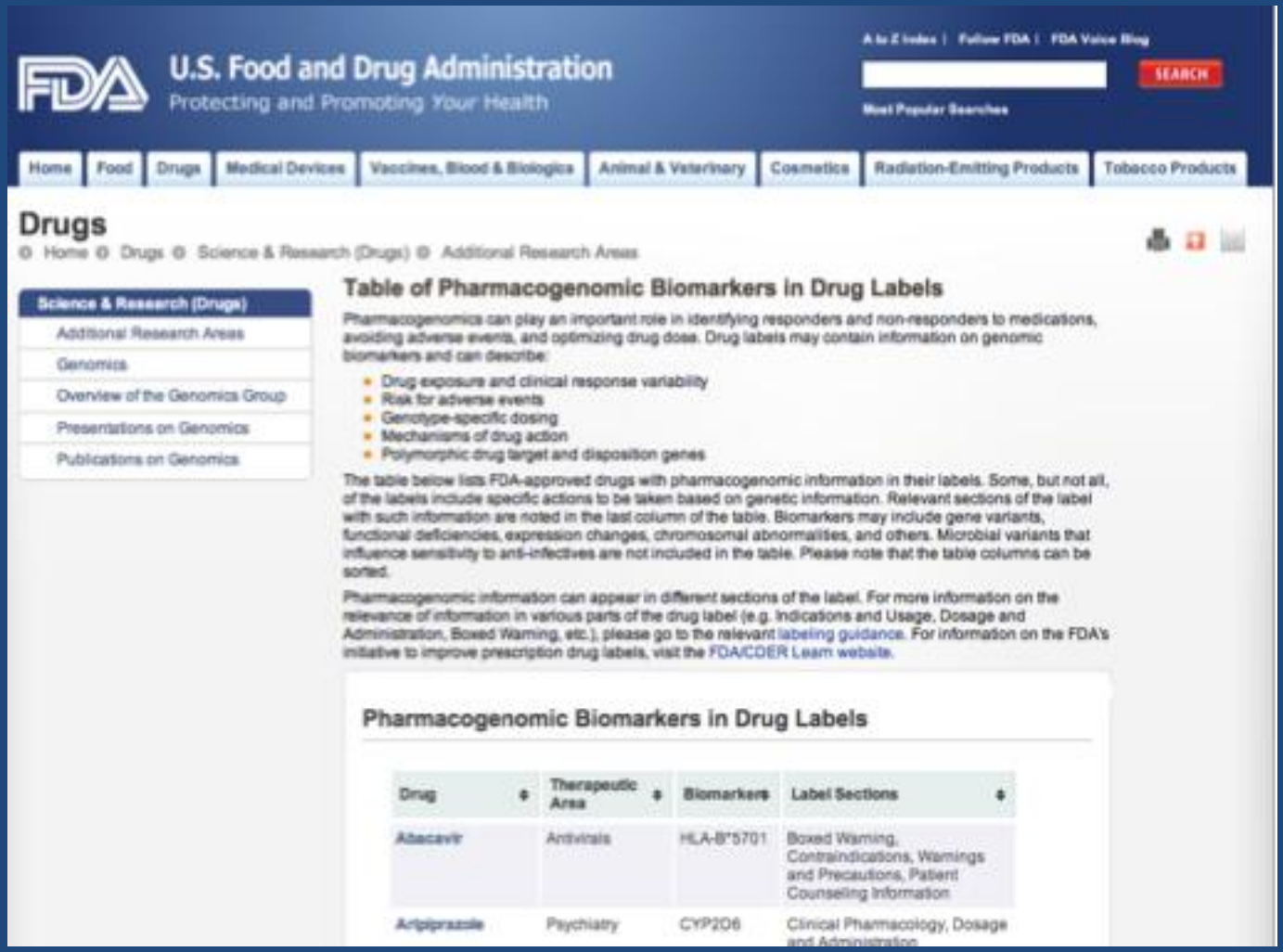
Efficient medical care

> 1 in 4

28% of the novel new drugs approved by FDA in 2015 are personalized medicines

Personalized Medicine Coalition, Jan. 2016

Nearly 160 Drugs with Genomic Information in the Label



PRECAUTIONS

General: PLAVIX prolongs the bleeding time and therefore should be used with caution in patients who may be at risk of increased bleeding from trauma, surgery, or other pathological conditions (particularly gastrointestinal and intraocular). If a patient is to undergo elective surgery and an antiplatelet effect is not desired, PLAVIX should be discontinued 5 days prior to surgery.

Due to the risk of bleeding and undesirable hematological effects, blood cell count determination and/or other appropriate testing should be promptly considered, whenever such suspected clinical symptoms arise during the course of treatment (see **ADVERSE REACTIONS**).

In patients with recent TIA or stroke who are at high risk of recurrent ischemic events, the combination of aspirin and PLAVIX has not been shown to be more effective than PLAVIX alone, but the combination has been shown to increase major bleeding.

Pharmacogenetics: Based on literature data, patients with genetically reduced CYP2C19 function have lower systemic exposure to the active metabolite of clopidogrel and diminished antiplatelet responses, and generally exhibit higher cardiovascular event rates following myocardial infarction than do patients with normal CYP2C19 function (see **CLINICAL PHARMACOLOGY: Pharmacogenetics**).

GI Bleeding: In CAPRIE, PLAVIX was associated with a rate of gastrointestinal bleeding of 2.0%, vs. 2.7% on aspirin. In CURE, the incidence of major gastrointestinal bleeding was 1.3% vs. 0.7% (PLAVIX + aspirin vs. placebo + aspirin, respectively). PLAVIX should be used with caution in patients who have lesions with a propensity to bleed (such as ulcers). Drugs that might induce such lesions should be used with caution in patients taking PLAVIX.

atenolol and nifedipine. The pharmacodynamic activity of PLAVIX was also not significantly influenced by the coadministration of **phenobarbital, cimetidine** or **estrogen**.

The pharmacokinetics of **digoxin** or **theophylline** were not modified by the coadministration of PLAVIX (clopidogrel bisulfate).

At high concentrations *in vitro*, clopidogrel inhibits P_{450} (2C9). Accordingly, PLAVIX may interfere with the metabolism of **phenytoin, tamoxifen, tolbutamide, warfarin, torsemide, fluvastatin,** and many **non-steroidal anti-inflammatory agents,** but there are no data with which to predict the magnitude of these interactions. Caution should be used when any of these drugs is coadministered with PLAVIX.

In addition to the above specific interaction studies, patients entered into clinical trials with PLAVIX received a variety of concomitant medications including **diuretics, beta-blocking agents, angiotensin converting enzyme inhibitors, calcium antagonists, cholesterol lowering agents, coronary vasodilators, antidiabetic agents** (including **insulin**), **thrombolytics, heparins** (unfractionated and LMWH), **GPIIb/IIIa antagonists, antiepileptic agents** and **hormone replacement therapy** without evidence of clinically significant adverse interactions.

There are no data on the concomitant use of oral anticoagulants, non study oral anti-platelet drugs and chronic NSAIDs with clopidogrel.

Drug/Laboratory Test Interactions

None known.

Carcinogenesis, Mutagenesis, Impairment of Fertility




Multiplex Tests are Already Having an Impact

OncoType DX (Breast Cancer)

Analyzes by qPCR, mRNA expression of a panel of 21 genes within a tumor to determine a Recurrence Score

MammaPrint (Breast Cancer)

Microarray-based prognostic breast cancer mRNA expression profiling test of 70 genes

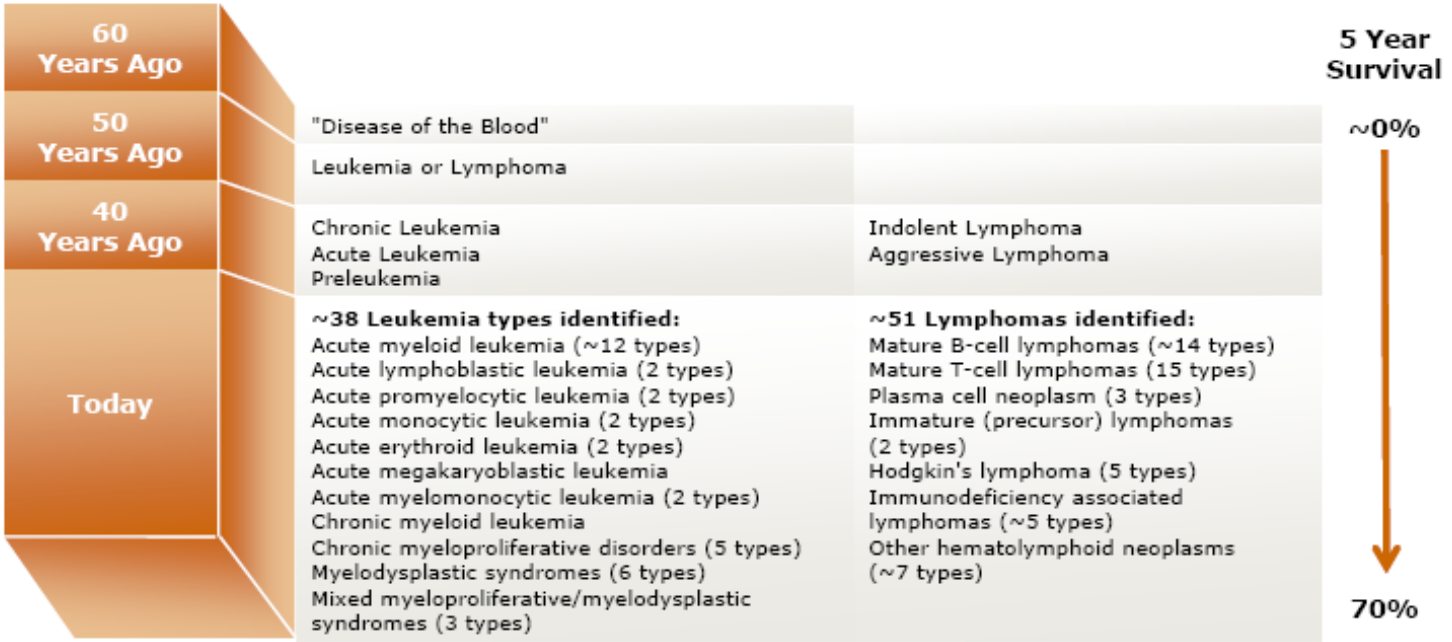
AlloMap (Heart Transplants)

qPCR-based expression profile of 11 genes to assist physicians in managing heart transplant patients for potential organ rejection

Tissue of Origin (15 common malignant tumor types)

Microarray technology considers 15 common malignant tumor types, including bladder, breast,and colorectal tumors based on mRNA expression on 1,550 genes

PM impacts diagnostic categories



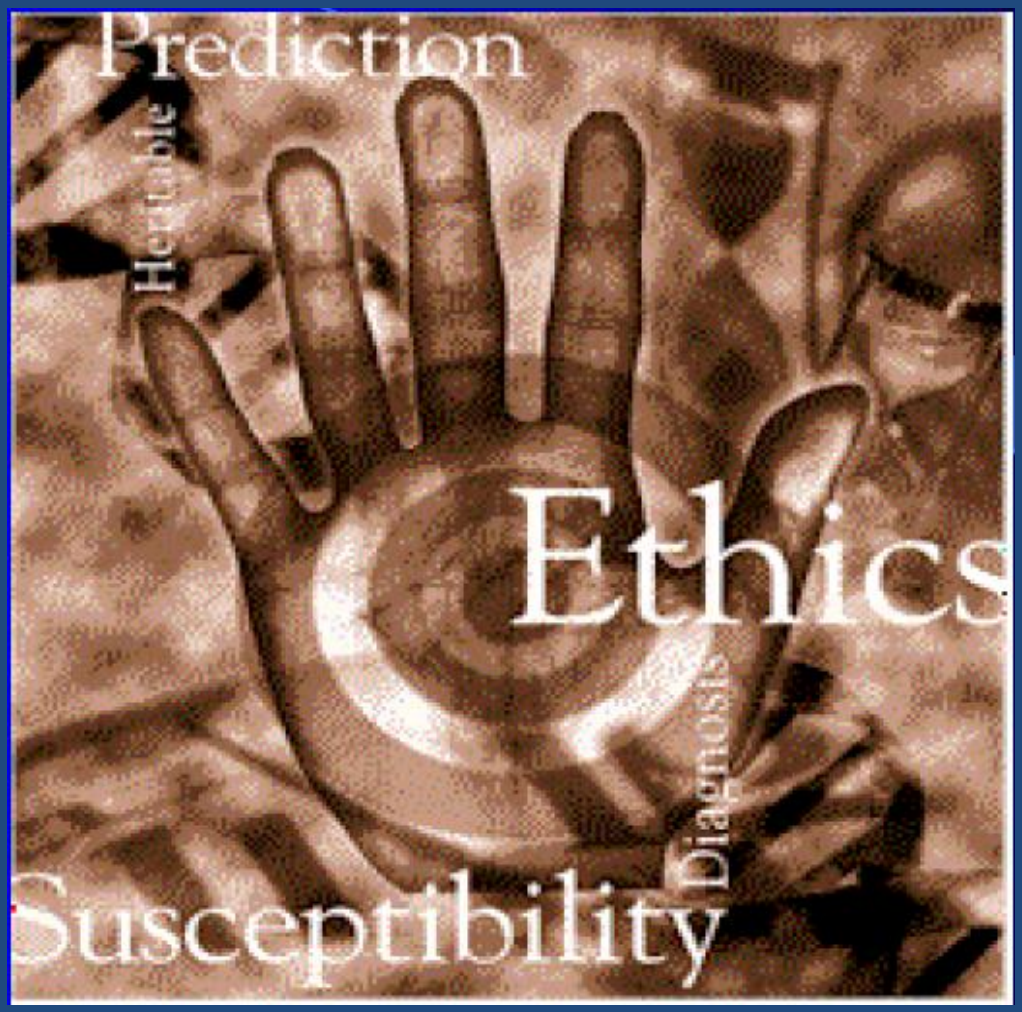
Ries LAG, Eisner MP, Kosary CL, Hankey BF, Miller BA, Clegg L, Mariotto A, Feuer EJ, Edwards BK (eds). *SEER Cancer Statistics Review, 1975-2002*, National Cancer Institute. Bethesda, MD, http://seer.cancer.gov/csr/1975_2002/, based on November 2004 SEER data submission, posted to the SEER web site 2005.

Source: Mara G. Aspinall, former President, Genzyme Genetics




What will likely happen??

- Personalized medicine will involve pharmacogenomic treatment approaches that transcend the one-size-fits-all approach
- Personalized medicine will focus on keeping people well and treating disease at its earliest stages!
- Laboratory medicine will lead the way!
- Disease signatures comprised of hundreds or thousands of data points will be the biomarkers of the future
- Drug companies will develop their markets around interventional treatments for disease signatures!!


Prediction
Ethics
Susceptibility
Diagnosis

AUTONOMY

What Do Patients Want

Provision of personalized genomic diagnostic technologies for breast and colorectal cancer: an analysis of patient needs, expectations and priorities

veral novel pharmacogenomic diagnostic tests are commercially available for breast and colorectal and are increasingly being used in clinical practice for improving treatment decisions. However, there evidence evaluating the value of these new genomic technologies from the perspective of patients. of an ongoing effort to understand the continuum of the process of adoption of genomic diagnostics, n in this study was to examine the value of genomic diagnostics to breast and colorectal cancer s, and their willingness to adopt and use genomic diagnostics. **Patients & methods:** We conducted s groups of breast and colorectal cancer patients from the oncology clinics at The Methodist Hospital, n, TX, USA. An adapted Q-sort instrument was also administered to focus group participants. **Results:** jority of breast and colorectal cancer patients are interested in using novel genomic diagnostics for g about treatment options. Most participants in our study expressed a willingness to pay out-of-pocket omic testing (z = 0.736). Reliability and validity of genomic testing were of significant concern (z = r the majority of breast and colorectal cancer patients. Participants identified several facilitators and s within health systems that might either facilitate or impede the widespread adoption and use of ic diagnostics in healthcare delivery. **Conclusion:** This study demonstrates breast and colorectal cancer s' willingness to adopt and pay for novel genomic diagnostics, as well as identifies several salient associated with patient preferences for genomic diagnostics.

RDS: breast cancer clinical adoption colorectal cancer focus groups
nic diagnostics patient expectations and priorities pharmacogenomics
methodology

Amalia M Issa[1,2,3], Janis F Hutchinson[2,4], Waqas Tufail[2], Erica Fletcher[2], Roseline Ajike[1,3] & Jose Tenorio[1,3]

reviously reported on primary care particularly for cancer care [15,16], it is critical
eadiness to accept and adopt the to examine and measure patient preferences for
rmacogenomic-based diagnostics the use of novel genomic diagnostics in breast

A national study of breast and colorectal cancer patients' decision-making for novel personalized medicine genomic diagnostics

Aim: Molecular diagnostics are increasingly being used to help guide decision-making for personalized medical treatment of breast and colorectal cancer patients. The main aim of this study was to better understand and determine breast and colorectal cancer patients' decision-making strategies and the trade-offs they make in deciding about characteristics of molecular genomic diagnostics for breast and colorectal cancer. **Patients & methods:** We surveyed a nationally representative sample of 300 breast and colorectal cancer patients using a previously developed web-administered instrument. Eligibility criteria included patients aged 18 years and older with either breast or colorectal cancer. We explored several attributes and attribute levels of molecular genomic diagnostics in 20 scenarios. **Results:** Our analysis revealed that both breast and colorectal cancer patients weighted the capability of molecular genomic diagnostics to determine the probability of treatment efficacy as being of greater importance than information provided to detect adverse events. The probability of either false-positive or -negative results

Cancer patients' acceptance, understanding, and willingness-to-pay for pharmacogenomic testing

Sinead Cuffe[a], Henrique Hon[a], Xin Qiu[b], Kimberly Tobros[a], Chung-Kwun Amy Wong[a], Bradley De Souza[a], Graham McFarlane[a], Sohaib Masroor[a], Abul K. Azad[a], Ekta Hasani[a], Natalie Rozanec[a], Natasha Leighl[a], Shabbir Alibhai[c], Wei Xu[b], Amalia M. Issa[d] and Geoffrey Liu[a]

Background Pharmacogenomics is gaining increasing importance in the therapeutics of cancer; yet, there is little knowledge of cancer patients' attitudes toward the use of pharmacogenomic testing in clinical practice. We carried out this study to explore cancer patients' acceptance, understanding, and willingness-to-pay for pharmacogenomic testing.

Materials and methods A broad cross-section of gastrointestinal, lung, breast, and other cancer patients were interviewed in terms of their acceptance of pharmacogenomic testing using hypothetical time, efficacy, and toxicity trade-off and willingness-to-pay scenarios.

Results Among the 96% of 123 adjuvant patients accepting making on pharmacogenomic testing; however, one in five patients lacked a basic understanding of pharmacogenomic testing.

Conclusion Among cancer patients willing to undergo chemotherapy, almost all wanted pharmacogenomic testing and were willing-to-pay for it, waiting several weeks for results. Although patients had a strong desire to be involved in decision-making on pharmacogenomic testing, a considerable proportion lacked the necessary knowledge to make informed choices. *Pharmacogenetics and Genomics* 24:348–355 © 2014 Wolters Kluwer Health | Lippincott Williams & Wilkins.

Pharmacogenetics and Genomics 2014, 24:348–355

The Patient Preferences for Personalized Medicine Instrument™ : Simulating Real-World Decision-Making

We would like you to consider an imaginary scenario not related to you. Please imagine you have just recovered from surgery to remove a a tumor. Your doctor has offered a genomic test to help you decide on treatment options. You will not have to undergo any additional invasive procedures for the test.

The results from the test will predict whether or not you are likely to benefit from chemotherapy. With these tests, patients who are unlikely to benefit from chemotherapy can avoid receiving such treatment and therefore avoid any side effects.

Please imagine you were in the situation described above and assume the options below were the only tests available. Please choose the test that you **most** prefer, and then please indicate whether you really would be willing to take the test you selected if you were in this situation.

What is the cost of testing to you personally?	$2,000	$500	$4,000
How will your test results be used?	You will decide how to use the test results, regardless of your risk of recurrence	Your doctor will decide how best to treat you based upon your results (for example if testing suggests that your risk of recurrence is low, you may not receive chemotherapy)	Your insurance company will use the test results to determine your coverage (for example if testing suggests that your risk of recurrence is low, your insurance company may not cover the cost of chemotherapy)
The chance the test will correctly predict patients' response to treatment	96% (96 out of 100 tests will correctly predict response to treatment) 	70% (70 out of 100 tests will correctly predict response to treatment) 	80% (80 out of 100 tests will correctly predict response to treatment) 
What information will the test provide?	Predict how likely you are to benefit from chemotherapy and how likely you are to develop severe side effects from chemotherapy.	Recurrence risk that cancer will return (stated as either low, medium or high risk); predict how likely you are to benefit from chemotherapy and how likely you are to develop severe side effects from chemotherapy.	Predict how likely you are to benefit from chemotherapy.
Who has access to your test results?	Patient and doctor	Patient, doctor and insurance company	Patient, doctor, insurance company and employer
	○	○	○

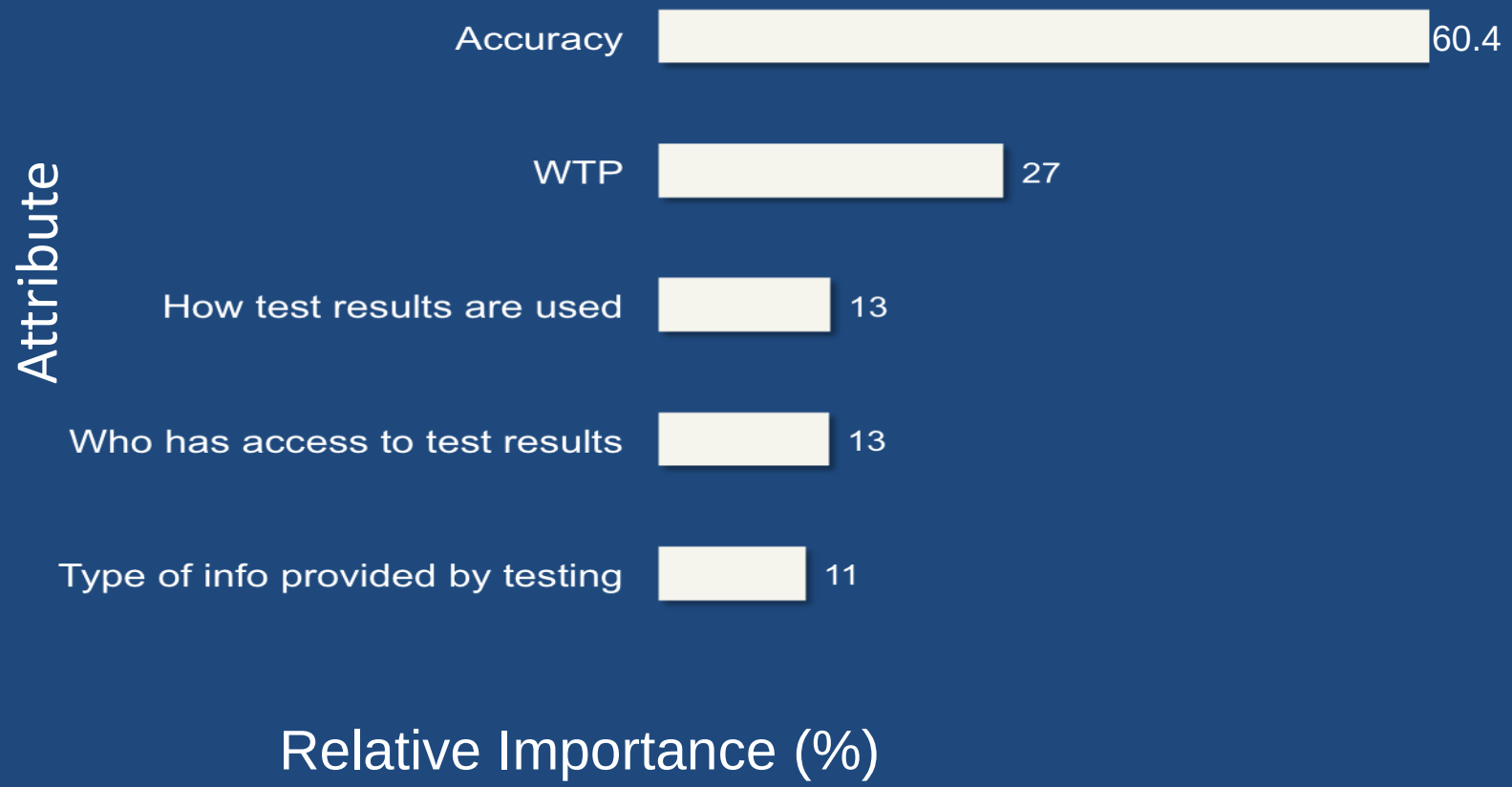
Given what you know about the test, please indicate whether you really would be willing to take the test you selected above if you were in this situation?

- ○ Yes
- ○ No

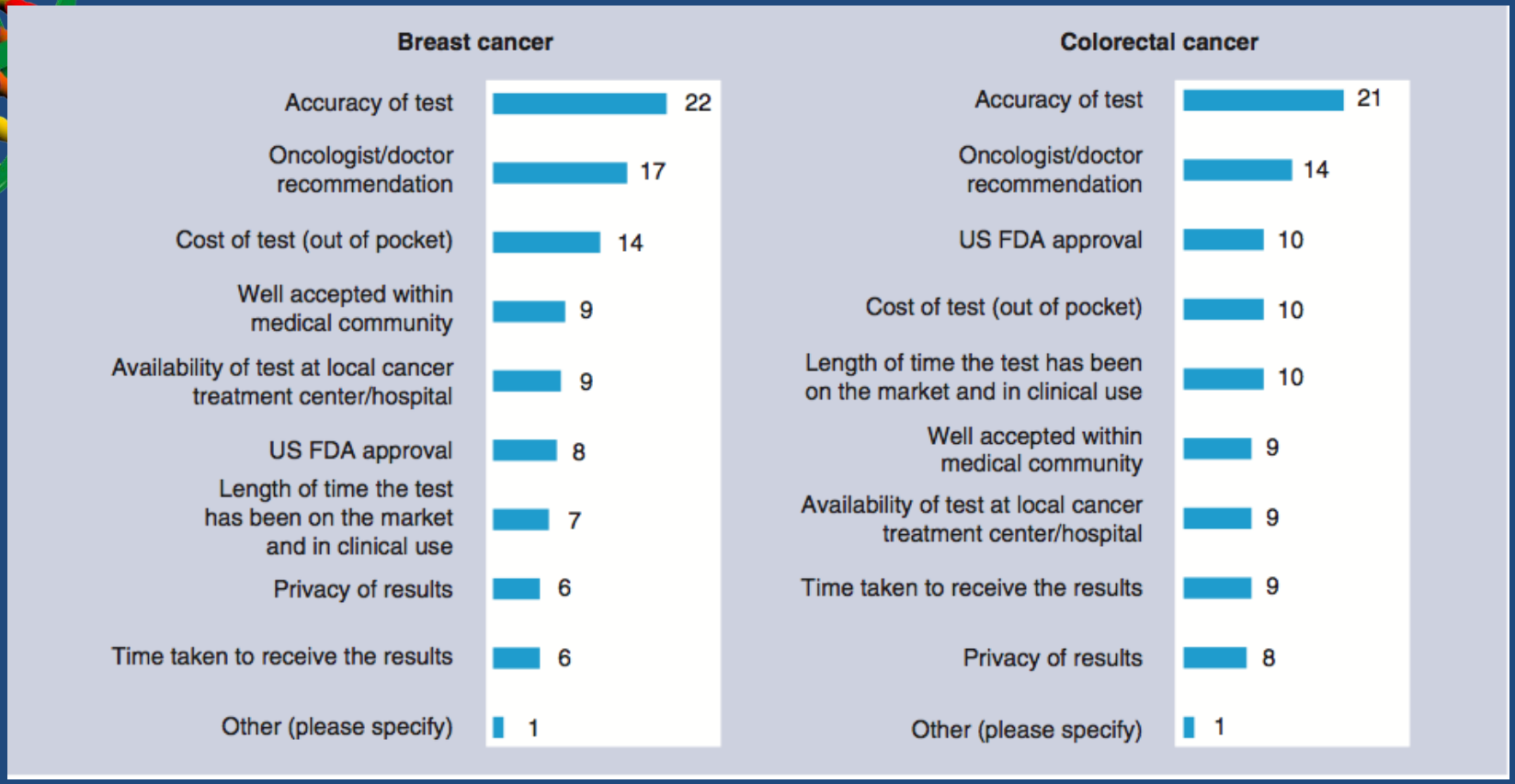
Issa, 2007

Attributes	Levels
Color	Black White Red
Size	SUV Truck Sedan
Doors	2-door 4-door

All attributes impact patients' decisions but Accuracy and WTP carry most weight



Attribute Relative Importance by Cancer Type






What We've Learned…

- Among various populations, patients are overwhelmingly willing to accept, pay for and use genomic diagnostic tests and personalized med. applications.
- Willingness to pay falls predictably at increasingly higher costs, however patients are willing to pay a higher cost if it would prevent insurance companies from having access to test results.
- Patients want physicians to be intermediaries (contrary to conventional wisdom and lit about pt. autonomy) when deciding about genomic testing. They want physicians to make specific recommendations.
- Test accuracy, specificity, sensitivity, and no false positive or false negative results were among most important attributes for patients.
- Patients want results of testing fast.

- Attribute `privacy' initially not ranked high
- `Doctor recommendation' ranked highly
- Pts expect high accuracy; acceptance by medical community and FDA of tests is important
- Patients trade-off privacy concerns for benefit
- Suggests that docs are indispensable intermediaries; somewhat contradicts lit. on pt. autonomy
- Challenges assumption that pts don't care about technical aspects

After a short stay in America, Michelangelo's David Returned to Europe

Identifying Personal Genomes by Surname Inference

Melissa Gymrek,[1,2,3,4] Amy L. McGuire,[5] David Golan,[6] Eran Halperin,[7,8,9] Yaniv Erlich[1]*

Sharing sequencing data sets without identifiers has become a common practice in genomics. Here, we report that surnames can be recovered from personal genomes by profiling short tandem repeats on the Y chromosome (Y-STRs) and querying recreational genetic genealogy databases. We show that a combination of a surname with other types of metadata, such as age and state, can be used to triangulate the identity of the target. A key feature of this technique is that it entirely relies on free, publicly accessible Internet resources. We quantitatively analyze the probability of identification for U.S. males. We further demonstrate the feasibility of this technique by tracing back with high probability the identities of multiple participants in public sequencing projects.

Surnames are paternally inherited in most human societies, resulting in their co-segregation with Y-chromosome haplotypes (*1*–*5*). Based on this observation, multiple genetic genealogy companies offer services to reunite distant patrilineal relatives by genotyping a few dozen highly polymorphic short tandem repeats across the Y chromosome (Y-STRs). The association between surnames and haplotypes can be confounded by nonpaternity events, mutations, and adoption of the same surname by multiple founders (*5*). The genetic genealogy community addresses these barriers with massive databases that list the test results of Y-STR haplotypes along with their corresponding surnames. Currently, there are at least eight databases and numerous surname project Web sites that collectively contain hundreds of thousands of surname-haplotype records (table S1).

The ability of genetic genealogy databases to breach anonymity has been demonstrated in the past. In a number of public cases, male adoptees and descendants of anonymous sperm donors used recreational genetic genealogy services to genotype their Y-chromosome haplotypes and to search the companies' databases (*6*–*9*). The genetic matches identified distant patrilineal relatives and pointed to the potential surnames of their biological fathers. By combining other pieces of demographic information, such as date and place of birth, they fully exposed the identity of their biological fathers. Lunshof *et al.* (*10*) were the first to speculate that this technique could expose the full identity of participants in sequencing projects. Gitschier (*11*) empirically approached this hypothesis by testing 30 Y-STR haplotypes of CEU participants in these

terms did not prevent re-identification. Representatives of relevant organizations that funded the original studies were notified and confirmed the compliance of this study with their guidelines (*12*).

As a primary resource for surname inference, we focused on Ysearch (www.ysearch.org) and

[1]Whitehead Institute for Biomedical Research, 9 Cambridge Center, Cambridge, MA 02142, USA. [2]Harvard–Massachusetts Institute of Technology (MIT) Division of Health Sciences and Technology, MIT, Cambridge, MA 02139, USA. [3]Program in Medical and Population Genetics, Broad Institute of MIT and Harvard, Cambridge, MA 02142, USA. [4]Department of Molecular Biology and Diabetes Unit, Massachusetts General Hospital, Boston, MA 02114, USA. [5]Center for Medical Ethics and Health Policy, Baylor College of Medicine, Houston, TX 77030, USA. [6]Department of Statistics and Operations Research, Tel Aviv University, Tel Aviv 69978, Israel. [7]School of Computer Science, Tel Aviv University, Tel Aviv 69978, Israel. [8]Department of Molecular Microbiology and Biotechnology, Tel-Aviv University, Tel Aviv 69978, Israel. [9]The International Computer Science Institute, Berkeley, CA 94704, USA.

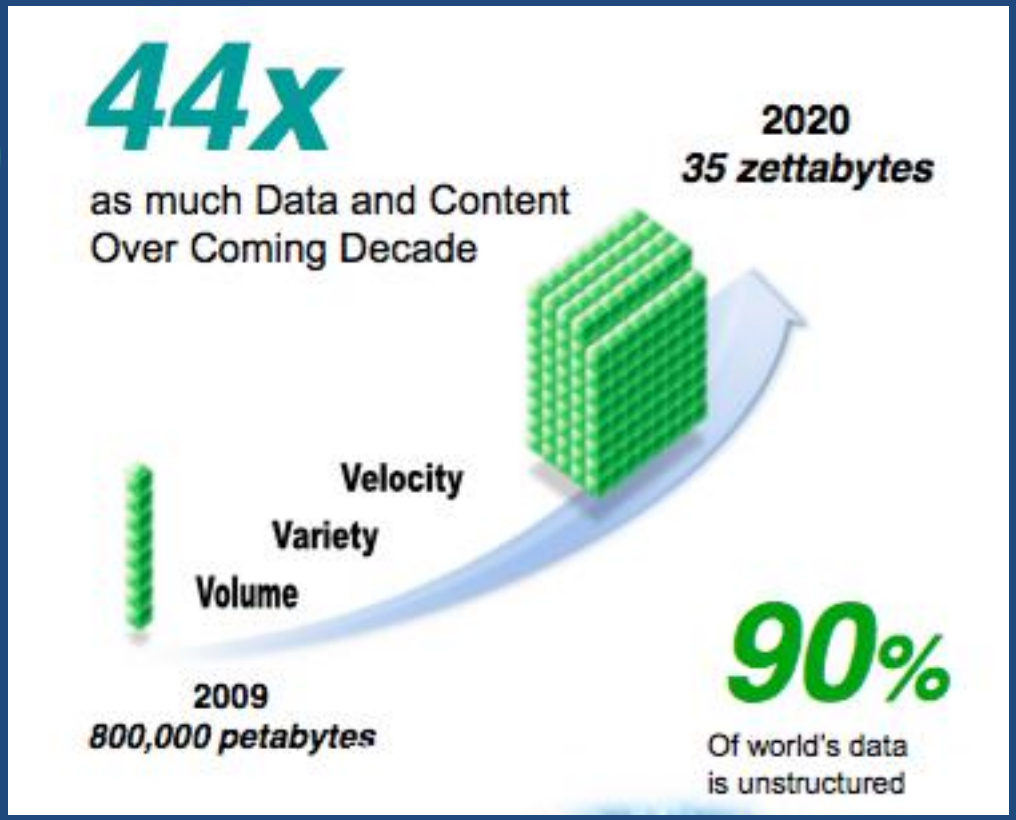
*To whom correspondence should be addressed. E-mail: yaniv@wi.mit.edu

"Surnames can be recovered from personal genomes by profiling short tandem repeats on the Y chromosome (Y-STRs) and querying recreational genetic geneology databases."




What MIT Group Did

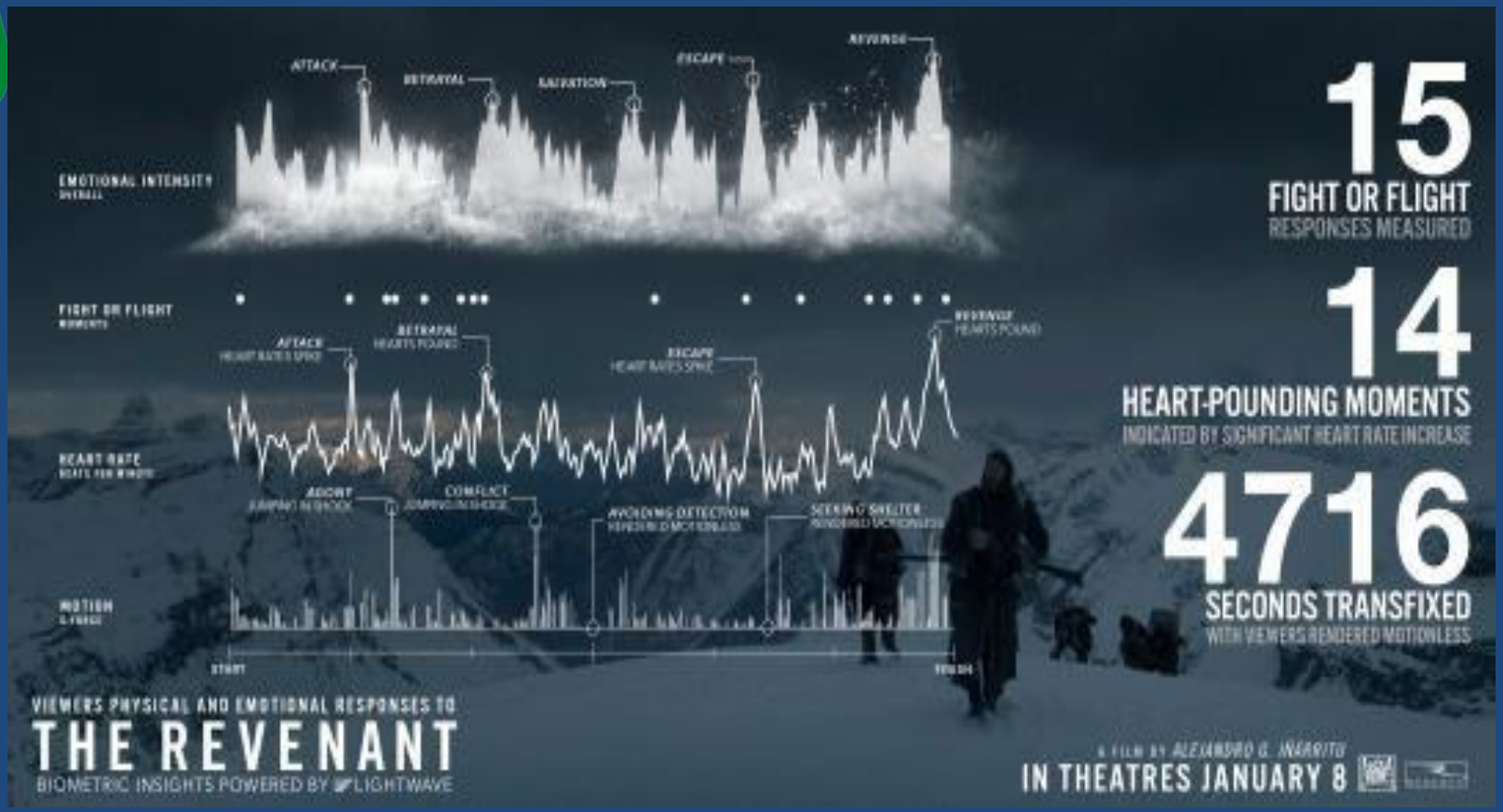
- 1000 Genomes Project database
- Includes participants' age and region where they live (all Americans are from CEPH population in Utah)
- Pulled out short tandem repeats on Y chromosome and matched to genetic geneology database to get surname
- Did a Google search to find obituary and was able to identify entire family tree
- Identified nearly 50 people this way – published method, not names of people identified


44x
as much Data and Content
Over Coming Decade
2020
35 zettabytes
Velocity
Variety
Volume
2009
800,000 petabytes
90%
Of world's data
is unstructured

NETFLIX

The Revenant

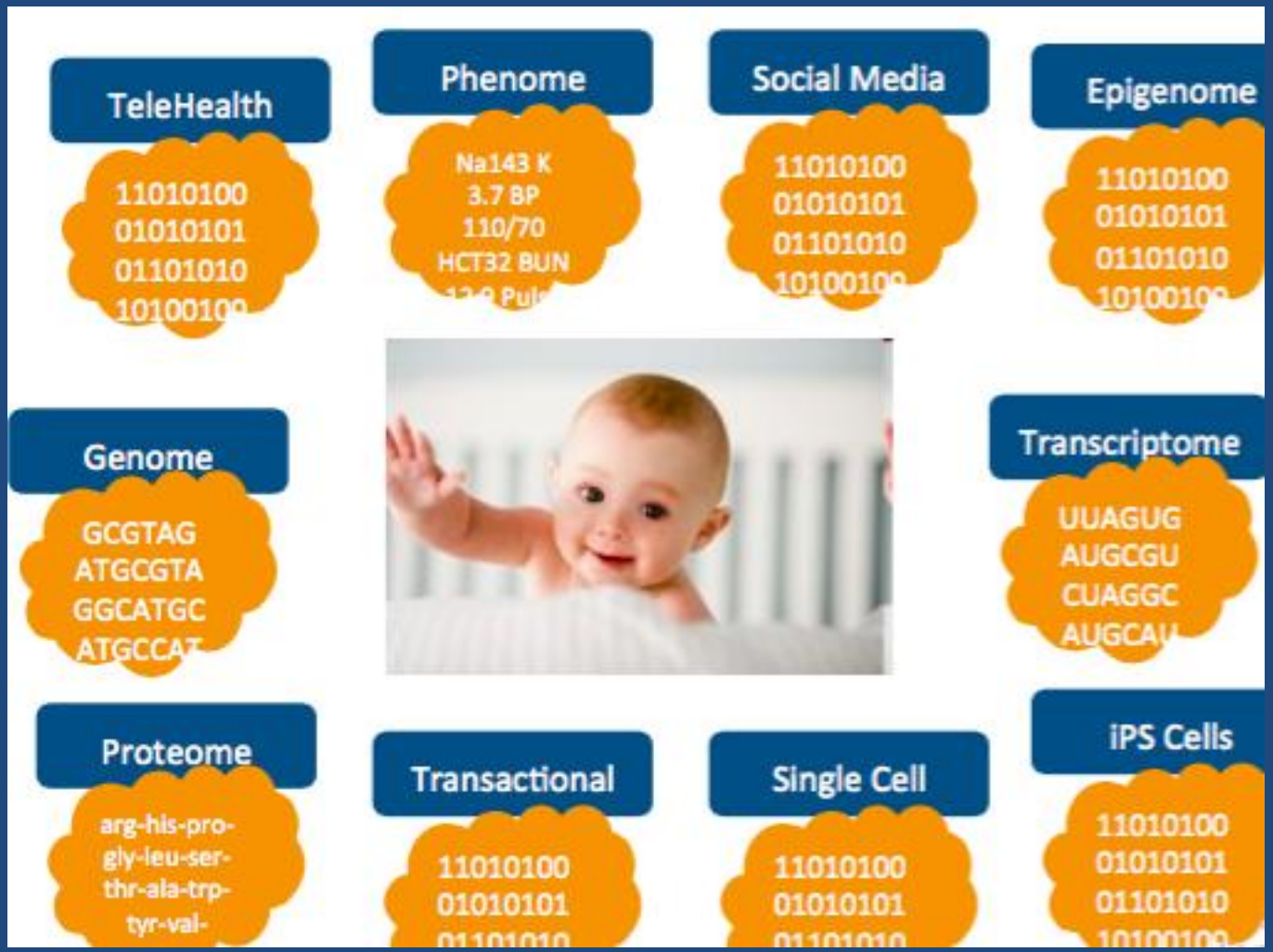
The Revenant






Rx

Dx


TeleHealth
11010100
01010101
01101010
10100100
Phenome
Na143 K
3.7 BP
110/70
HCT32 BUN
Social Media
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01010101
01101010
Epigenome
11010100
01010101
01101010
Genome
GCGTAG
ATGCGTA
GGCATGC
Transcriptome
UUAGUG
AUGCGU
CUAGGC
Proteome
arg-his-pro-
gly-leu-ser-
thr-ala-trp-
tyr-val-
Transactional
11010100
01010101
Single Cell
11010100
01010101
iPS Cells
11010100
01010101
01101010

Eyjafjallajökull volcanic eruption
Iceland, 2010


TOTAL FLIGHTS CANCELED
100,000
TOTAL PASSENGERS STRANDED
7 MILLION




Critical Question:

What concentration of volcanic ash is harmful to jet engines?

Archbishop S. Tomasi:

- “The fruits of scientific progress, rather than being placed at the service of the entire human community, are distributed in such a way that inequalities are actually increased.”
- He then quoted St. John Paul II’s statement to the Jubilee 2000 Debt Campaign:
- “The law of profit alone cannot be applied to that which is essential for the fight against hunger, disease, and poverty.”

How can the Church contribute to the dialogue?

Here There be Dragons!

Multi-level Factors Affecting Implementation of PM

- Point of care (MD knowledge, patient demand)
- Microsystem, team (norms, culture)
- Clinic, hospital (policies, leadership)
- Delivery system (organizational/fiscal policies, leadership, resources)
- Professional norms (local, regional, national)
- Patients, businesses, other stakeholders (community, region, province/state, nation)
- Local, regional, national regulations


The Future
NEXT EXIT


©AFP


MAIN ST
CHURCH ST

Laron Syndrome

Growth Hormone Receptor Deficiency Is Associated with a Major Reduction in Pro-Aging Signaling, Cancer, and Diabetes in Humans

Jaime Guevara-Aguirre[1,*†], Priya Balasubramanian[2,3,*], Marco Guevara-Aguirre[1], Min Wei[3],...
+ See all authors and affiliations

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The Alternative

Our Mission Statement

“The Spirit of the Lord is upon me,*because he has anointed me to bring glad tidings to the poor.

He has sent me to proclaim liberty to captives and recovery of sight to the blind;

to let the oppressed go free,

and to proclaim a year acceptable to the Lord.”

(Luke 4:18-19)