

Navigating The Technological Future or Star Trek's Tricorder: Science Fiction or Future Science?

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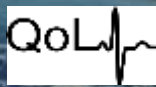
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21st Congress of the EAHP, Vienna, Austria, 2016

Disclosure

Relevant Financial Relationships NONE

Off-Label Investigational Uses NONE

Fasten Your Seatbelts



Machines That Sent Man To The Moon ('60s)



Smartwatch Vision ('80s)



Today...



Your Phone Is More Powerful Than The Computer In The Spaceship NASA Launched This Week



Matt Rosoff
 Dec 8, 2014, 3:01 PM



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PRINT

- These 12 Things Will Happen When You Make...
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(Download - Online Game)

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The Orion spaceship, which NASA launched this week as a first step on a mission to take astronauts to Mars, has a less powerful computer than your smartphone.

It's widely known that today's smartphones have more computing power than all of NASA did when it started sending astronauts to the moon.



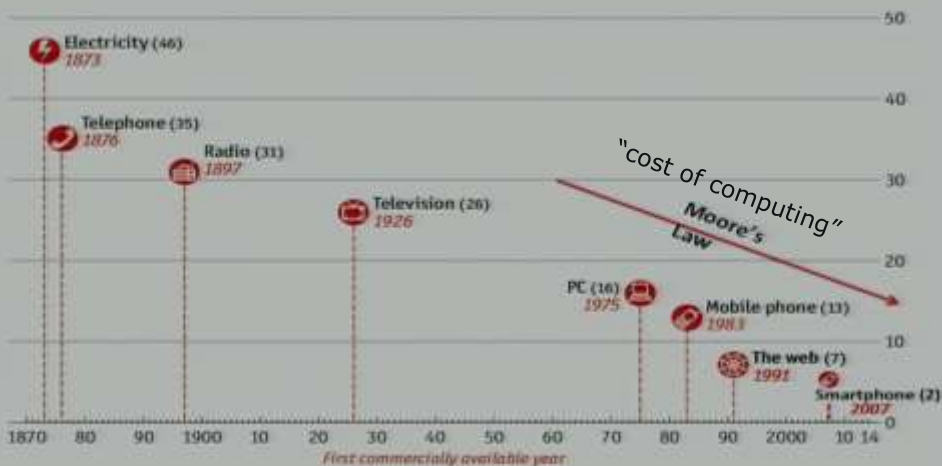
Most smartphones have more computing power than The Orion spaceship.

BUSINESS INSIDER UK

ears ago!
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 it?

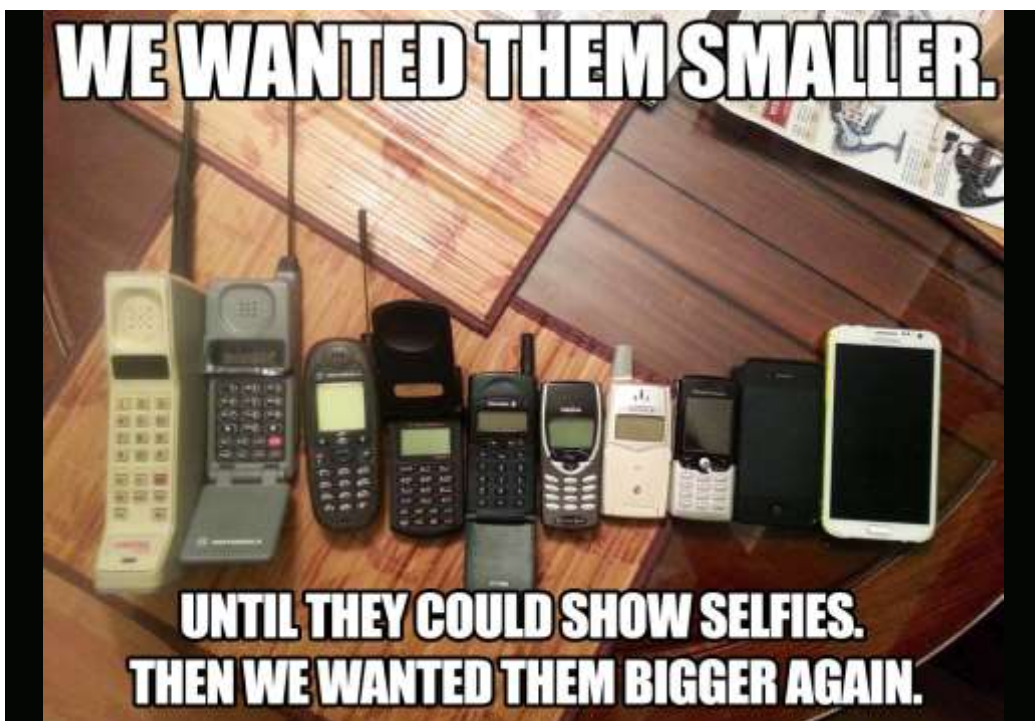
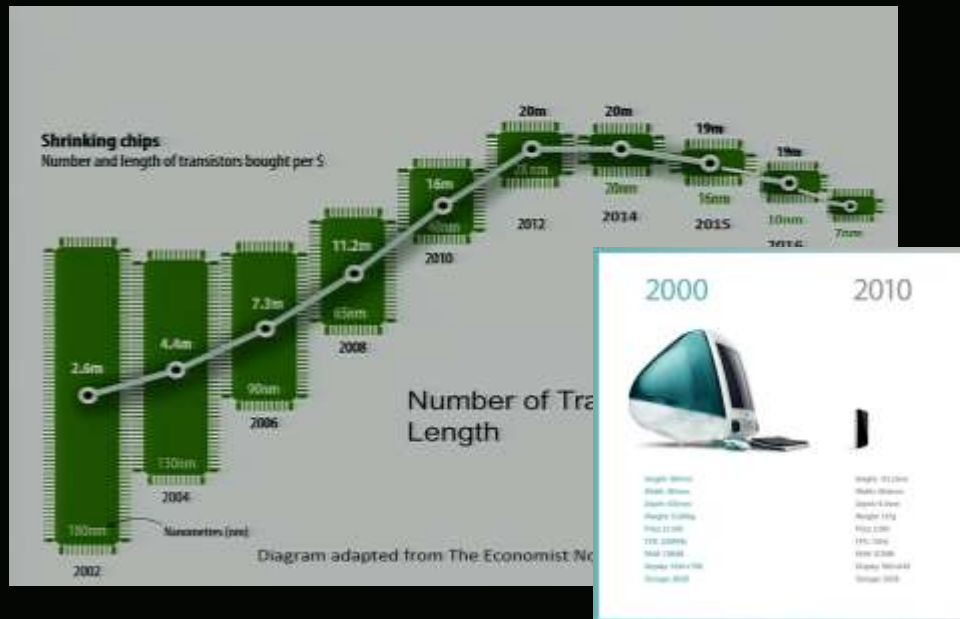
Technology adoption

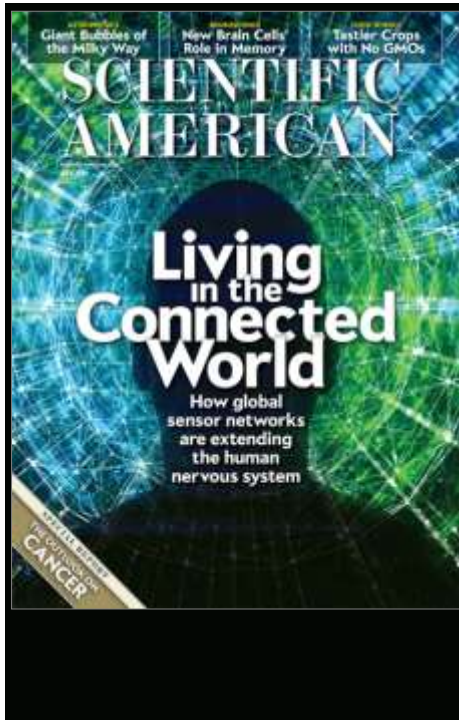
Years until used by one-quarter of American population



The Economist

2 Billion Transistors in Your iPhone 6





Almost 200 Million Google Searches By The End Of My Talk



The Downside: Homo-Distractus



It keeps me from looking at my phone every 30 seconds...

Back to Health...

Actual Causes of Death in the United States, 2000

Alt H, Macken, PhD; James B. Marks, MD, MPH; Donna F. Stroup, PhD, MSc; John L. Gortmaker, MD, MPH
[+ Author Affiliations]

JAMA. 2004;291(15):1230-1235. doi:10.1093/jama.291.10.1230.

Text Box: A A A

Article Tables References

ABSTRACT

ABSTRACT | METHODS | RESULTS | COMMENT | REFERENCES

Context Modifiable behavioral risk factors are leading causes of mortality in the United States. Quantifying these will provide insight into the effects of recent trends and the implications of reduced prevention opportunities.

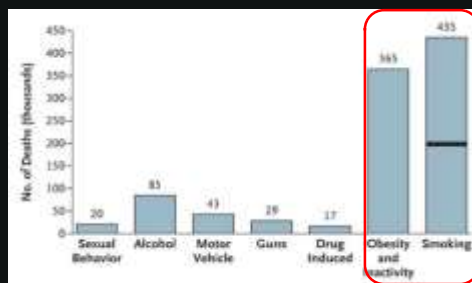
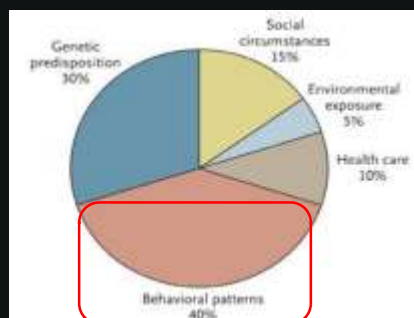
Objectives To identify and quantify the leading causes of mortality in the United States.

Design Comprehensive MEDLINE search of English-language articles that identified epidemiological, clinical, and laboratory studies linking risk behaviors and mortality. The search was initially restricted to articles published during or after 1990, but we later included relevant articles published in 1990 to December 31, 1999. Prevalence and relative risk were identified during the literature search. We used annual mortality data reported to the Centers for Disease Control and Prevention to identify the causes and number of deaths. The estimates of cause of death were compared by multiplying estimates of the cause-attributable fraction of preventable deaths with the total mortality data.

Main Outcome Measures Actual causes of death.

Results The leading causes of death in 2000 were tobacco (435 000 deaths; 18.1% of total US deaths), poor diet and physical inactivity (435 000 deaths; 18.1%), and alcohol consumption (83 000 deaths; 3.6%). Other actual causes of death were intentional agents (75 000), toxic agents (33 000), motor vehicle crashes

JAMA
The Journal of the American Medical Association



Challenge Today

**Imprecision medicine =
*Population health &
average patient***

Personalized medicine: Time for one-person trials

Nicholas J. Schork

29 April 2015

Precision medicine requires a different type of clinical trial that focuses on individual, not average, response to therapy, says Nicholas J. Schork.

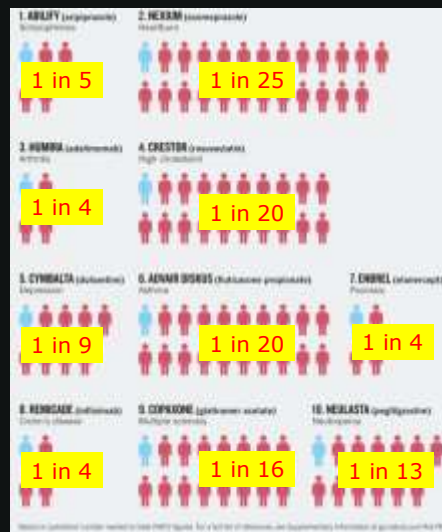
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Subject terms: Cancer | Drug discovery | Medical research | Health care



nature

Top 10 Drugs Our Patients Do Not Respond To (US)



Wasted Efforts (US-based Numbers, by E. Topol)

Small Number of Drugs Drive Big Medicare Bill

All costs incurred for top 10 drugs in billions

Nexium	Heartburn	\$253
Advair Diskus	Asthma	226
Crestor	Cholesterol	222
Abilify	Antipsychotic	211
Cymbalta	Antidepressant	196
Spiriva	Asthma	196
Namenda	Dementia	156
Januvia	Diabetes	146
Lantus Solostar	Diabetes	137
Revlimid	Cancer	135

Source: Centers for Medicare and Medicaid Services

THE WALL STREET JOURNAL

1 May 2015

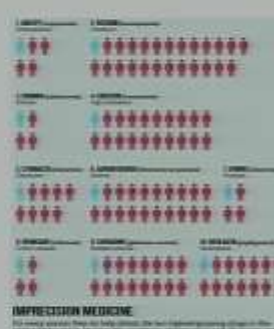
Top Prescription Drugs in Medicare: Part D

Total \$18.8B

Estimated Waste

\$2.42
2.15
2.10
1.69
1.76
1.37
1.56
1.02
.27
.54

Response Rates



IMPRESSION MEDICINE

10 ways to save money by helping doctors. The best way to save money is to help doctors. The best way to save money is to help doctors. The best way to save money is to help doctors.

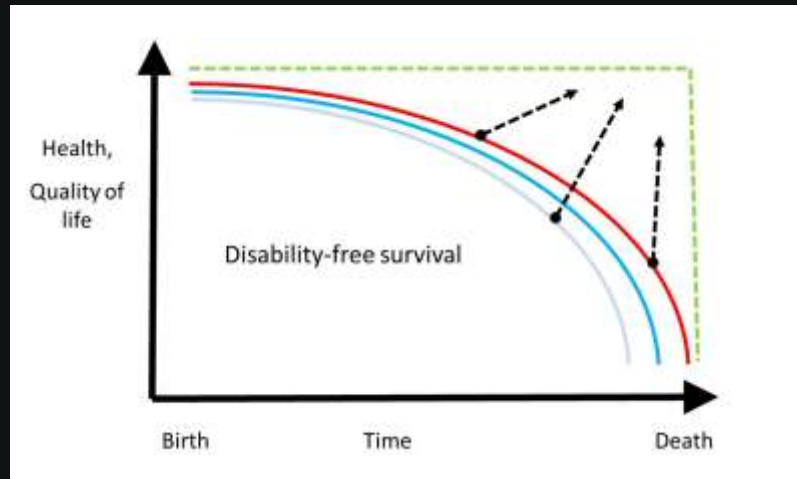
nature 30 April 2015

79% costs on 10 top drugs wasted

Imprecision medicine *Population,* *average patient;*



Squaring The Curve



COMPETITION #2 TEAMS

CMR
UNITED STATES
TEAM LEADER:
EUGENE CHAN

BIOVOTION
SWITZERLAND
TEAM LEADER:
ANDREAS LINDSEY

BIBEN LIFE SCIENCE
UNITED STATES
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SHAN WANG

ENDOTRONIX
WIRELESS HEALTH
MONITORING
UNITED STATES
TEAM LEADER:
HARRY HOWLAND

GOLDEN GORNER
MAGNETIC
BIOSENSING
UNITED STATES
TEAM LEADER: SHU
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QUALCOMM TRICORDER XPRIZE®

ABOUT NEWS TEAMS

DEADLINE FOR \$10 MILLION QUALCOMM TRICORDER XPRIZE EXTENDED TO EARLY 2017

Next phase of consumer testing to start in September 2016

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Ultimate Tricorder (Elysium Movie)



Precision medicine

[Personalized, Preventative, Proactive, Participatory]

- *Average is over: patient;*
- *POC is where the patient is*
- *Toolbox is expanded beyond a stethoscope and a pill*
- *Approach to health is holistic*

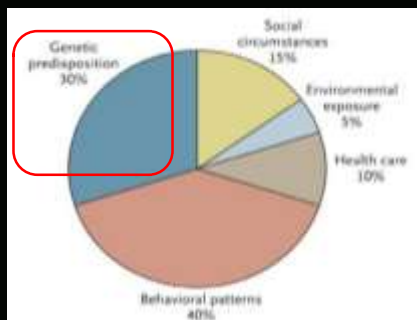
Towards Star Trek Tricorder

- POC Diagnostics / Portable Medical Devices 
- Wearables 
- Information Systems & Artificial Intelligence (AI) 
- 3-Dimensional (3D) Printing 
- Crowdsourcing 
- Star Trek State Of Mind





Contributors To Premature Death

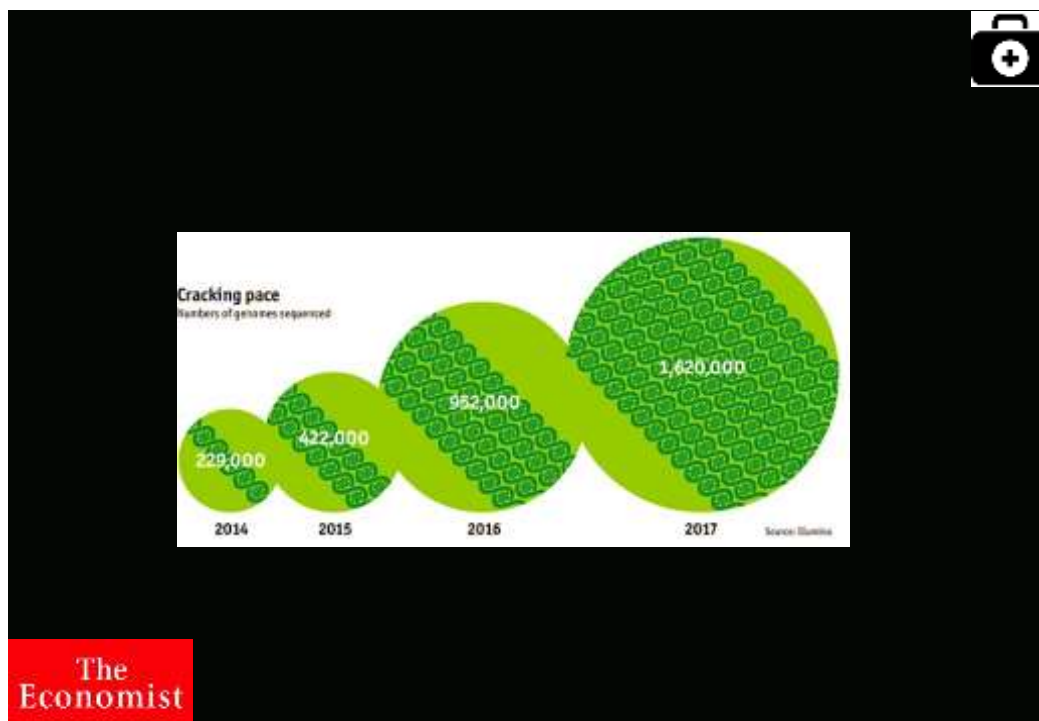
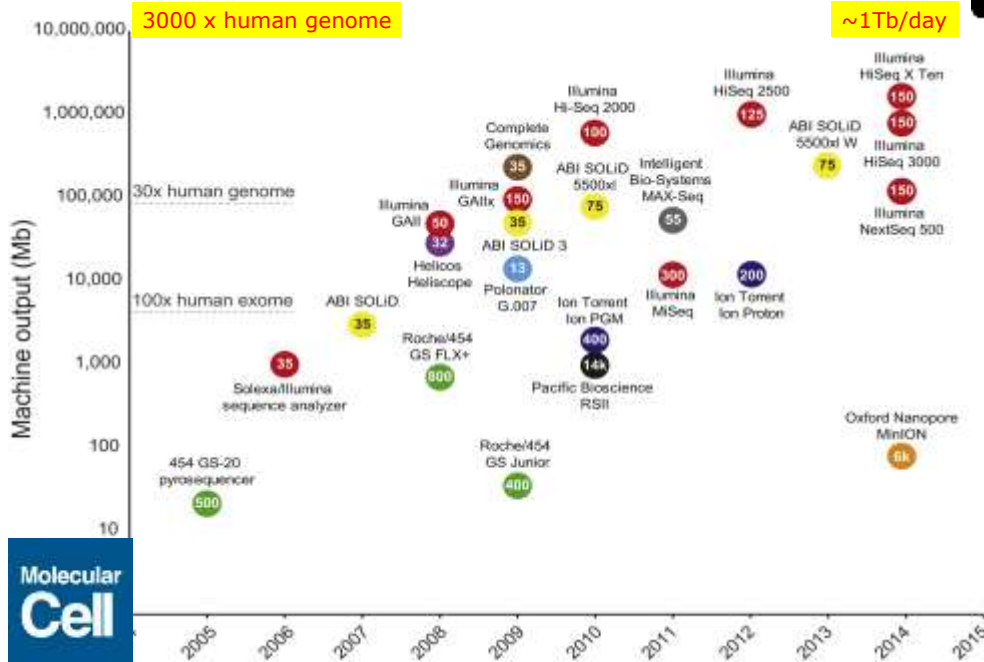


JAMA
The Journal of the American Medical Association

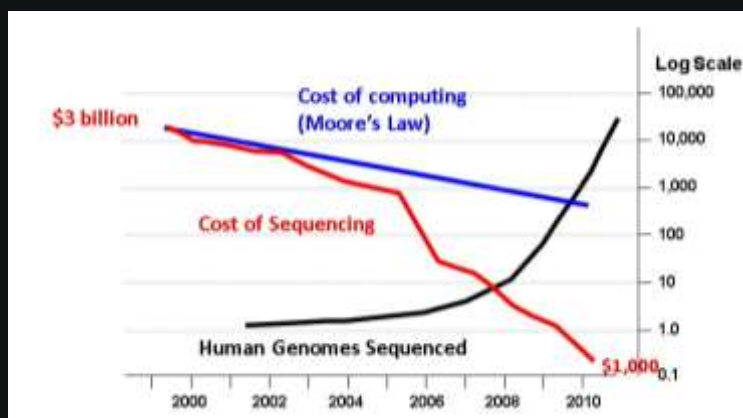
GENETIC TESTING NHGRI FACT SHEETS genome.gov

- Find Genetic Factors That Could Be Passed to Your Children
- Screen Newborns for Certain Treatable Conditions
- Discover Genetic Factors That Increase Your Disease Risk
- Organize Your Genome
- Pinpoint Genetic Factors That Caused Your Disease
- Predict How Severe Your Disease Might Be
- Choose the Best Medicine and Current Care

Timeline of Commercial High-Throughput Sequencing Platforms (speed/day)



Decreasing Cost



The Economist



Screen Newborns for Certain Treatable Conditions



NIH Studies Explore Promise of Sequencing Babies' Genomes

[Hydrogenation](#) | Date: 4 July 2018 | 11:00 AM

In a few years, all new parents may go home from the hospital with not just a bundle of joy, but with something else—the complete sequence of their baby's DNA. A new research program funded at \$25 million over 5 years by the National Institutes of Health (NIH) will explore the promise—and ethical challenges—of sequencing every newborn's genome.

The past projects build on decades-old state screening programs that take a drop of blood from early every newborn's heel and test it for biochemical markers for several rare disorders. With more disorders, knowing a child at birth can help doctors prevent

...times miss cases or turn up false positives, however. And yes, not all 3000 or so known or suspected diseases

Science



Fast sequencing saves newborns

Rapid analysis of infant genomes is aiding diagnosis and treatment of intractably ill babies.

DEBATA

[illegible]

and healthy. Had physicians used the OSHA, all the 4 conventional gunshot wounds, the diagnosis could have taken more than a month — by which time he would probably have died.


[illegible]

After the story first broke, Kingpin's group left messages for the producers of *90210*, *Baywatch*, *The Children's Movie Show*, *Shogun*, *60 Minutes* and the Internet, telling them to "cancel" any programs with shows of *90210*. Indeed, they are threatened with "extensive financial and legal" action. The producers will soon be asked to remove any references to *90210* and to avoid any publicity that is not completely true, and whether it helps parents to make decisions about any of the child's life, based on having a bad dream. Even when it is not *90210*, Kingpin says, "parents suspect and diagnose our parents' choice of parents and what basic information about the genetic condition [they carry]."

Engineers call the modelling technique a "heuristic" approach, in which they start at the beginning with perfect knowledge of the system and then gradually add in the uncertainty of the real world. The model is then repeatedly executed. The growing amount of uncertainty eventually causes the model to be unable to quickly identify maximum in the clutch growth. Once uncertainty the DGL and size (cannot influence) to larger sizes, parts of the growth are discarded at their completion. After taking a given "best" clinger and adding more model information to the baby's genotype, the group starts the sequence all over again. The model is then executed again, and the process is repeated until a desired distribution has been reached.

Stakeholders a general public report +

nature



Scripps Translational
Science Institute

The Scripps team is now trying to better understand the **ADCY5 variant** that Lilly has, and to see if they can identify a treatment that directly addresses the problems caused by this faulty gene. Meanwhile, Steve and Gay are talking to

Genetics
in Medicine

Case	Phenotype	Outcome	Possible diagnosis	Functional confirmation
1	Complex movement disorder	ADCT2 de novo gain-of-function mutation	Yes	Yes
2	Lymphoproliferative disorder	Possible inherited candidate causative mutations in GIMAP9	Yes	Not performed
3	Inflammatory bowel disease	Possible inherited candidate causative mutations in MST1R	Yes	Not performed
4	Fibromyalgia	No cause identified	No	N/A
5	Intelligence deficit	No cause identified	No	N/A
6	Urticaria and vasculitis	Possible inherited candidate causative mutations in MYPT	Yes	Not performed
7	Skin and neurological disorder	Potential but unconfirmed diagnosis of a subtype of epidermolysis bullosa due to inherited mutations in DSTT	Yes	Ongoing
8	Developmental delay	No cause identified	No	N/A
9	Epileptic encephalopathy	KCNB7 de novo missense mutation and confirmed EKV2.1 dysfunction	Yes	Yes
10	Developmental delay	Possible inherited candidate causative mutations in STX10	Yes	N/A
11	Familial coronary artery disease	Possible inherited candidate causative mutation in TGF	Yes	Ongoing
12	Muscular atrophy	No cause identified	No	N/A
13	Infantile autism	No cause identified	No	N/A
14	Recurrent fever	Potential but unconfirmed diagnosis of a subtype of Chediak-Higashi syndrome due to an inherited mutation in DST	Yes	N/A
15	Congenital hypertrichosis	Known pathogenic de novo ABCD3 mutation identified	Yes	Yes
16	Tapered achromia	Ongoing	Ongoing	Ongoing
17	Blastic keratosis	Ongoing	N/A	N/A

Where is Your Tricorder?

Noninvasive in vivo monitoring of tissue-specific global gene expression in humans

Winston Hui^{1,2}, Weiyang Pan^{1,2}, Chelsea Gervasi³, H. Christina Fan⁴, Geoffrey A. Hargrave⁵,
Tory Wynn-Coray¹, Yael J. Shumilov¹, Yasser Y. El-Gayour¹, and Stephen R. Quake^{1,2}

Author Affiliations

Contributed by Stephen R. Quake, April 4, 2014 (received for review February 3, 2014)

A condensed this paper published

Abstract Full Text Authors & Info Figures B Metrics Related Content PPT PDF

Significance

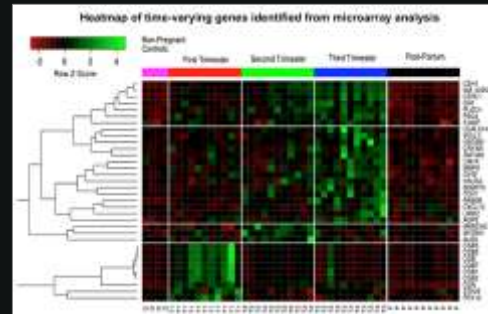
Circulating cell-free RNA in the blood provides a potential window into the health, phenotype, and developmental programs of a variety of human organs. We used high-throughput methods of RNA analysis such as microarrays and next-generation sequencing to characterize the global landscape of circulating RNA in human subjects. By focusing on tissue-specific genes, we were able to identify the relative contributions of these tissues to circulating RNA and monitor changes during tissue development and neurodegenerative disease states.

Abstract

Circulating cell-free RNA in the blood provides a potential window into the health, phenotype, and developmental programs of a variety of human organs. We used high-throughput methods of RNA analysis such as microarrays and next-generation sequencing to characterize the global landscape of circulating RNA in a cohort of human subjects. By focusing on genes whose expression is highly specific to certain tissues, we were able to identify the relative contributions of these tissues to circulating RNA and to monitor changes in tissue development and health. As one application of the approach, we performed a longitudinal study in pregnant women and analyzed their cord-blood cell-free RNA transcriptomes across all three trimesters of pregnancy and after delivery. In addition to the analysis of mRNA, we observed and characterized noncoding species such as long noncoding RNA and circular RNA transcriptome whose presence had not been previously observed in human plasma. This demonstrates that it is possible to track specific, longitudinal phenotypic changes in both the mother and the fetus and that it is possible to directly measure transcripts from a variety of fetal tissues in the maternal blood sample. We also studied the role of neuro-specific transcripts in the blood of healthy adults and those suffering from the neurodegenerative disorder Alzheimer's disease and showed that disease-specific neural transcripts are present at increased levels in the blood of affected individuals, a finding that may thus provide broad insights into neurodegeneration.

PNAS

The Molecular Stethoscope



Choose the Best Medicine and
Correct Date

Therapy: This time it's personal

Lauren Grivitz

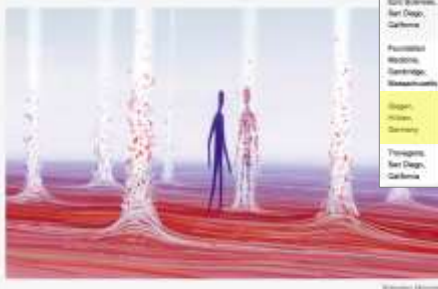
Nature 509, 552–554 (20 May 2014) | doi:10.1038/999582a
Published online 20 May 2014

PDF Citation Reprints Rights & permissions Article metrics

Tailoring cancer treatment to individual and evolving tumours is the way of the future, but scientists are still working out the details.

Subject terms: Cancer therapy | Drug development | Targeted therapies

Chemotherapy | Immunotherapy | Cancer genetics | Personalized medicine



Elaine Mardis and her colleagues first encountered 30-year-old Lucy (not her real name) in 2010 at the Dana-Farber Institute for Genomic Medicine in Boston, Massachusetts. Lucy had been referred to the hospital because she had a subtype of the most treatable form of cancer — which is up, or overactive, triggering

Genetic testing companies are developing sophisticated ways to match patients to therapies — and even determine whether therapy is necessary. Here are some of the most promising.

Company	Test	Technology	Development stage
Genomic Health, Redwood City, California	OncoPrint	Assesses molecular profiles in tumours. Predicts whether chemotherapy will be beneficial, as well as likelihood of response.	Launched oncology test for breast cancer in 2014. Test now also available for other cancer types.
Genomic Health, San Diego, California	FoundationOne	Identifies tumour cells circulating in blood, and tests them for response to and efficacy of the drug effectiveness of the drug.	Partnering with pharmaceutical and technology companies and cancer centres. Tests are currently in clinical trials and not yet commercially available.
Foundation Medicine, Cambridge, Massachusetts	FoundationOne	Sequenced tumours for alterations in 250 cancer-related genes for solid tumours and 450 genes for haematological cancers. Then, matches mutations in drugs that are either approved by the US Food and Drug Administration or in clinical trials.	This clinical product is available in oncology. FoundationOne for solid tumours, launched in 2013, and FoundationOne for haematological cancers, launched in 2013.
Roche, Basel, Switzerland	Targeted sequencing	Uses the polymerase chain reaction to amplify DNA in tumour cells and then sequences the DNA to identify mutations.	Approved by the US Food and Drug Administration for testing in conjunction with afatinib to treat metastatic non-small-cell lung cancer patients for the first time with afatinib.
Theranos, San Francisco, California	Mini-sequencing	Analyzes tumour DNA in urine to identify mutations and predict response to therapy.	Not yet commercially available.

Drug / Condition	Gene	O.R.	Comment
Urethral for Squamous Carcinoma	IGF1R	100%	Efficiency in Non-Squamous
Interferon-α for Hepatitis C	IL28B	88%	Efficiency to cure viral infection
Carbamazepine for Multiple Sclerosis	HLA-A*31:01	98%	Response: Adverse Effects
Simvastatin for LDL Cholesterol Lowering	SLCO1B1	17%	Severe muscle inflammation
Chloroquine for Malaria	HLA-B*57:01	91%	Direct toxicity
Isotretinoin for skin cancer	CYP2C8*3	14%	Response: Adverse Effects
Acetaminophen for pain management	UGT1A1	36%	Severe toxicity

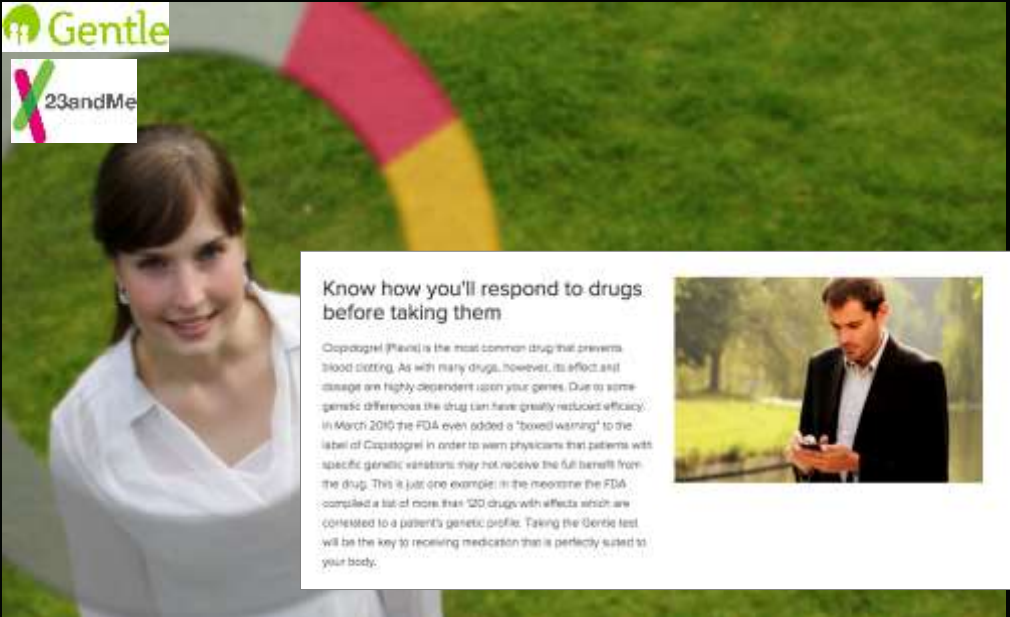
Consumers: Genetics & Drug Response

Choose the Best Medicine and Correct Dose

Gentle
23andMe

Know how you'll respond to drugs before taking them

Clopidogrel (Plavix) is the most common drug that prevents blood clotting. As with many drugs, however, its effect and dosage are highly dependent upon your genes. Due to some genetic differences the drug can have greatly reduced efficacy. In March 2010 the FDA even added a "boxed warning" to the label of Clopidogrel in order to warn physicians that patients with specific genetic variations may not receive the full benefit from the drug. This is just one example: in the near future the FDA compiled a list of more than 100 drugs with effects which are connected to a patient's genetic profile. Taking the Gentle test will be the key to receiving medication that is perfectly suited to your body.



infectious diseases

point of care diagnostics
portable medical devices



Story of Joshua Osborne Infection

NEW! ADULT BENEF REPORTS

Actionable Diagnosis of Neuroleptospirosis by Next-Generation Sequencing

Michael R. Wilson, M.D., James W. Hazzard, Ph.D., G.W. Serrano, B.S., D.L.S., Irene Higgins, M.L., Lisa Babin, M.D.,
Quinn T. B.S., Sherron M. Siskind, M.D., Ph.D., Sarah Thompson, M.D., Kim A. Walters, B.A., Steve Henson, M.D.,
M.S., Robert Siskind, M.D., Elizabeth Siskind, M.D., M.S.L.S., Valen Carroll, M.D., Patricia H. Smith, M.D., Kim
D. Hunt, M.D., Thomas L. Magle, Ph.D., Christa M. Roney, M.D., Renee Gutierrez, M.P.H., Sheryl L. Henderson,
M.D., Ph.D., Anne E. Carr, M.S., Joseph L. Goffin, Ph.D., and Sharon Y. Cho, M.D., Ph.D.
E-Mail: msw@143d.com 143d.com 2014-12-15 15:15:00, 15:15:00, 15:15:00

Abstract	Article	References	Clinical Evidence (36)	Website
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More than half the general meningococcal population, serovar undifferentiated, displays some clinical severity (Fig. 1).¹⁰ Because more than 100 different serotypes are regarded as isolates serogrouped, serotyping a diagnosis with this use of culture, serologic tests, and pathogen-specific PCR analysis can be difficult. Undetected next-generation sequencing has the potential to revolutionize our ability to discover emerging pathogens, especially newly identified viruses.^{11,12} However, the usefulness of next-generation sequencing for the diagnosis of infectious diseases is a directly related trademark is largely unexplored.¹³ We used undetected next-generation sequencing to identify a *Brucella* spp. case, bacterial cause of meningococcalitis. In this case, the results of next-generation sequencing contributed directly to a dramatic effect on the patient's care, resulting ultimately in a favorable outcome.

CASE REPORT

CASE REPORT
A 14-year-old boy with severe combined immunodeficiency (SCID) caused by adenosine deaminase deficiency and partial immune reconstitution after he had undergone two bone marrow transplantations, initially presented in the emergency department in our area after having had headache and fever, with temperatures up to 38.0°C, for 6 days (Figure 1A). He was admitted to the hospital and discharged 1 day later after resolution of the fever and headache.

The patient's subsequent medications included monthly infusions of intravenous immune globulin for *Streptococcus agalactiae* and *Haemophilus influenzae* as well as the oral prophylactic antibiotics amoxicillin and trimethoprim-sulfamethoxazole. He had no further episodes of cellulitis but still had minor petechiae. He died from a myocardial infarction in Puerto Rico during the first 3 weeks of August 2010 (day 142), where he stayed in a nursing and the recent Malaria, a 77-year-old male resident had been hospitalized for 3 days with fever and weakness. The patient had also resided in Florida in Miami 2012, where he spent in a good at a resort where there were a number of blood.

 **The NEW ENGLAND JOURNAL OF MEDICINE**



Joshua Osborn, 14, lay in a coma at American Family Children's Hospital in Madison, Wis. For weeks his brain had been swelling with fluid, and a battery of tests had failed to reveal the cause.

but a spinal tap turned up no pathogens. Even a biopsy of his brain tissue told the doctors nothing.

After only 96 minutes, the results appeared on a computer monitor. Joshua's cerebrospinal fluid contained DNA from a potentially lethal type of bacteria called *Leptospira*. As dangerous as *Leptospira* can be, it is readily treated with penicillin.

Where is Your Tricorder?

Health care: Bring microbial sequencing to hospitals

Sharon Peacock

22 May 2014

Analysing bacterial and viral DNA can help doctors to pick effective drugs quickly, says Sharon Peacock.

PDF Rights & Permissions

Subject terms: Geriatrics • Microbiology • Health care • Infection

A patient goes to her doctor with fever, cough and night sweats. Rapid tests confirm the diagnosis of tuberculosis and hint at multidrug resistance. But to suggest the optimum drug combination, as many as eight weeks of laboratory testing are required — a timescale dictated by the slow growth rate of the pathogen (*Mycobacterium tuberculosis*). In the meantime, the doctor must make an educated guess about which medicines to prescribe, increasing the risk of ineffective treatment and spread of infection.

Yet it would take less than a week to sequence a culture of *M. tuberculosis* and to detect mutations that indicate which drugs the bacteria are resistant to. My colleagues and I demonstrated ³ this in a research setting last year using a sputum culture from a tuberculosis patient. We have also shown that whole-genome sequencing can detect resistance of other pathogens to carbapenem antibiotics, drugs reserved to treat the most serious infections. Although a range of genetic mechanisms can confer resistance, sequencing is informative in all species tested so far, including *Acinetobacter baumannii* and *Klebsiella pneumoniae*, which can infect the most vulnerable hospital patients ⁴. Sequence information can also be used to confirm outbreaks and help to bring them to a close.

Although technology for microbial sequencing has existed for years, it is yet to help patients on a routine basis. Now that pathogen detection can be completed in less than a day, the time is right is, at least in the developed world. This will allow local diagnostic laboratories and the clinician. Both are more a matter of will.





Discover Genetic Factors That Increase Your Disease Risk

Realizing the promise of cancer predisposition genes

Nazneen Rahman

Nature 505, 302–338 (16 January 2014) | doi:10.1038/nature12691
Received: 31 October 2013 | Accepted: 21 November 2013 | Published online: 15 January 2014
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Abstract

Abstract | Discovery of CPDs | Characteristics of CPDs | Genotype-phenotype associations | Clinical utility of CPDs | Future opportunities and challenges | References | Acknowledgements | Author information | Supplementary Information

Genes in which germline mutations confer highly or moderately increased risks of cancer are called cancer predisposition genes. More than 100 of these genes have been identified, providing important scientific insights in many areas, particularly the mechanisms of cancer causation. Moreover, clinical utilization of cancer predisposition genes has had a substantial impact on diagnosis, optimized management and prevention of cancer. The recent transformative advances in DNA sequencing hold the promise of many more cancer predisposition gene discoveries, and greater and broader clinical applications. However, there is also considerable potential for incorrect inferences and inappropriate clinical applications. Realizing the promise of cancer predisposition genes for science and medicine will thus require careful navigation.

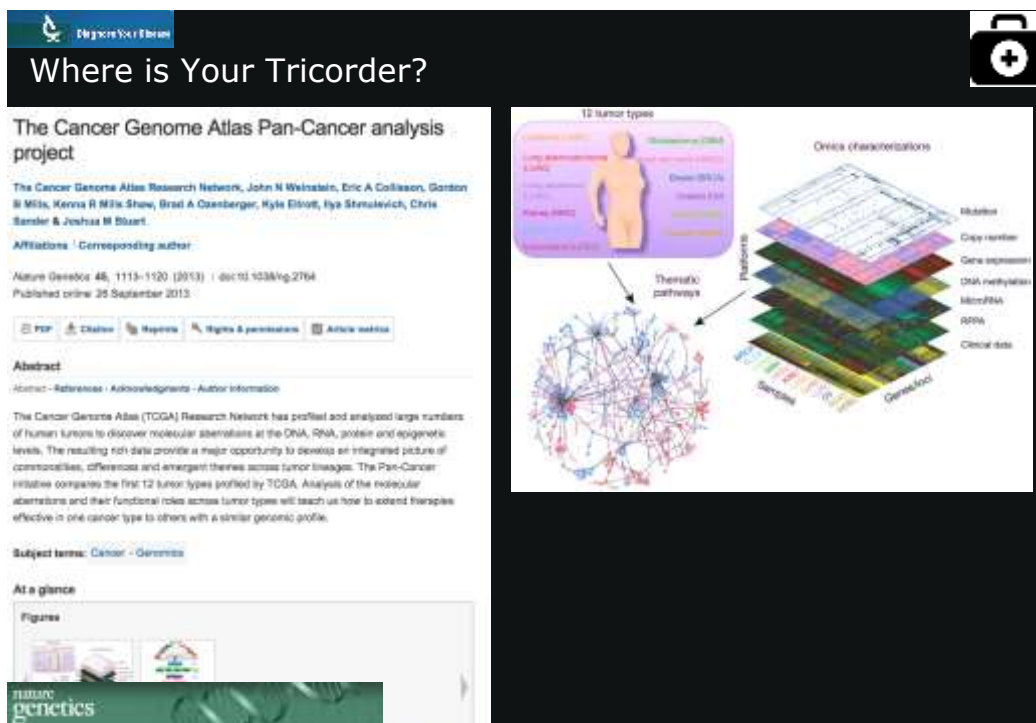
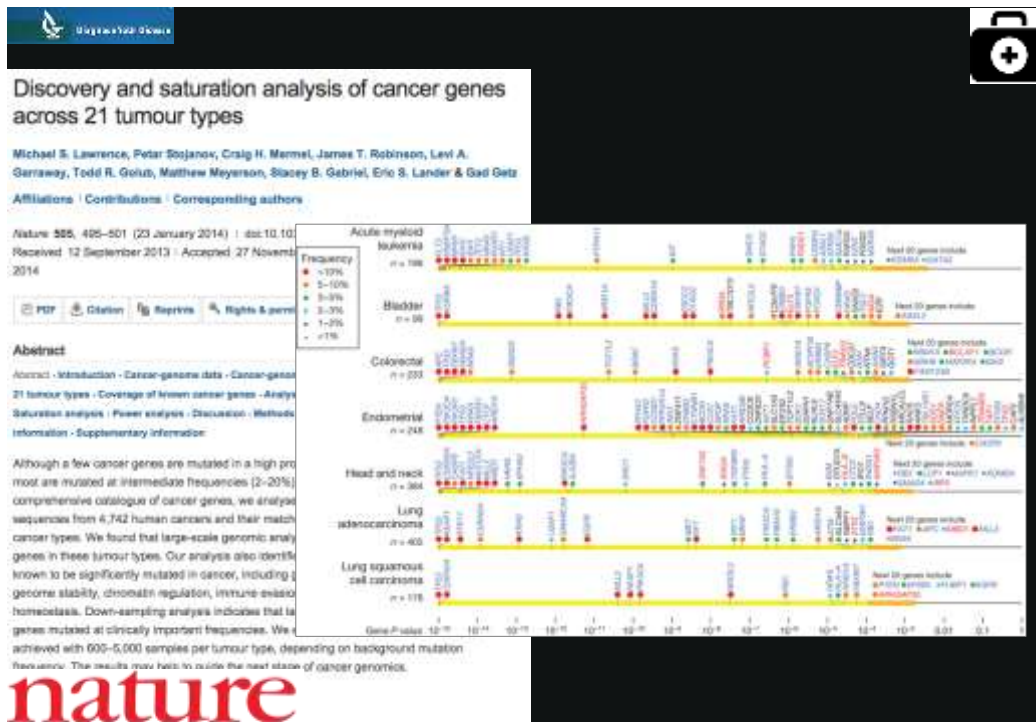
Subject terms: Cancer

Genetic predisposition to cancer has been recognized for centuries, initially through observation of unusual familial clusterings of cancer. In 1588, neuroanatomist Paul Broca published one of the earliest reports on the subject, detailing a striking history of breast cancer in 15 members of his wife's family¹. Broca, controversially for the time, proposed that this was evidence of hereditary predisposition to cancer. Fifty years later, biologist Theodor Boveri published his visionary theory that somatic acquisition of "particular, incorrect chromosome combinations" underlies cancer. His theory, which proposed that errors in chromosome segregation during cell division could lead to cancer, predating it could result in stimulate cell division². In 1971, the discovery of the first cancer gene, the retinoblastoma gene, was required to be

nature

Chromosomal locations of 114 cancer predisposition genes






Discover Genetic Factors That Increase Your Disease Risk

Consumers: Genetics & Cancer

New Genetic Tests for Breast Cancer Hold Promise

By ARDEN DOLACK APRIL 11, 2015



At the same time, the nation's two largest clinical laboratories, Quest Diagnostics and LabCorp, formerly bitter rivals, are joining with French researchers to pool their data to better interpret mutations in the two most breast cancer risk genes, known as BRCA1 and BRCA2. Other companies and laboratories are being invited to join the effort, called BRCA Share.


The announcements being made on Tuesday, although coincidental in their timing, speak to the surge in competition in genetic risk screening for cancer: since 2013, when the Supreme Court invalidated the gene patents that gave Myriad Genetics a monopoly on BRCA testing.

The field has also been propelled by the actress and filmmaker Angelina Jolie, who has a BRCA1 mutation and has written about her own decision to have her breasts, ovaries and fallopian tubes removed to sharply reduce her risk of developing cancer.



But the issue of who should be tested remains controversial. The effort of the start-up, Color Genomics, to "democratize access to genetic testing," in the words of the chief executive, Brad Gil, is generating concern among some experts.

The New York Times BRCA1 and BRCA2, one of many genes

color Genomics



VeritasGenetics

beyond genetics

point of care diagnostics
portable medical devices



First Tricorder: Stethoscope (1816)



Zargis Medical



Eko Devices



Thinklabs



Where is Your Tricorder? All Around.



An ICU Monitor That Fits On Your Wrist

A new medical device wants to make patient vitals more portable and networked, but designing devices for the medical field is nothing like the consumer electronics sector.



Alarms Off Alarms Paused Alarm Acknowledged




Anyone who's been unfortunate enough to spend time in an ICU knows how frustrating it can be. Even for patients who are often so tethered to tubes and wires they're often bedbound.

FAST COMPANY

Blood Pressure (Withings), SpO₂ (iChoice), ECG (Alivecor)



'Sticker' Based Diagnostic (RDS)



ECG (1 lead)
Heart Rate (HR)
HR variability (Hrvar)
Respiratory Rate
Respiratory Depth
Oxygen Saturation (SpO₂)
Temperature
Physical Activity

Wearable, Wireless,
Waterproof



Review Seizure reporting technologies for epilepsy treatment: A review of clinical information needs and supporting technologies

Jonathan Bland¹, Thani Khushf², Bittak Aducci³, Joshua Andrew Sherrington⁴, Sandra Palmer⁵

→ Show more

(doi:10.1016/j.seizure.2015.08.016)

Get rights and content

Highlights

- Limited recording and annotation tools are available for characterizing patient motion during seizures.
- Existing seizure detection systems tend to have high false positive rates.
- Inertial, oral worn seizure detection systems coupled with video capture systems may offer promise for addressing both problems.

Abstract

This review surveys current seizure detection and reporting technologies to aid in clinical decision-making during seizures. Data were collected from neurologists and a literature review distinguishing between patients exhibiting generalized tonic-clonic seizures (GTCS) as achieving more accurate seizure counts. The neurologists to select the correct class of antiepileptic drug (AED) efficiency during long-term treatment. Neurologists reported they would like to have video capture during an initial consultation. Presently, on technology review we identified that only a subset of patient self-reporting performance due to high false detection devices coupled with video capture for to address collecting seizure counts that are not reporting during day and night time use.

Keywords

Epilepsy, Seizure reporting, Accelerometry, Non-EEG seizure detection, EEG-based seizure detection, Automated seizure detection

seizure
European Journal of Epilepsy

epilepsy action
The Official Journal of Epilepsy Action

E4[®] wristband



PPG Sensor

Photoplethysmography Sensor - Measures Blood Volume Pulse (BVP), from which heart rate, heart rate variability (HRV), and other cardiovascular features may be derived



3-axis Accelerometer

Captures motion-based activity



Event Mark Button

Tags events and correlates them with physiological signals



EDA Sensor (GSR Sensor)

Electrodermal Activity Sensor - Used to measure sympathetic nervous system arousal and to derive features related to stress, engagement, and excitement.



Infrared Thermopile

Reads peripheral skin temperature



Internal Real-Time Clock

Temporal resolution up to 0.2 seconds in streaming mode

Ear (CellScope), Eye (PEEK, eyeNetra), Oral Health (OScan)



Portable Ultrasound (Philips, Toshiba)



Where is Your Tricorder? In Your Pocket.



Colon Check Via a Pill (PillCam)



A new option.

For the majority of patients, doctors recommend a colonoscopy. But for some patients, an invasive colon exam such as a colonoscopy can be risky due to bleeding or sedation concerns, or other factors. PillCam® COLON offers an accurate minimally invasive alternative that avoids potential risks while reducing anxiety and fear.

[Assess your risk »](#)



polyp



RESEARCH ARTICLE Comprehensive serological profiling of human populations using a synthetic human virome

George J. Xu^{1,2,3,4,5,*}, Tomasz Kida^{1,2,3,5}, Qikai Xu^{1,2}, Mami Z. Li^{1,2}, Suzanne D. Vernon⁶, Thambi Ndung'u^{6,7,8,9,10}, Kiet Ruanrungsitham¹¹, Jorge Sanchez¹², Christian Brander¹³, Raymond T. Cheng^{1,4}, Kevin C. O'Connor¹², Bruce Walker^{13,14}, H. Benjamin Larman¹⁵, Stephen J. Elledge^{1,2,3,4,5,†}

¹ * Author Affiliations

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^{1,4,†} These authors contributed equally to this work.

Science (8 Jul 2015)
vol. 348, issue 6270, pp.
DOI: 10.1126/science.1260388

Article Figures & Data Info & Metrics

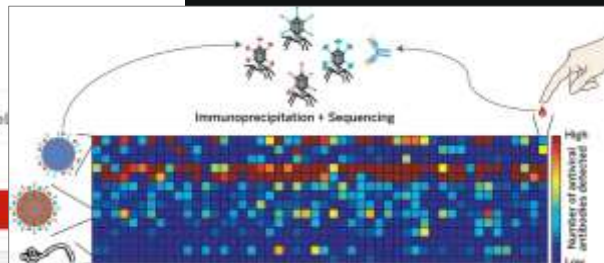
You are currently viewing the abstract.

Viral exposure—the complete history

In addition to causing illness, viruses leave indelible footprints behind, permanently altering the immune system. Blood tests that detect and provide information about both past and present viral exposures. We measure only one virus at a time. Using a synthetic representation of peptides, Xu et al. developed a blood test that identifies antibodies to specific viruses. They analyzed blood samples from nearly 600 people and found that most had been exposed to at least one virus. Differences in the rates of exposure to specific viruses were targeted the same viral epitopes.



science.aaa0698



Where is Your Tricorder? Attached To Your Phone.



Cholesterol (Cornell)



STD/HIV, syphilis
(Columbia)



BP, blood glucose, lipids,
incl. bleeding (Qloudlab)



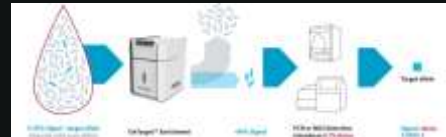
Blood, allergens in food,
urine analysis
mercury in water
(holomic/cellmic)



Vit. D, fertility,
influenza
inflammation,
testosterone
(Cue)



Where is Your Tricorder? Coming Soon To Your Lab.



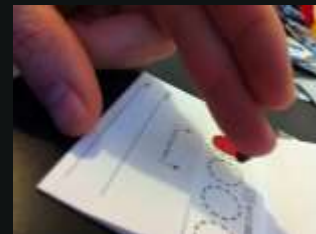
Consumers: Blood Tests (incl. drug-induced nutrient depletion)



HemoLink



Talking20



Consumers: Cancer



Get these Screenings

Cervical cancer

RATINGS

- for women age 21 to 65
- for women of all other ages

SWARTZ'S RECOMMENDATION: A Pap smear (a microscopic analysis of cervical tissue) and a human papillomavirus (HPV) test, which looks for the virus that can cause the cancer.

WHO NEEDS IT? Women age 21 to 30 should have a Pap smear every three years. Those 30 to 65 can go five years between Pap smears if they have had 10 Pap tests. High-risk women may need to be screened more often. Women 65 and older don't need to be tested as long as they've had regular screenings when they were younger. Women under 21 don't need to be screened because the cancer is uncommon before then and the tests are not accurate for them.

RISK FACTORS: A family history of the disease, a history of HPV infection, using birth-control pills for five or more years, having three or more children, and having weakened immunity because of HIV infection or other causes.

Colon cancer

RATINGS

- for people age 50 to 75
- for people 76 to 85
- for people 40 and older
- for people 40 and younger

SWARTZ'S RECOMMENDATION: Colonoscopy (view of the entire colon with a flexible scope) every 10 years. Sigmoidoscopy (view of the lower third of the colon) every five years plus a stool test every three years, or a stool test every year.

WHO NEEDS IT? People age 50 to 75 should be regularly screened. Older people should talk with their doctor about the benefits and harms of the test based on their health and risk factors. Younger people should consider taking only if they are at high risk. Tests for the cancer is uncommon before age 50.

RISK FACTORS: A family history of the disease or a personal history of precancerous polyps, inflammatory bowel disease, obesity, smoking, type 2 diabetes, excessive alcohol consumption, and a diet high in red or processed meats.

Breast cancer

RATINGS

- for women age 50 to 74
- for women 40 to 49
- for women 75 and older
- for women 75 and younger

SWARTZ'S RECOMMENDATION: Mammogram (an X-ray of the breast).

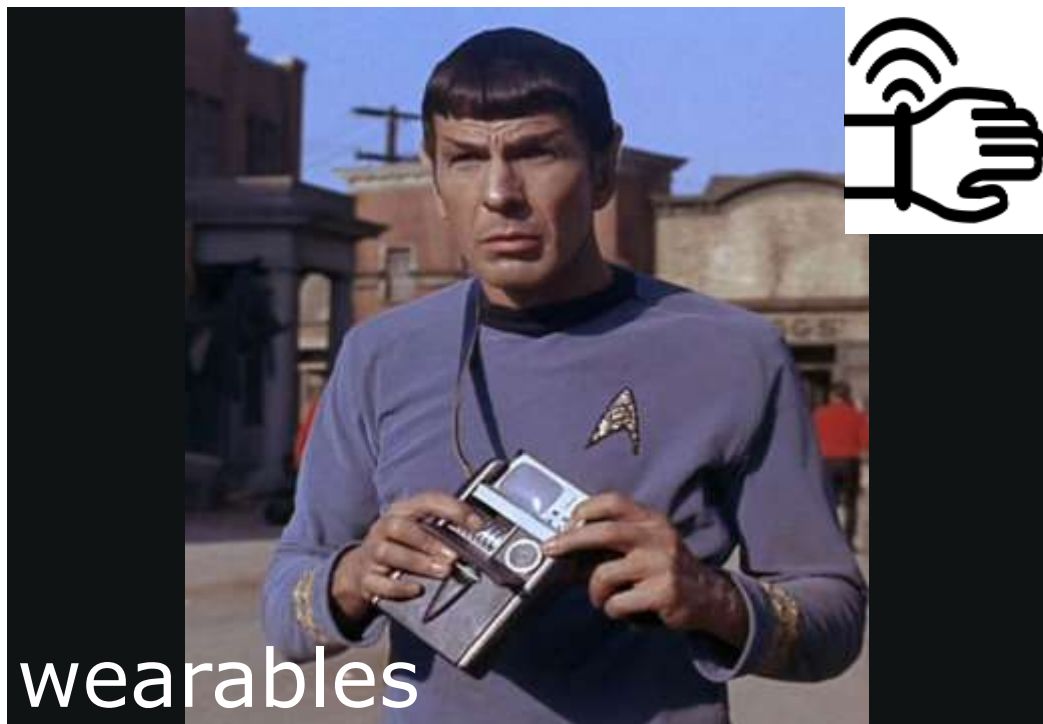
WHO NEEDS IT? Women age 40 to 74 should have mammograms every two years. Women in their 40s or those 75 and older should talk with their



Cancer screening remains stuck in a 1960s view of the disease.

Consumers: Self-diagnosis (Scanadu)





Bracelets, Bands, Smart Watches (And Weight Scales)



Steps (kcal)
Activities
Sleep
HR, Temp, GSR
Phone notifications



Diabetes Control (Dexcom Sensor, Multiple Watches)



Medication Reminder (WebMD, PillPack)



Medication Reminder (Google)



Fully integrated wearable sensor arrays for multiplexed *in situ* perspiration analysis

Wei Gao, Sam Emami-Naeini, Hsin Yin Yin Nyein, Samyuktas Challa, Kevin Chen, Austin Peck, Hossein M. Fahad, Hiroki Ota, Hiroaki Shiraki, Tatsuke Kiriya, Der-Hsien Lien, George A. Brooks, Ronald W. Davis & Ali Javey

Affiliations | Contributions | Corresponding author

Nature 529, 506–514 (26 January 2016) | doi:10.1038/nature16521

Received 26 June 2015 | Accepted 23 November 2015 | Published online 27 January 2016

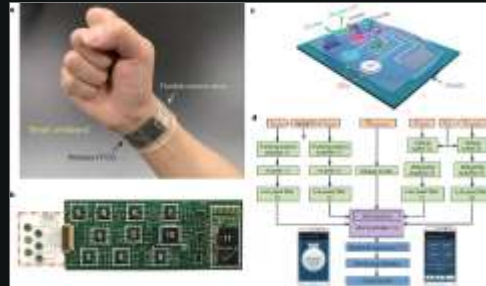
PDF | Cite this article | Reprints | Rights & permissions | Article metrics

Wearable sensor technologies are essential to the realization of personalized medicine through continuously monitoring an individual's state of health^{1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12}. Sampling human sweat, which is rich in physiological information¹³, could enable non-invasive monitoring. Previously reported sweat-based and other non-invasive biosensors either can only monitor a single analyte at a time or lack on-site signal processing circuitry and sensor calibration mechanisms for accurate analysis of the physiological state^{14, 15, 16, 17, 18}. Given the complexity of sweat secretion, simultaneous and multiplexed screening of target biomarkers is critical and requires full system integration to ensure the accuracy of measurements. Here we present a mechanically flexible and fully integrated (that is, no external analysis is needed) sensor array for multiplexed *in situ* perspiration analysis, which simultaneously and selectively measures sweat metabolites (such as glucose and lactate) and electrolytes (such as sodium and potassium ions), as well as the skin temperature (to calibrate the response of the sensors). Our work bridges the technological gap between signal transduction, conditioning (amplification and filtering), processing and wireless transmission in wearable biosensors by merging plastic-based sensors that interface with the skin with silicon integrated circuits consolidated on a flexible circuit board for complex signal processing. This application could not have been realized using either of these technologies alone owing to their respective inherent limitations. The wearable system is used to measure the detailed sweat profile of human subjects engaged in prolonged indoor and outdoor physical activities, and to make a real-time assessment of the physiological state of the subjects. This platform enables a wide range of personalized diagnostic and physiological monitoring applications.

nature article for devices

Sweat Analysis

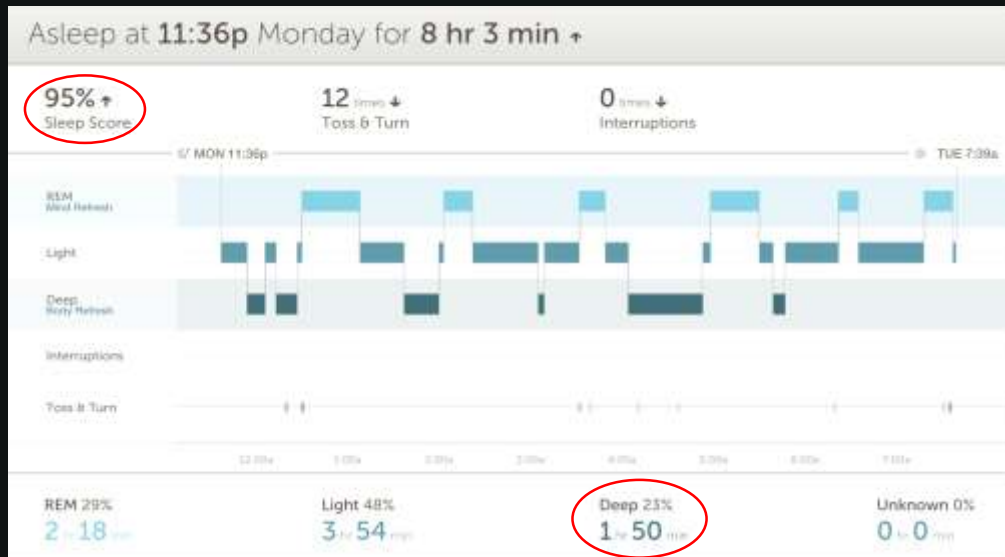
Sweat metabolites (glucose and lactate)
Electrolytes (sodium and potassium ions)
Skin temperature



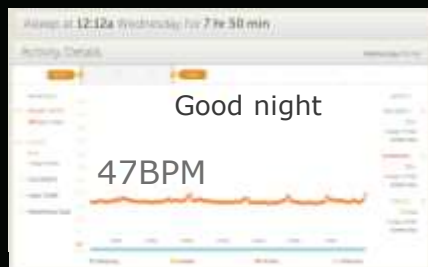
Sleep Quality (BASIS PEAK)



Sleep Quality (BASIS PEAK)



Sleep Quality (BASIS PEAK)





Sleep Quality (BASIS PEAK)

Good Night



Stressful (Job Talk the Next Day)



Vivid Dream



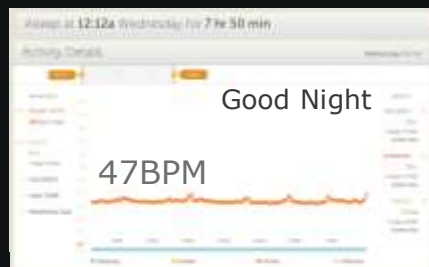
No Dinner – Nighttime Hypoglycemia



Sleep Quality (BASIS PEAK)



Good Night



Stressful (Job Talk the Next Day)



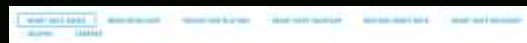
Vivid Dreams



No Dinner – Nighttime Hypoglycemia



Smart Textiles (Myontec, Hexoskin, Athos)



Excess Fluid in CVD (Edema.dk)



Excess Fluid in Heart Failure (toSense)



Heart Rate
Resp Rate

Thoracic Fluid
Stroke Volume
Cardiac Output
Physical Activity

Smart Lenses Measuring Glucose Level (Google)



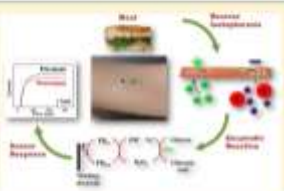
Tattoo-Based Noninvasive Glucose Monitoring: A Proof-of-Concept Study

Amay J. Bhandolkar,[†] Wenhao Jia,[†] Ceren Yardinci,[‡] Xuan Wang, Julian Ramirez, and Joseph Wang*

Department of NanoEngineering, University of California, San Diego, La Jolla, California 92093, United States

 Supporting Information

ABSTRACT: We present a proof-of-concept demonstration of an all-printed temporary, tattoo-based glucose sensor for noninvasive glycemic monitoring. The sensor represents the first example of an easy-to-wear flexible tattoo-based epidermal diagnostic device combining reverse iontophoretic extraction of interstitial glucose and an enzyme-based amperometric biosensor. *In vitro* studies reveal the tattoo sensor's linear response toward physiologically relevant glucose levels with negligible interference from common coexisting electroactive species. The iontophoretic biosensing tattoo platform is reduced to practice by applying the device on human subjects and monitoring variations in glycemic levels due to food consumption. Correlation of the sensor response with that of a commercial glucose meter underscores the promise of the tattoo sensor to detect glucose levels in a noninvasive fashion. Control on-body experiments demonstrate the importance of the reverse iontophoresis operation and validate the sensor specificity. This preliminary investigation indicates that the tattoo-based iontophoresis-sensor platform holds considerable promise for efficient diabetes management and can be extended toward noninvasive monitoring of other physiologically relevant analytes present in the interstitial fluid.



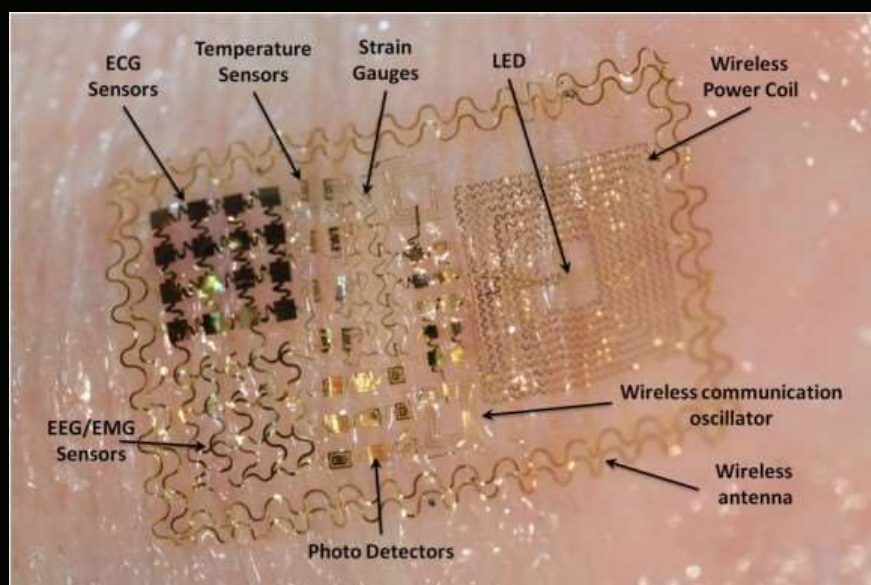
Diabetes is one of the most widely spread modern lifestyle diseases affecting hundreds of millions of people and is among the leading causes of deaths globally.^{1,2} Frequent monitoring of glucose is essential for optimal management of the disease and avoiding its associated problems.³ Extensive research has led to the introduction and widespread use of self-testing blood glucose meters.⁴ However, such self-testing methods rely on inconvenient and painful blood sampling from the finger tip that compromises the patient's compliance. Efforts aimed at addressing this drawback have resulted in several commercial continuous glucose monitoring systems. These enzyme-based microcathode sensors are inserted under the skin to measure glucose levels in the skin interstitial fluid (ISF).⁵⁻⁸ Such minimally invasive sensing methods are based on the correlation between glucose levels in the ISF and

glucose sensor. Reverse iontophoresis involves applying a mild current to the epidermis causing ions to migrate across the skin and toward the electrodes.¹¹ Sodium ions are the major charge carriers due to the negative charge of the human skin at neutral pH. The migration of sodium ions from across the cathode leads to electro-osmotic flow of the ISF toward the cathode. During this ISF flow, glucose is also toward the cathode. Thus, this technique can be noninvasive monitoring of ISF glucose levels.¹¹ If device was later discontinued as patients require initiation. This limitation has been addressed by employing a lower current density for the glucose extraction to new noninvasive reverse iontophoresis sensors.¹²⁻¹⁴ However, these protocols have either not been used *in vivo* conditions^{15,16} or require off-

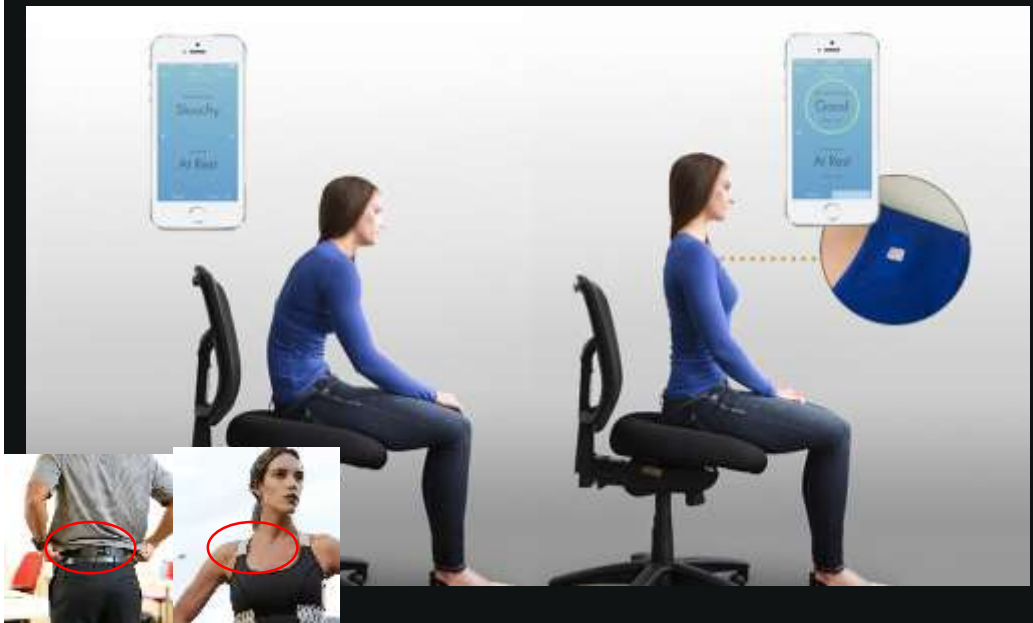


analytical
chemistry

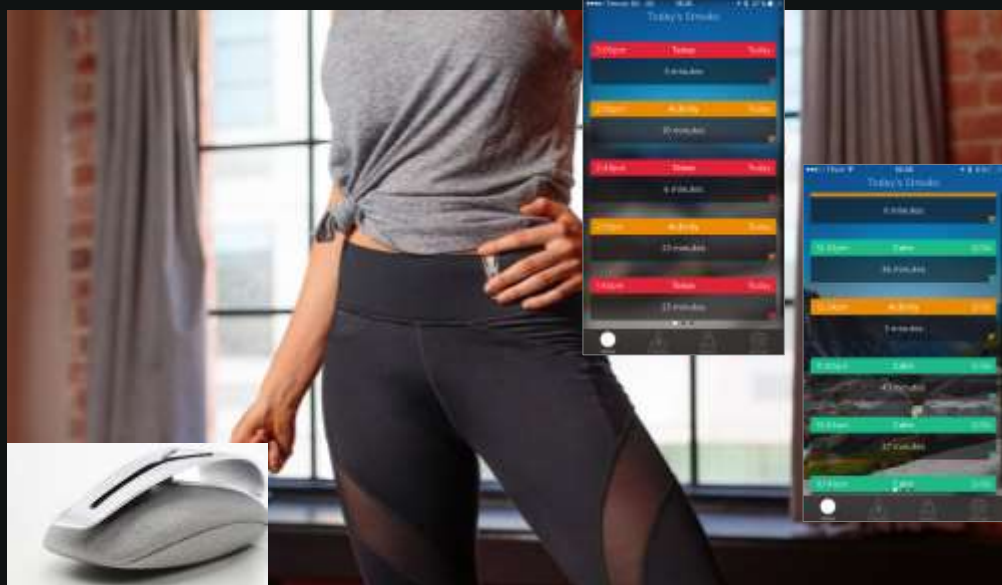
Tattoos incl. ECG, EMG, ..., Temp, Hydration Level (MC10)



Posture (Lumo Lift)



Brain & Mind (Resp Rate by SPIRE)



Brain & Mind (GSR by PIP, voice by BeyondVerbal, EEG by MUSE, NeuroPro)



Learn to manage your stress with Pip

NeuroTrail
The ambulatory EEG headset

desire
Thinking and wanting

NeuroTrail
The ambulatory EEG headset

Brain decoding: Reading minds

By scanning blobs of brain activity, scientists may be able to decode people's thoughts, their dreams and even their intentions.

Kenn Smith

23 October 2013

[PDF](#) [Signs & Permissions](#)

Jack Gallant perches on the edge of a velvet chair in his lab at the University of California, Berkeley, fixed on the screen of a computer that is trying to decode someone's thoughts.

On the left-hand side of the screen is a reel of film clips that Gallant showed to a study participant during a brain scan. And on the right side of the screen, the computer program uses only the details of that scan to guess what the participant was watching at the time.

Anne Hathaway's face appears in a clip from the film *Bride Wars*, engaged in heated conversation with Kate Hudson. The algorithm confidently labels them with the words "woman" and "face", in large type. Another clip appears — an underwater scene from a wildlife documentary. The program struggles, and eventually offers "whale" and "seal" in a small, tentative font.

"This is a minute, but it doesn't know what that is," says Gallant, talking about the program as one might a recalcitrant student. They had trained the program, he explains, by showing it patterns of brain activity elicited by a range of images and film clips. His program had encountered large aquatic mammals before, but never a minnow.

Listen

Neuroscientists can predict what a person is seeing or dreaming by looking at their brain activity.

[Go to full podcast](#)

Media reports have suggested that such techniques bring mind-reading "from the realms of fantasy to fact", and "could influence the way we do just about everything". The *Economist* in London even cautioned its readers to "be afraid", and speculated on how long it will be until scientists promise telepathy through brain scans.

Although companies are starting to pursue brain decoding for a few applications, such as market research and lie detection, scientists are far more interested in using this process to learn about the brain itself. Gallant's group and others are trying to find out what underlies those different brain

uses to make sense of the world at the basic principles governing and emotion (see 'Decoding for

nature



DECODING FOR DUMMIES

Training: Images (shoe, cat) → Brain activity → Decoding (SHOE, CAT)

Testing: Image (shoe) → Brain activity → Decoding (SHOE?)

Using training the program could guess the object named in the brain images (the neural data were patterns of activity).

Food Scanner (TellSpec, MyScio)



Environment: Air Quality (atmotube, sensaris, TZOA)



Blow (on) Your Phone: Lung Performance (SpiroSmart)



Tracking Lung Health With a Cell Phone

Breathe in, breathe out. Did and repeat.

January 16, 2013

Today, a deep sigh at your smartphone could reveal a well-developed emotional connection with your gadget. But one day those sighs could tip off your doctor to a latent or worsening lung condition.

A group at the University of Washington, in collaboration with Seattle Children's Hospital, is developing a way to check how healthy your lungs are when you breathe out at your smartphone.

For patients with conditions like asthma, chronic bronchitis, or cystic fibrosis doctors sound out their pipes using a spirometer, a device that measures volumes of air breathed in and out. The exhaled volume indicates if the patient's air passages are clogged and leading to difficulty breathing.

Recently, a group at **Shrout's Public Lab** at the University of Washington figured out how to measure exhaled breaths using the microphone on a smartphone.

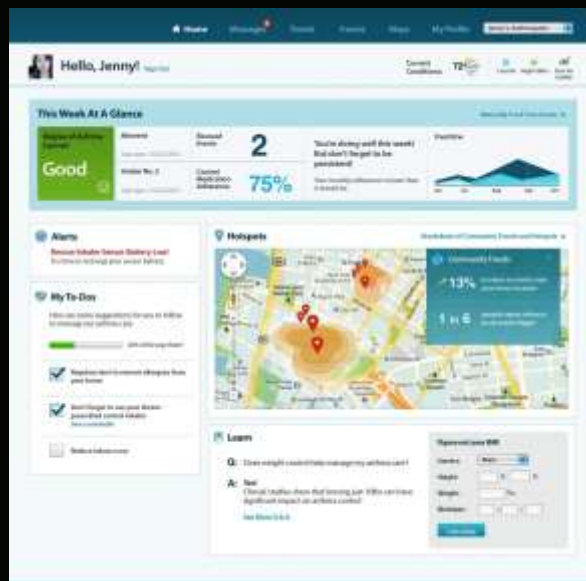
The **SpiroSmart** app estimates the volume of air exhaled by the sound waves recorded as you breathe out. The goal was to create a home lung test explained in a **press release**. In a **press release**, the system seemed reliable. The group presented that at other last year.

MIT Technology Review

reading lung function from



Where? GPS For Asthma Inhalers (PropellerHealth)



Medication: Which is Which? (MedSnap)



Medication Reminder: Smart PillBox (GlowCap)

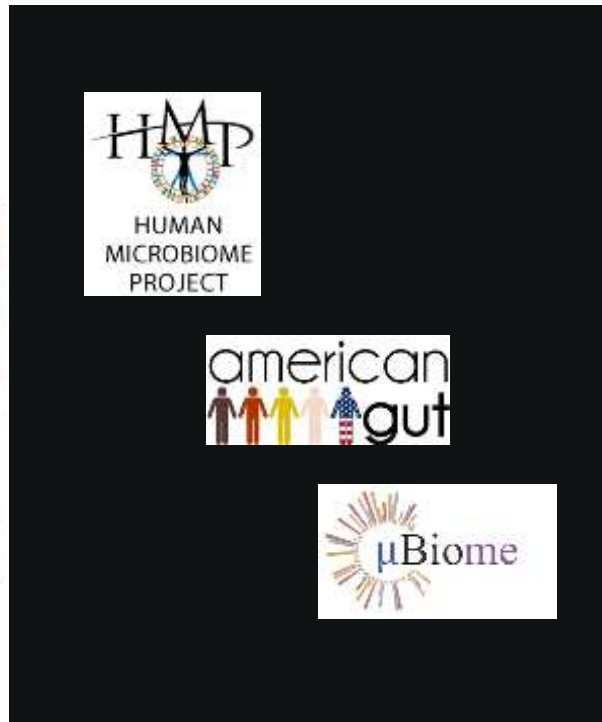


Medication Adherence: Pill & Sensor & 'Sticker' (Proteus)



Medication Adherence: Pill & Sensor & 'Sticker' (Proteus)





Where is Your Tricorder? In the Patient's Pocket.

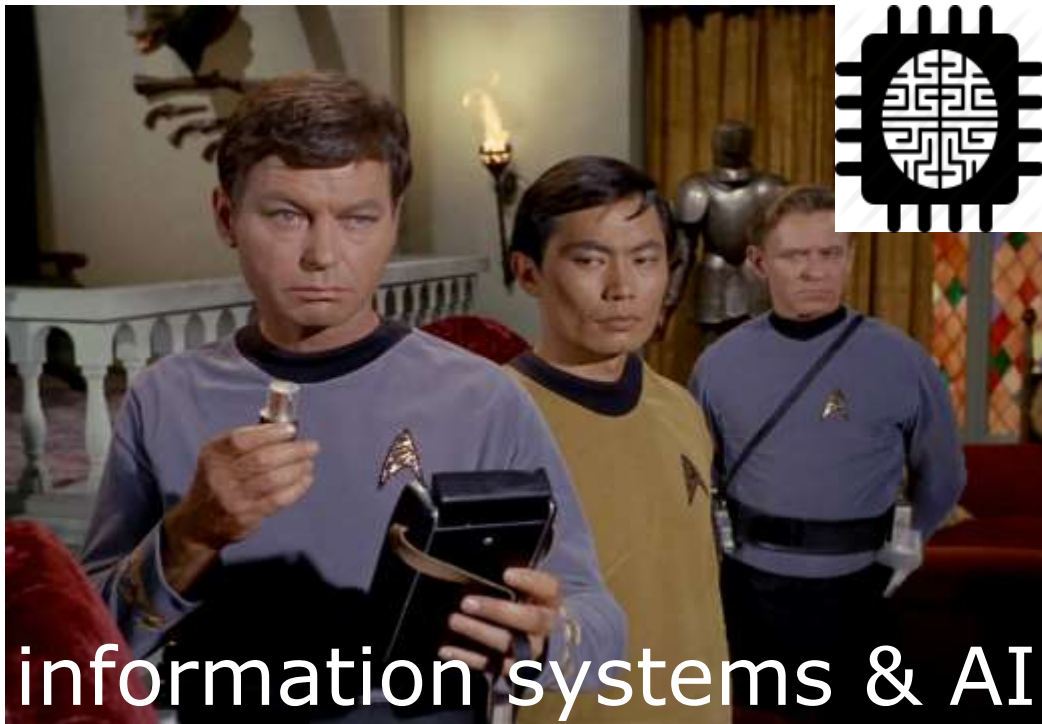


Wearable
Wireless
Waterproof
Multipurpose
Unobtrusive
Fashionable
Long battery lifetime

Further: Non-contact, Ingestible, Bio-degradable, Injectable



You can't list your iPhone as your primary-care physician



Opinion | Biomedical | Diagnostics

Big Data Is Transforming Medicine

New self-monitoring devices will help collect our vital stats into powerful databases, allowing us to prevent health problems as well as treatment success failure

By Susan Hassler

Posted 28 May 2015 | 15:00 GMT



Illustration: Bryan Christie Design

See *Spot in Time*, John Jerome detailed the pursuit of excellent execution over time. How do you

What's the next big thing in big data? Bigger data.

By Michael Levitt | Published: JUNE 2, 2015, 5:06 AM EDT



The digital world is exploding with data that has yet to be analyzed. Businesses are just starting to wake up to the possibilities.

With more Internet-connected devices, machines, and applications talking to one another than ever before.

FORTUNE

BRAIN SCAN

Medicine by numbers

Susan Ellenberg is a biostatistician trying to avoid mistakes in an era of Big Data and high-tech personalized medicine

By Tim J. Minchin | From the front section

"If we didn't take any risks, we wouldn't approve any drugs," says Susan Ellenberg, a professor of biostatistics at the University of Pennsylvania. "Some people will always want a new drug sooner and say they're willing to take a chance. Others will ask, why didn't you study it longer and find out about this horrible side-effect?"

During her long career, Dr. Ellenberg has used data to quantify and communicate these risks. Along the way she has helped to shape a discipline that owes as much to ethics and philosophy as it does to pure mathematics. Now medicine is entering a new digital age, one of Big Data and high-tech personalized treatments that are tailored to an individual's genetic make-up. But more data does not necessarily mean better data, so amidst the increasing complexity it will be as important as ever to measure correctly which treatments work and which do not.

It is a job Dr. Ellenberg is well suited to. She has already played a big part in improving the data-monitoring committees that now oversee virtually all clinical trials; she has helped establish standard practices for tracking dangerous treatments; and she has encouraged patient lobbies to find a voice in clinical testing.

The Economist



Without the right analytical methods, more data just gives a more precise estimate of the wrong thing

Smarter Care (Google, Dell, IBM)

Smart care: how Google DeepMind is working with NHS hospitals

A smartphone app piloted by the NHS could improve communication for hospital staff and help patients get medical care faster



By Tim J. Minchin | From the front section

Google DeepMind, the tech giant's London-based company most famous for its groundbreaking use of artificial intelligence, is developing a software to partnership with NHS hospitals to alert staff to patients at risk of deterioration and death through failure failure.

DeepMind Health

CLINICIAN-LED TECHNOLOGY

Analytics Predict Which Patients Will Suffer Post-Surgical Infections

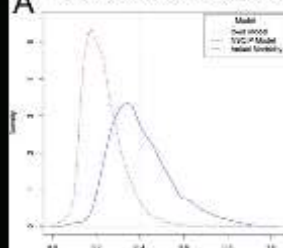
ARTICLE COMMENTED ON

BY RACHAEL KINGS

The University of Iowa Hospitals and Clinics is reducing the rate of surgical infections by using predictive analytics. At the end of 2014, the rate of infections for patients of colon surgery dropped 68% over a two-year period.

Using a variety of data, including information from the patient's medical records and outcomes of the surgery itself such as patient vital signs during the operation, the University of Iowa can predict which patients are likely to have the highest risk of infection. Before these patients leave the operation room, doctors can create a plan to reduce that risk whether that's altering medication or using different techniques or testing the wound.

A Distribution of mortality prediction 2010-11 (p. 1270)



Surgical complications, such as surgical site infections that occur after a patient is discharged, are the third leading reason for unplanned hospital readmission according to a study from Northwestern Medicine and the American College of Surgeons, published February 3 in JAMA. Under the Affordable Care Act, Medicare will, in some cases, reduce reimbursement to a hospital that has too many unplanned readmissions within 30 days.

The techniques DeepMind uses are only precise, but there's quite a lot of variation in post-surgical care among hospitals and even within units of the same hospital, said Dr. John Conrad, associate chief medical officer and director of surgical quality and safety at the University of Iowa Hospitals and Clinics. "What we're really trying to do is bring that same precision to the decision-making around the operation," he told CIO journal.

There are many factors that determine whether a patient will have a surgical site

THE WALL STREET JOURNAL

JOURNAL OF GASTROINTESTINAL SURGERY

Smarter Care (Google, Dell, IBM)



IBM's Watson is better at diagnosing cancer than human doctors

MONITORING BY JEFFREY H. LEE FOR WIREIMAGE.COM



IBM's Watson – the language-fluent computer that beat the best human champions at a game of the US TV show *Jeopardy!* – is being turned into a tool for medical diagnosis. Its ability to absorb and analyze vast quantities of data is, IBM claims, better than that of human doctors, and its deployment through the cloud could also reduce healthcare costs.

The first stages of a planned wider deployment, IBM's business agreement with the Memorial Sloan-Kettering Cancer Center in New York and American private healthcare company Wellpoint will use Watson available for test to any hospital or clinic that wants to get its opinion on matters relating to oncology. Not only that, but it'll suggest the most affordable way of paying for it in America's exorbitantly complex healthcare market. The hope is it will improve diagnosis while reducing their costs at the same time.



knowledge relating to oncology. That's just lung, prostate and breast cancers to begin with, but with others to come in the next few years). Watson's ingestion of more than 600,000 pieces of medical evidence, more than two million pages from medical journals and the further ability to search through up to 1.5 million patient records for further information gives it a breadth of knowledge no human doctor can match.

Two years ago, IBM announced that Watson had

"learned" the same amount of knowledge as a year medical student. For the last Wellpoint have been working to a substantial and accurate com-

claimed that, in tests, Watson's successful diagnosis rate for lung cancer is 90 percent, compared to 50 percent for human doctors.

WIRED

Smarter Care (Google, Dell, IBM)



Computers Can Predict Schizophrenia Based on How a Person Talks

A new study finds an algorithmic word analysis is flawless at determining whether a person will have a psychotic episode.

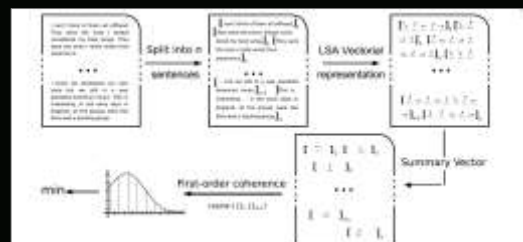


ARRIVING LATELY | APR 26, 2015 | TECHNOLOGY

Although the language of thinking is deliberate—in *me think*, I have to do some *thinking*—the actual experience of having thoughts is often passive. Ideas pop up like *darndelusions*, thoughts occur suddenly and escape without warning. People swim in and out of pools of thought in a way that can feel, paradoxically, *mindless*.

Most of the time, people don't actively track the way one thought flows into the next. But in psychiatry, much attention is paid to such intricacies of thinking. For instance, disorganized thought, evidenced by disjointed patterns in speech, is considered a hallmark characteristic of schizophrenia. Several studies of at-risk youths have found that doctors are able to guess with impressive accuracy—the best predictive models hover around 79 percent—whether a person will develop psychosis based on tracking that person's speech patterns in interviews.

A corollary, it seems, can do better.



the Atlantic

Published Wednesday by researchers at Columbia University, and the IBM T. J. Watson Research Group journal *Schizophrenia*. They

npj | Schizophrenia

Smarter Care (Google, Dell, IBM)



AMIA J. Summits Transl. Sci. Proc. 2014, 2014, 122–126.
Published online 2014 Apr 7.

PMID: 24633593

Towards Personalized Medicine: Leveraging Patient Similarity and Drug Similarity Analytics

Ping Zhang, PhD, Fei Wang, PhD, Jieping Hu, PhD, and Robert Sordet, MD

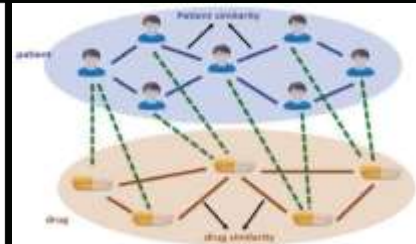
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Abstract

Go to:

The rapid adoption of electronic health records (EHR) provides a comprehensive source for exploratory and predictive analytic to support clinical decision-making. In this paper, we investigate how to utilize EHR to tailor treatments to individual patients based on their likelihood to respond to a therapy. We construct a heterogeneous graph which includes two domains (patients and drugs) and encodes three relationships (patient similarity, drug similarity, and patient-drug prior associations). We describe a novel approach for performing a label propagation procedure to spread the label information representing the effectiveness of different drugs for different patients over this heterogeneous graph. The proposed method has been applied on a real-world EHR dataset to help identify personalized treatments for hypercholesterolemia. The experimental results demonstrate the effectiveness of the approach and suggest that the combination of appropriate patient similarity and drug similarity analytics could lead to actionable insights for personalized medicine. Particularly, by leveraging drug similarity in combination with patient similarity, our method could perform well even on new or rarely used drugs for which there are no records of known past performance.



For each drug from DrugBank20, then we calculated the pairwise drug target similarity between drugs d_x and d_y based on the average of sequence similarities of their target protein sets:

$$\text{sim}_{\text{target}}(d_x, d_y) = \frac{1}{|P(d_x)| \cdot |P(d_y)|} \sum_{i=1}^{|P(d_x)|} \sum_{j=1}^{|P(d_y)|} \text{SW}(P_i(d_x), P_j(d_y))$$

Proceedings — AMIA Joint Summits
on Translational Science



AI: From Good to Bad (2009-2013 by Google)



Assessing Google Flu Trends Performance in the United States during the 2009 Influenza Virus A (H1N1) Pandemic

Shantanu Choudhury, PhD, Andrew A. Choudhury, PhD, and S. Sridhar

Published August 14, 2011 • DOI: 10.1371/journal.pone.0020010

Author	Author	Author	Author	Author
Shantanu Choudhury	Andrew A. Choudhury	S. Sridhar	Shantanu Choudhury	Andrew A. Choudhury

Abstract

Background

Google Flu Trends (GFT) uses

real-time analysis of the

search engine to predict

influenza-like illness (ILI)

in the United States.

Methods

We compared GFT

performance with CDC

data during the 2009

influenza pandemic.

Results

GFT accurately predicted

the timing and magnitude

of the 2009 influenza

peak, but overestimated

the peak magnitude.

Conclusions

Google Flu Trends

can provide a useful

tool for monitoring

influenza activity in

real-time, but its

performance should

be evaluated carefully.

Keywords

Google Flu Trends

performance

2009 influenza

pandemic

influenza-like illness

(ILI)

search engine

data analysis

public health

monitoring

tool

evaluation



When Google got flu wrong

US web search giant's leading web-based method for tracking seasonal flu

BY STEVE KRAVITZ

WASHINGTON, D.C. (AP) — Google's leading method for tracking seasonal flu, which has been widely praised for its accuracy, is actually quite wrong, according to a new study by researchers at the University of Washington.

The study, published in the journal *PLoS ONE*, found that Google's Flu Trends algorithm, which uses search engine data to predict flu activity, overestimated the peak of the 2009-2010 flu season by as much as 100 percent.

The researchers also found that Google's algorithm was less accurate in predicting the timing of the flu season's peak.

Google Flu Trends has been widely praised for its accuracy, but the new study suggests that it may not be as reliable as once thought.

The study was led by researchers at the University of Washington, who compared Google's Flu Trends data with data from the Centers for Disease Control and Prevention (CDC).

The researchers found that Google's algorithm was more accurate in predicting the timing of the flu season's peak than in predicting the magnitude of the peak.

The study also found that Google's algorithm was less accurate in predicting the timing of the flu season's peak in the United States than in other countries.

The researchers suggest that Google's algorithm may be overrelying on search engine data, which can be influenced by a variety of factors, including changes in search engine algorithms and user behavior.

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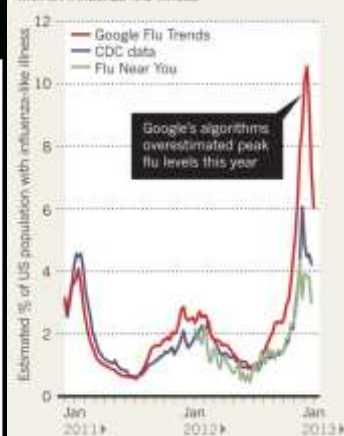
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FEVER PEAKS

A comparison of three different methods of measuring the proportion of the US population with an influenza-like illness.



Google's algorithms overestimated peak flu levels this year

PLOS ONE

nature

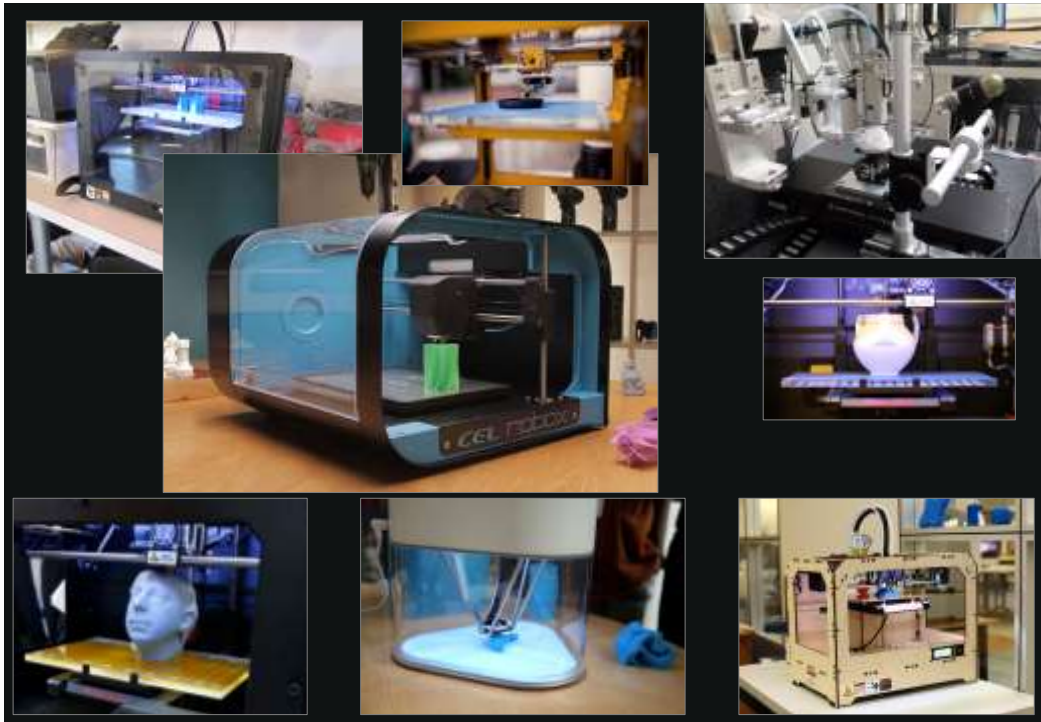
AMIA J. Summits Transl. Sci. Proc. 2014, 2014, 122–126.
Published online 2014 Apr 7.



My 'check gallbladder' light came on



3D printing



Limbs/Casts
 Prosthetic Parts
 Medical Equipment
 Tailor-made Sensors
 Medical Models
 Bones
 Trachea
 Heart Valve
 Ear Cartilage
 Synthetic Skins
 Tissues with Blood Vessels



3D Printing In-vivo (biopen by Cegene Therapeutics)





Where is Your Tricorder? Inside 3D Printed Drugs.

Why it matters that the FDA just approved the first 3D-printed drug

By Dominic Rosenthal August 11, 2015



These may look like regular pills, but these Sildenafil tablets have actually been manufactured in a layered process via 3D printing. (Aprecia Pharmaceuticals via AP)

For the first time ever, the FDA has approved a 3D-printed prescription pill for consumer use. This 3D-printed pill, which will sold by Aprecia Pharmaceuticals under the name Spritam, could be used by the more than 3 million people who suffer from certain types of erectile dysfunction. The approval of this printing innovation could have far-reaching implications for the future of drug manufacturing.

The Washington Post

Where is Your Tricorder? Inside 3D Printed Drugs.



Where is Your Tricorder? Inside 3D Printed Fish Delivering Drugs.



Tiny, 3D-Printed Fish to Swim in Blood Stream, Deliver Drugs

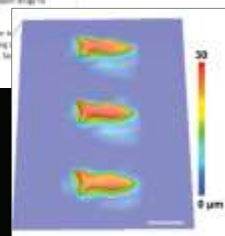
and the authors to be used for research purposes



New 3D-printed fish-shaped microfish — called microfish — could one day transport drugs to specific organs in the human body and be able to sense and remove toxins.

These microfish, smaller than the width of a human hair, are groundbreaking for being so simple to create, but remarkably high-tech in what they can do, including sensing and delivering drugs, according to researchers at the University of California, Berkeley.

Microfishes Could Push Drugs Through Veins



ADVANCED MATERIALS

WIRED

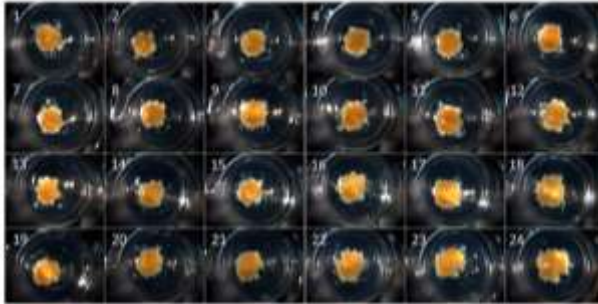
3d Printed Tissue to Test Drugs (Liver, Kidney by Organovo)

Now Printing: Micro-Livers

A La Jolla biotech boosts drug testing with human organs made on demand.

BY JOSH BAKT

Published: 2010.06.24 08:45 AM



PHOTOGRAPHY BY JOSH BAKT FOR SAN DIEGO MAGAZINE. THE 3D PRINTED LIVERS WERE CREATED BY ORGANOVO, A LA JOLLA, CALIF. BIOTECH COMPANY.

Once novel, 3-D printing is making a big splash, producing human organs. But those applications merely scratch the surface of what's possible, and

San Diego
MAGAZINE

“Multiple drugs have shown toxicity in late-stage trials. This is an opportunity to understand how a drug will work in humans.”

Printing Full Organs (Kidney, Liver)

Wake Forest®
School of Medicine

Patients & Visitors | Referring Physicians | Research | Education

Replacement Organs and Tissues

- Bioengineering
- Adult Renal Transplantation
- Blood Vessel Research
- Engineering Eggs for IVF
- Engineering a Kidney
- Human Liver
- Replacing a Human Ear

Human Liver

An Institute research team has reached an early, but important, milestone in the quest to grow replacement livers in the lab. They are the first to use human liver cells to successfully engineer miniature livers that function - at least in a laboratory setting - like human livers. The next step is to see if the livers will continue to function after transplantation in an animal model.

The ultimate goal of the research, published in the journal *Nature*, is to provide a solution to the shortage of donor livers available for patients who need transplants. Laboratory-engineered livers could also be used to test the safety of new drugs.

While the research suggests exciting possibilities, the researchers stressed that they are at an early stage and many technical hurdles must be overcome before it could benefit patients. One challenge is to learn to grow billions of liver cells at one time in order to engineer livers large enough for patients.

The engineered livers, which are about an inch in diameter and weigh about 20 ounces, would have to weigh about one pound to meet the minimum needs of the human body, said the scientists. Even at that larger size, the organs wouldn't be as large as human livers, but would likely provide enough function. Research has shown that human livers functioning at 30 percent of capacity are able to sustain the human body.

Liver Manufacture



Human on a Chip (Wyss Institute, Harvard)

Organ-on-a-chip and the kidney

Open Access funded by The Korean Society of Nephrology

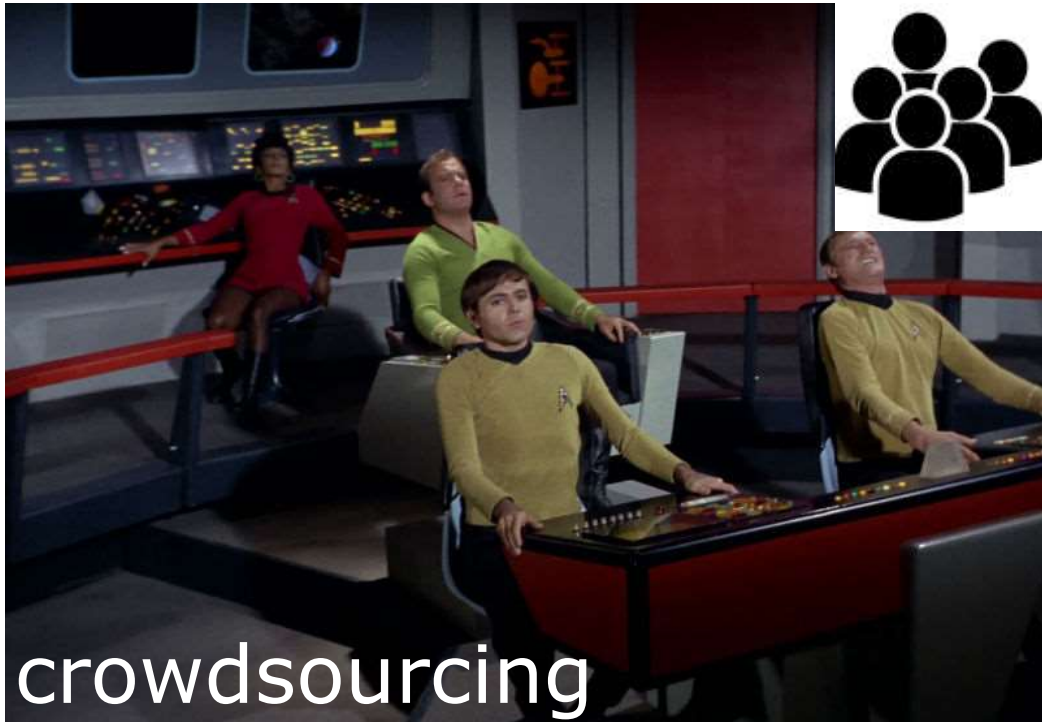
Abstract

Traditional approaches to drug development are advancing but still have many limitations that arise from real biological systems and their associated physiological phenomena being too complicated. Microfluidics is a novel technology in the field of engineering, which provides new options that may overcome these hurdles. Microfluidics handles small volumes of fluids and may apply to various applications such as DNA analysis chips, other microfluidic chips, microfluidic chips, and microfluidic technologies. Recently, organ-on-a-chip applications allow the fabrication of microfluidic devices that work as a single organ or multiple organs. Relevant to the field of nephrology, renal tubule-on-a-chip devices integrated with microfluidic devices for modeling tubular cells.



**KIDNEY RESEARCH
AND CLINICAL PRACTICE**





Laurie Becklund dies at 66; former L.A. Times reporter, author



Laurie Becklund covered the war in El Salvador, writing books that would change national perceptions of the war. (Associated Press/Markus Handberg)

In the Big Database, the real is artificial. Consider what Web 2.0 does. Even the tiniest company can now reach stock they sell, compare themselves to others, review history, predict trends. Why can't we create such a database for cancer patients, so we can all learn from patient experience and make more educated decisions on what treatments will extend and improve lives?

Los Angeles Times

Op-Ed As I lay dying

By Laurie Becklund



The patients' list database, or the Big Database, isn't dead? (Associated Press)

Published on: 03/12/16, 4:24 PM

I am dying. Literally, at my home in Hollywood, of metastatic breast cancer, the only kind of breast cancer that kills. For six years I've known I was going to die. I just didn't know when.

Then, a couple of weeks before Christmas, a new, deadly diagnosis gave me a deadline: No doctor would operate on me if I make it to 2016.

Previously, I told my friends and family, that you'll never see that I died after "fighting a courageous battle with breast cancer." This time, this line disabuses the dead and the dying by suggesting that we, the victims, are responsible for our deaths or that the fight we enter is not even fair.

Previously you'll never wear a pink ribbon in my name or drop a dollar into a basket that goes to breast cancer "awareness" for "early detection for a cure," the mantra of hand-wringing ignorant Susan G. Komen, which has propagated a distorted message about breast cancer and how to "treat" it.

I'm proud that early detection doesn't cure cancer. I had more than 20 mammograms, and none of them caught my disease. In fact, we now have significant studies showing that routine mammogram screening, which may result in mastectomies, unnecessary treatment and radiation overexposure, can harm more people than it helps.

In 1996, during a self-exam, I found a peanut-sized lump in one breast that turned out to be stage one breast cancer. I had the "best," most common, kind of breast cancer, found it early, got a lumpectomy and about dose of radiation. Five years out, my doctor told me there was little chance of recurrence and said, "Have a great life!"

Patients Connect

Crohnology



Smart Patients

computational
biology

ANALYSIS



Accelerated clinical discovery using self-reported patient data collected online and a patient-matching algorithm

Paul Wicks, Timothy E Vaughan, Michael P Massagli & James Heywood

Patients with serious diseases may experiment with drugs that have not received regulatory approval. Online patient communities structured around quantitative outcome data have the potential to provide an observational environment to monitor such drug usage and its consequences. Here we describe an analysis of data reported on the website PatientsLikeMe by patients with amyotrophic lateral sclerosis (ALS) who experimented with lithium carbonate treatment. To reduce potential bias owing to lack of randomization, we developed an algorithm to match 149 treated patients to multiple controls (447 total) based on the progression of their disease course. At 12 months after treatment, we found no effect of lithium on disease progression. Although observational studies using unblinded data are not a substitute for double-blind randomized control trials, this study reached the same conclusion as subsequent randomized trials, suggesting that data reported by patients over the internet may be useful for accelerating clinical discovery and evaluating the effectiveness of drugs already in use.

To investigate the use of alternative medicine, of benefits to systems. First, it is important to know, helping them to scientific literacy. Second, there is an obligation to collect data on the safety of self-experimentation. Unproven treatments might have substantial safety concerns, and risks to patients may be increased without a way to report safety issues. Finally, there is the chance that something (i.e., off-label usage, a change in dosage, delivery route or combination with other treatments) might actually be shown to be efficacious, leading to further study.

ALS is a condition where both randomized trials and nonrandomized clinical studies have yet to provide an effective therapy. It is a cruel and rapidly fatal neurodegenerative disease causing progressive weakness and muscle atrophy; median survival from symptom onset is 2–5 years¹. In 2008, a study described the potential efficacy of lithium carbonate to slow the progression of ALS in a small, single-blind trial of 16 treated patients and 28 controls². Despite skepticism from the medical community^{3–6}, some ALS patients were enthusiastic about the treatment⁷ and by their own initiative used an online approach to gather data. PatientsLikeMe built a lithium-specific data collection tool (see Supplementary Fig. 1) to capture information about the 346 ALS patients registered with the PatientsLikeMe

effect of lithium on disease progression. Although observational studies using unblinded data are not a substitute for double-blind randomized control trials, this study reached the same conclusion as subsequent randomized trials, suggesting that data reported by patients over the internet may be useful for accelerating clinical discovery and evaluating the effectiveness of drugs already in use.

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nature
biotechnology

Online communities such as PatientsLikeMe that provide robust outcome data may have the potential to assess the effectiveness of treatments in ways that clinical studies inherently cannot meet

Medical Investigation for Patients by Crowds

Select a case
Which case do you feel best qualified to solve?

Case #1233
Age: 28
Symptoms: He has a ulcer on his left ankle since last 8 months which is not healing. The wound first appeared after a viral course.
Max Reward: 15,000 ₺
See Full Case

Case #1761
Age: 28
Symptoms: She has pain through out her entire body, which are worse in her back (shoulders to feet) and down the legs.
Max Reward: 15,000 ₺
See Full Case

Case #9933
Age: 47
Symptoms: Having not surgery to correct a scoliotic curve impairment.
See Full Case

Confirm or correct your diagnosis

\$39,726,354
in healthcare costs to using Crowdmel

You don't need a medical degree to help save a life

Choose one:

The big medical data miss: challenges in establishing an open medical resource

Eric J. Topol

Nature Reviews Genetics 16, 253–254 (2015) | doi:10.1038/nrg3943
Published online: 17 April 2015

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Abstract

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I call for an international open medical resource to provide a database for every individual's genomic, metabolomic, microbiomic, epigenomic and clinical information. This resource is needed in order to facilitate genetic diagnoses and transform medical care.

Subject terms: Genetic databases · Medical genomics · Personalized medicine

Predictive medicine

Laurie Becklund was a noted journalist who died in February 2015 at age 60 from breast cancer. Soon thereafter, the Los Angeles Times published her op-ed entitled "As I lay dying" (Ref. 1). She lamented, "We are each, in effect, one-person clinical trials. Yet the knowledge generated from those trials will die with us because there is no comprehensive database of metastatic breast cancer patients, their characteristics and what treatments did and didn't help them". She went on to assert that, in the era of big data, the lack of such a resource is "criminal", and she is absolutely right.

"We are each, in effect, one-person clinical trials"

Internet of DNA

Around the same time of this important op-ed, the MIT Technology Review published their issue entitled "10 Breakthrough Technologies 2015" and on the list was the "Internet of DNA" (Ref. 2). While we are often reminded that the world we live in is becoming the "Internet of Things", I have not seen this terminology applied to DNA before. The article on the "Internet of DNA" declared, "The unfolding calamity in genomics is that a great deal of life-saving information, though already in the hands of scientists, is being lost. As genomes are sequenced and the data are stored in vast databases, a growing number of large phenotypic and genotypic data sets are being lost. This information and insight in the



"We are each, in effect, one-person clinical trials"

"a massive, open, online medicine resource ... would help to quickly identify the genetic cause of the disorder"

Projects & Initiatives

Amesbury Club
Apple's Record of Kid
Global Alliance for Genomics and Health
Govmi
Matchmaker Exchange
Open Humans
Personal Genome Project
TrioCoke



Where is Your Tricorder? Online. In the App Store.



Apps to Track Exercise, Sleep Help Patients Participate in Clinical Trials

Smartphone data is used for growing number of studies on diabetes, asthma, cardiovascular disease



There are now dozens of apps that can track a patient's health and behavior, and some can even monitor vital signs.

By David W. Rosenberg, April 12, 2015 4:15 p.m. ET

Smartphones, like many people, are everywhere. In fact, a study by 2015, more than 80 percent of people own one.

Recently, by installing it on a new phone, for patients to participate in clinical trials. These trials are often for new drugs, treatments, or devices. They are often used to test a new drug or device, or to see if a new treatment is better than the old one.

"I've never seen a study like this before," says Dr. David Rosenberg, a professor at the University of California, San Francisco, who is one of the leading researchers in the field.

The app, called "Tricorder," is one of the first of its kind. It allows patients to track their health and behavior, and to share that data with their doctors. It also allows patients to track their health and behavior, and to share that data with their doctors.

Tricorder is a free app, and it's available on both the iPhone and the Android. It's a great way for patients to track their health and behavior, and to share that data with their doctors.

THE WALL STREET JOURNAL



Since the apps were launched March 9, some 60,000 patients have enrolled in five studies just by downloading the apps from the app store, answering a few questions about the disease and clicking through a consent form. None of the patients had to see a doctor to sign up.

Academic researchers doing similar trials might need several years to enroll only a few hundred patients. Pharmaceutical companies need scores of research sites and hundreds of millions of dollars to find 20,000 patients for a major drug trial.



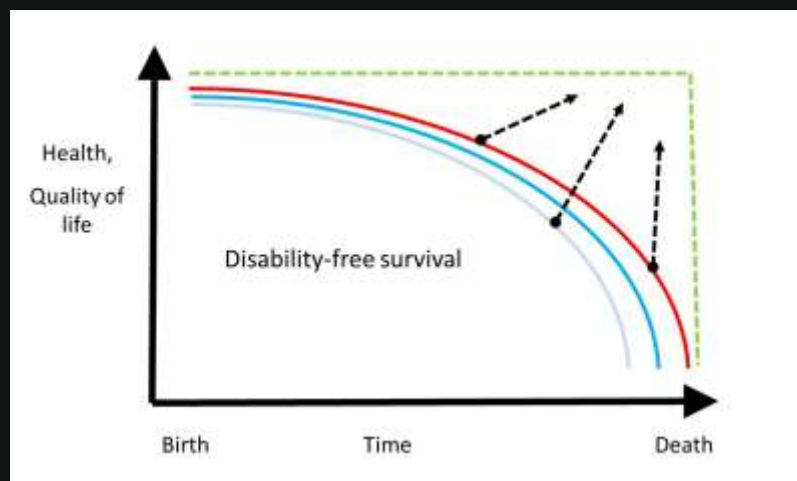
- POC Diagnostics / Portable Medical Devices
- Wearables
- Information Systems & AI
- 3D printing
- Crowdsourcing



Star Trek state of mind



Squaring The Curve



The Challenge (One of Many)



News

Anonymizing patient records for genomics

New method for concealing identity could open up more data for science.

David Greiner

Combining genetic information with existing medical records could allow researchers to rapidly identify genes linked to diseases. But bringing together diagnostic and genetic information in one place risks compromising the confidentiality of patients.

Now a team from Vanderbilt University in Nashville, Tennessee, has developed a method they say can anonymize electronic medical records, eliminating the risk of individual patients being identified while preserving the ability of researchers to do such work.

There is a huge push under way in the United States and elsewhere to create and exploit electronic medical records (see ["Critical epidemiology: Archived abstracts"](#)). Combining the diagnosis codes that list a patient's conditions in these records with genetic information from the patient could save time and money in genome-wide association studies, which seek to link genetic variations with diseases.

If their new approach is adopted it could open up vast new amounts of data for researchers to crunch while keeping patient data anonymous, the team say.

"There are lots of different types of information that exist within medical records. In the past it has been shown that demographic information is readily linkable to public information that could lead to re-identification. That is — are also genomics researcher in the study. Main:



Diagnostic data held in medical records could be very useful to geneticists. DNYSP/Shutterstock



They're Your Vital Signs, Not Your Medical Records

Americans don't own their own health information, and access to it is controlled by others. Time to change that.



By JENNIFER GORDON
JENNIFER.GORDON@NYC.NY

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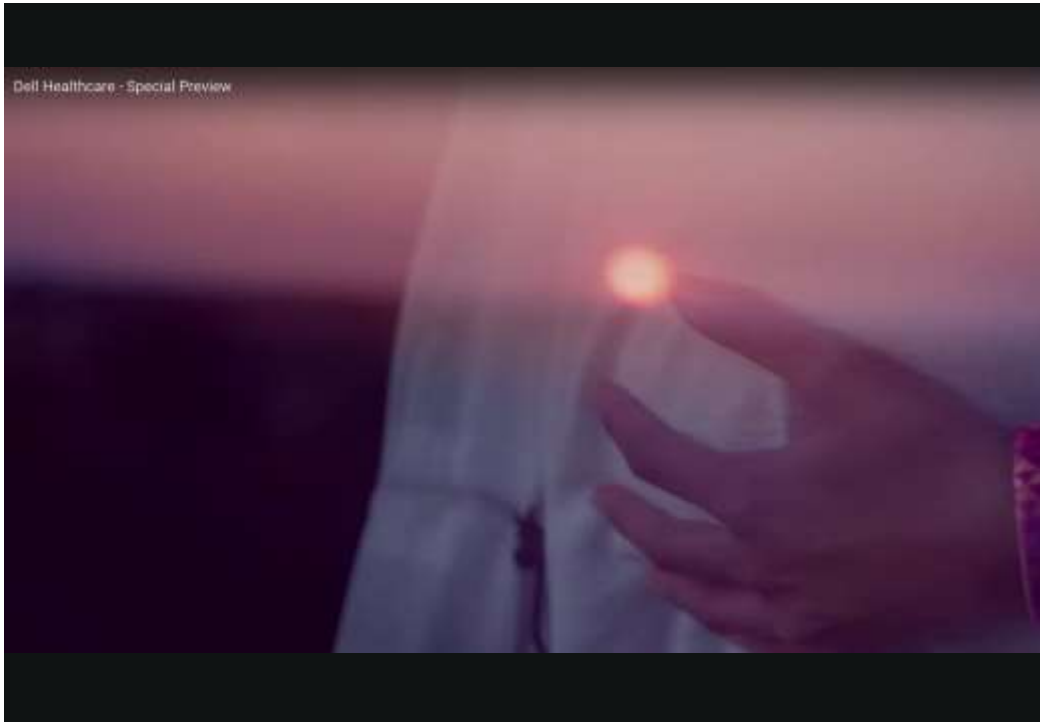
Experts predict that in five years we will generate 60 times more health information than today. Diagnoses, treatments, 3D-scanned images and vital signs already are being captured and stored. Healthcare, biotechnology, insurance and government agencies

THE WALL STREET JOURNAL





The Challenge (One of Many) → We Are Working On It!



Precision medicine

[Personalized, Preventative, Proactive, Participatory]

- *Average is over: patient;*
- *POC is where the patient is*
- *Toolbox is expanded beyond a stethoscope and a pill*
- *Approach to health is holistic*

Connect with Me to Design *Your* Next Tricorder!

Prof. Katarzyna Wac^{1,2} & QoL Team & Funding Agencies Supporting The Research

¹ Human-Centric Computing, University of Copenhagen, Denmark

² Quality of Life Technologies lab, University of Geneva, Switzerland

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TWITTER: @katewac

LINKEDIN and SLIDESHARE: /KatarzynaWac



21st Congress of the EAHP, Vienna, Austria, 2016

You have been pretty sedentary for 60 minutes...
Time to stretch your legs?

