

Technology Trends

Medical Technology

Center for Learning in Retirement

CLR Fall 2020

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Week 6

The What

- ~~Artificial Intelligence & Machine Learning~~
- ~~Robots & Drones~~
- ~~Autonomous Transportation Systems~~
- ~~Surveillance~~
- ~~(Cyber) Crime, Security & Warfare~~
- Medical Tech
- Media (incl. Social Media)
- (Virtual) Money & Blockchain
- Communication
- Earth & Sky
- Space

Medical



ANTHONY ATALA
Printing a human kidney

Surgeon Anthony Atala demonstrates an early-stage experiment that could someday solve the organ-donor problem: a 3D printer that uses living cells to output a transplantable kidney. Using similar technology, Dr. Atala's young patient Luke Massella received an engineered bladder 10 years ago; we meet him onstage. NOTE: This talk was given in 2011, and this field of science has developed quickly since then. Read "Criticisms & updates" below for more details.



MAX LITTLE
A test for Parkinson's with a phone call

Parkinson's disease affects 8.3 million people worldwide, causing weakness and tremors, but there's no objective way to detect it early on. Yet, Applied mathematician and TED Fellow Max Little is testing a simple, cheap tool that in trials is able to detect Parkinson's with 99 percent accuracy — in a 30-second phone call.



PATIENCE MTHUNZI
Could we cure HIV with lasers?

Swallowing pills to get medication is a quick, painless and often not entirely effective way of treating disease. A potentially better way? Lasers. In this passionate talk, TED Fellow Patience Mthunzi explains her idea to use lasers to deliver drugs directly to cells infected with HIV. It's early days yet, but could a cure be on the horizon?



QUYEN NGUYEN
Color-coded surgery

Surgeons are taught from textbooks which conveniently color-code the types of tissues, but that's not what it looks like in real life — until now. At TEDMED Quyen Nguyen demonstrates how a molecular marker can make tumors light up in neon green, showing surgeons exactly where to cut.



SIDDHARTHA MUKHERJEE
Soon we'll cure diseases with a cell, not a pill

Current medical treatment boils down to six words: Have disease, take pill, kill something. But physician Siddhartha Mukherjee points to a future of medicine that will transform the way we heal.



JACK CHOI
On the virtual dissection table

Onstage at TED2012, Jack Choi demonstrates a powerful tool for training medical students: a stretcher-sized multi-touch screen of the human body that lets you explore, dissect and understand the body's parts and systems.



DEBORAH RHODES
A test that finds 3x more breast tumors, and why it's not available to you

Working with a team of physicists, Dr. Deborah Rhodes developed a new tool for tumor detection that's 3 times as effective as traditional mammograms for women with dense breast tissue. The life-saving implications are stunning. So why haven't we heard of it? Rhodes shares the story behind the tool's creation, and the web of politics and economics that keep it from mainstream use.



YOAV MEDAN
Ultrasound surgery — healing without cuts

Imagine having a surgery with no knives involved. At TEDMED, Yoav Medan shares a technique that uses MRI to find trouble spots and focused ultrasound to treat such issues as brain lesions, uterine fibroids and several kinds of cancerous growths.



DANIEL KRAFT
Medicine's future? There's an app for that

Daniel Kraft offers a fast-paced look at the next few years of innovations in medicine, powered by new tools, tests and apps that bring diagnostic information right to the patient's bedside.



MARK KENDALL
Demo: A needle-free vaccine patch that's safer and way cheaper

One hundred sixty years after the invention of the needle and syringe, we're still using them to deliver vaccines; it's time to evolve. Biomedical engineer Mark Kendall demos the Nanopatch, a one-centimeter-by-one-centimeter square vaccine that can be applied painlessly to the skin. He shows how this tiny piece of silicon can overcome four major shortcomings of the modern needle and syringe, at a fraction of the cost.



RUPAL PATEL
Synthetic voices, as unique as fingerprints

Many of those with severe speech disorders use a computerized device to communicate. Yet they choose between only a few voice options. That's why Stephen Hawking has an American accent, and why many people end up with the same voice, often to incongruous effect. Speech scientist Rupal Patel wanted to do something about this, and in this wonderful talk she shares her work to engineer unique voices for the voiceless.



ROGER STEIN
A bold new way to fund drug research

Believe it or not, about 20 years' worth of potentially life-saving drugs are sitting in labs right now, untested. Why? Because they can't get the funding to go to trials; the financial risk is too high. Roger Stein is a finance guy, and he thinks deeply about mitigating risk. He and some colleagues at MIT came up with a promising new financial model that could move hundreds of drugs into the testing pipeline.

Topics

- Print your own medicine
- Medical data
- Medicine's wireless future (2009)
- Medicine's great 'inversion' (2015)
- Surgical robots
- Using DNA websites to catch criminals

Lee Cronin: Print Your Own Medicine (2.5 min)



Lee Cronin: Print Your Own Medicine - [TED Talk Link](#)

- 3-D Printable Chemistry – Reactionware
 - Embed Chemical – Biological Links
 - Universal set of ‘inks’ – apps to ‘print your own medicine’
- Print drugs at ‘point of need’
- On-the-fly molecular assembly

Anders Ynnerman: Visualizing the Medical Data Explosion (8 min)



Anders Ynnerman: Visualizing the Medical Data Explosion - [TED Talk Link](#)

- Yesterday – 100 slices, 50mb
- Today – 24000 images, 20gb
- Tomorrow – (time-resolved) 1024^3 voxels*, 1tb
 - Put slices together into a ‘block’ of data
 - Leveraging off-the-shelf ‘GPUs’ for processing data
- Virtual autopsy vs physical autopsy – ‘autopsy table’
- Real-time brain function visualization

[*Voxel](#) - A voxel represents a single sample, or data point, on a regularly spaced, three-dimensional grid. This data point can consist of a single piece of data, such as an opacity, or multiple pieces of data, such as a color in addition to opacity. In [CT](#) scans, the values are [Hounsfield units](#). Different types of value are acquired from [MRI](#) or [ultrasound](#).

Eric Topol: The Wireless Future of Medicine (8 min)

2009



The great Inversion of Medicine (7 min)

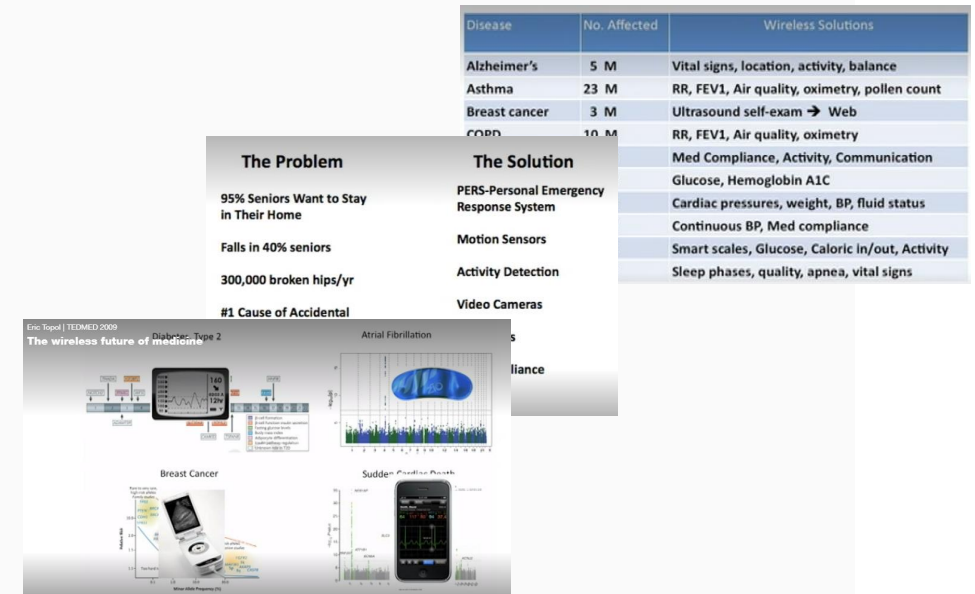
6 years later



Eric Topol: The Wireless Future of Medicine -

[TED Talk Link](#)

- Digital Medical Wireless Devices
 - Electrocardiogram, vital signs (AirStrip), fetal monitoring, glucose sensors, sleep, etc.
 - Handheld ultrasound, iRhythm patch (body area network)
 - Corventis PiiX vital sign monitoring (device for active monitoring)
- Why now?
 - Consumer-driven healthcare – living by numbers
 - Sleep
 - Diabetes – continuous monitoring
 - New targets for wireless medicine
 - Aging in Place
- The Future – the era of wireless medicine
 - Convergence – detection



[The great Inversion of Medicine | Eric Topol | TEDxSanFrancisco](#)

Targets for Wireless Medicine

Disease	No. Affected	Wireless Solutions
Alzheimer's	5 M	Vital signs, location, activity, balance
Asthma	23 M	RR, FEV1, Air quality, oximetry, pollen count
Breast cancer	3 M	Ultrasound self-exam → Web
COPD	10 M	RR, FEV1, Air quality, oximetry
Depression	21 M	Med Compliance, Activity, Communication
Diabetes	24 M	Glucose, Hemoglobin A1C
Heart Failure	5 M	Cardiac pressures, weight, BP, fluid status
Hypertension	74 M	Continuous BP, Med compliance
Obesity	80 M	Smart scales, Glucose, Caloric In/out, Activity
Sleep Disorders	40 M	Sleep phases, quality, apnea, vital signs

Aging in Place

The Problem

**95% Seniors Want to Stay
in Their Home**

Falls in 40% seniors

300,000 broken hips/yr

**#1 Cause of Accidental
Death**

The Solution

**PERS-Personal Emergency
Response System**

Motion Sensors

Activity Detection

Video Cameras

Vital Signs

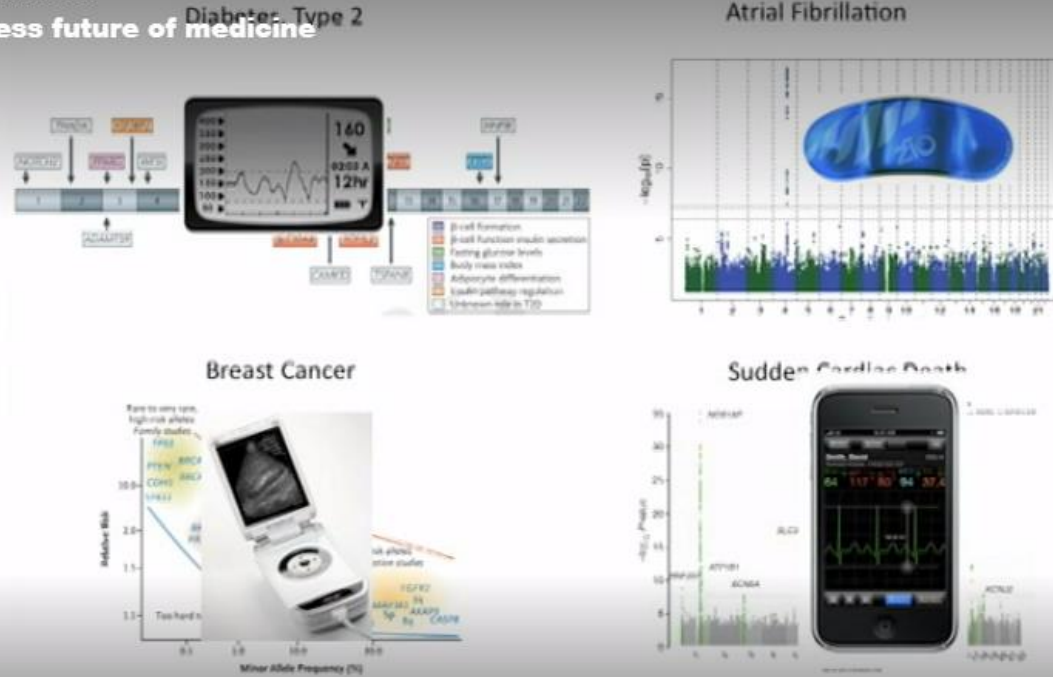
Pill Compliance

iShoe

Impacts

Eric Topol | TEDMED 2009

The wireless future of medicine



future of medicine Impact on Hospital/Clinical Resources

Hospital Beds

Out-Patient Visits

Assisted Living Facilities

Sleep Labs

Holter Monitor

Mammography

Ultrasound/
Echocardiography

Impact on Diseases

Diabetes

Sudden Cardiac Death

Atrial Fibrillation

Hypertension

Breast Cancer

Hip Fractures

Sleep Disorders

Surgery's past, present and robotic future |
Catherine Mohr (10 min)

The TED logo is displayed in a bold, red, sans-serif font. The letters are thick and blocky, with a slight shadow effect that gives them a three-dimensional appearance. The 'T' is the largest, followed by the 'E' and then the 'D'.

Ideas worth spreading

Surgery's past, present and robotic future | Catherine Mohr

- (1980) Laparoscopy – same surgeries through little incisions
 - Difficult to learn and administer – terrible ergonomics
- da Vinci robot adds a ‘wrist’ for improved precision
 - Great innovation – why isn't all surgery being done this way
 - Cost
 - Time-consuming, cumbersome for repositioning, setup, adding ports...
 - Solution – bring all instruments in to one place (single tube)
 - Result – small incision, better precision, quicker recovery
 - Add markers/dies, use special cameras to identify tumors...
 - “Reach it all, see it all, heal the disease, leave the patient whole”



[Robotic Surgery in Upstate New York | Ronald Marsh](#)

[The Rise of Robots in the Operating Room | Dr. Robert Webster III](#)

Robotic Surgery and Robots in the Operating Room

[Robotic Surgery in Upstate New York, Ronald Marsh](#) (2.5 min)



Robotic Surgery and Robots in the Operating Room

[The Rise of Robots in the Operating Room, Dr. Robert Webster III](#) (10.5 min)



Medical

- 5 disruptive healthcare innovations of this moment

- Artificial Intelligence enables accurate diagnostics and personalized medical care
- Indigo light technology keeps medical facilities free from bacteria, fungi and viruses
- Artificial retina restores sight in the visually impaired
- DARPA's brain-controlled prosthetics enable injured war veterans to regain mobility
- Introducing: real-life tricorders* inspired by Star Trek

*In the [Star Trek](#) universe, a **tricorder** is a multifunction hand-held device used for [sensor](#) (environment) scanning, [data analysis](#), and data recording.



Medical

- [The healthcare industry – 6 techniques that will disrupt it](#)
 - Telemedicine and remote care
 - [6 healthcare technologies that will render your family doctor obsolete](#)
 - Surgical and humanoid robots to take care of our health
 - The [Gamification](#) in the healthcare industry
 - 3D printing revolution in healthcare
 - Iron Man: Powered exoskeletons and prosthetics
 - Rise of the cyborg culture

How do you feel about putting your fate in machines when it comes to your health instead of a real-life doctor?

Should Investigators Use DNA Websites to Catch Criminals? (1 min)



Resources

- Videos

- [Printing a human kidney - Anthony Atala – YouTube](#) (subset)
- [Medicine's Future? There's an App for That](#) (older – good)
- [Eythor Bender: Human exoskeletons -- for war and ... - TED Talks](#)
- [Amanda Boxtel: Walking 2.0: Humanizing Machines with Functionality ...](#)
- [TEDxSF - Berkeley Bionics - Merging Technology and the Human ...](#)
- [Catherine Mohr: Surgery's past, present and robotic future | TED Talk](#) (good)
- [Robotic Surgery in Upstate New York | Ronald Marsh | TEDxFMCC ...](#)
- [The Rise of Robots in the Operating Room | Dr. Robert Webster III ...](#)
- [Surgery's past, present and robotic future | Catherine Mohr](#)

[10 TED Talks About Advances in Health Technology](#)

[Add using DNA to track criminals](#)

[Singularity U video \(short\)](#)

Discussion

- Does this 'emerging' technology' have the potential to benefit everyone equally?
- What are its risks and rewards?
- Does it promote autonomy (self-determination) or dependence?