Medical Tech

Technology Trends
CLR Fall 2018
Glen Maxson & Alan Freedman
Medical

Printing a human kidney
Surgeon Anthony Atala demonstrates how a 3D printer can create an organ. Using bioprinting technology, Dr. Anthony Young patient Luque Madera was treated an engineered bladder. 10 years ago, we gave him inpatient. NOT31: This tech was first in 2011, and the first kidney has been created since then. Read "Children & Updates" below for more details.

A test for Parkinson’s with a phone call
Parkinson’s disease affects 6.3 million people worldwide, causing weakness and tremors, but there is no cure. Anthony Atala’s new device can detect Parkinson’s from a cell phone.

Could we cure HIV with lasers?
Tackling AIDS: The most powerful tool for finding cure? A potential answer: Lasers. In this TED talk, Shinya Yamanaka describes the use of lasers to destroy HIV-infected cells.

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, Oren Magen demonstrates how a commercial marker can make tumors stick out in neon green, making surgeons easily see them.

Soon we’ll cure diseases with a cell, not a pill
Current medical treatments, cells down to the level of the cell, have been delivering disappointing results. In this TED talk, Hans Clevers points to a future of medicine that will transform the way we live.

On the virtual dissection bible
Oranges at TSLCC, Japan One demonstrates a powerful tool for teaching medical students. A virtual body multi-touch system of the human body that allows you explore, dissect, and understand the body’s parts and systems.

A test that finds 3x more breast tumors, and why it’s not available to you
Working with a team of physicians, Dr. Deborah Rhode reveals a new test for breast tumors that’s three times as effective as the current mammography for women with dense breast tissue. The life-saving implications are stunning, so why hasn’t the test been approved? Dr. Rhode shares the story behind the test’s creation, and the role of politics and economics that keeps it from mainstream use.

Ultrasound surgery — healing without cuts
Maybe having surgery with no knives involved. At TEDMED, Yael Mezula shares her work on using ultrasound to heal cuts and wounds. The only tool required is a loudspeaker.

Medicine’s future? There’s an app for that
Don’t we all have a smartphone? This TED talk offers a fascinating look at the next two years of innovation in medicine powered by new tools and apps that are bringing diagnosis information right to the patient’s bedside.

Dexam A needle-free vaccine patch that’s safer and more cheaper
One hundred years after the discovery of the needle and syringe, we’re still using them to deliver vaccines. It’s time to evolve. Designer engineer Mark Kendall presents Synoma, a needle-free, non-surgical vaccine delivery system that can be applied painlessly to the skin. He shows how this tiny peel-off system can overcome fear and phobia by making vaccines less painful.

Synthetic voices, as unique as fingerprints
Many of the voices we hear around us are computer-generated. This TED talk challenges us to think about how we can use the voice to distinguish the unique voice of the individual.

A bold new way to fund drug research
Being told not to invest in 10 billion part of potentially life-saving drugs is absurd. Ideas like this are in their experimental phase. But because they aren’t yet approved for sale, the financial risk is too high. This talk is a finance guru, and he thinks maybe about sourcing the investment to the people, who actually love the idea, in a more direct way. His 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)
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
## Targets for Wireless Medicine

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

<table>
<thead>
<tr>
<th>The Problem</th>
<th>The Solution</th>
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<tbody>
<tr>
<td>95% Seniors Want to Stay in Their Home</td>
<td>PERS-Personal Emergency Response System</td>
</tr>
<tr>
<td>Falls in 40% seniors</td>
<td>Motion Sensors</td>
</tr>
<tr>
<td>300,000 broken hips/yr</td>
<td>Activity Detection</td>
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<tr>
<td>#1 Cause of Accidental Death</td>
<td>Video Cameras</td>
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<tr>
<td></td>
<td>Vital Signs</td>
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<tr>
<td></td>
<td>Pill Compliance</td>
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<td></td>
<td>iShoe</td>
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Impacts

<table>
<thead>
<tr>
<th>Impact on Hospital/Clinical Resources</th>
<th>Impact on Diseases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hospital Beds</td>
<td>Diabetes</td>
</tr>
<tr>
<td>Out-Patient Visits</td>
<td>Sudden Cardiac Death</td>
</tr>
<tr>
<td>Assisted Living Facilities</td>
<td>Atrial Fibrillation</td>
</tr>
<tr>
<td>Sleep Labs</td>
<td>Hypertension</td>
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<tr>
<td>Holter Monitor</td>
<td>Breast Cancer</td>
</tr>
<tr>
<td>Mammography</td>
<td>Hip Fractures</td>
</tr>
<tr>
<td>Ultrasound/Echocardiography</td>
<td>Sleep Disorders</td>
</tr>
</tbody>
</table>
Surgery’s past, present and robotic future | Catherine Mohr (10 min)
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)
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?