



**Federal Aviation
Administration**

New Medical Technology & Consequences for Aeromedical Screening

Presented at: ECAM 2018

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Date: September 2018



Personal Biomedical Devices

*Induced Pluripotent Stem Cells
&
Regenerative Medicine*

Body-Worn Medical Sensors & Body Networks

*Genomics, Gene Therapy,
Microbiomics*

Neurotechnology

Nanomedicine

Medical Robotics

Artificial Tissues & Organs

The Weak Link is the Human Being



Practical Implications for Flight Crews





Flight crews are directly responsible for the safety of flight operations, and the main challenge for aerospace medicine practitioners is to ensure the medical fitness and performance readiness of generally “normal” individuals who work in “abnormal” aerospace environments

Clinical Aerospace Medicine & Medical Certification/Clearance Issues



- Clinical aerospace medicine issues impacting health monitoring, prevention, screening, diagnosis, treatment and rehabilitation
- Most medical personnel around the world are not likely to be very familiar with these advanced medical technologies
- Aerospace medical certification/licensing issues (fitness for flight) - Advanced medical technologies have an impact on the medical clearance of airline/spaceline crews and their flight careers
- Flight crews are a highly mobile population who can travel to other countries where advanced medical technologies may be readily available to patients while in the US are not approved by the FDA



Human-Machine-Environment Interactions





The traditional approach to understand the complex interactions between humans, machines and environment is evolving fast with the implementation of advanced medical technologies that can blur the differences between purely human and purely machine, and where the human body even has the potential to be modified to tolerate different types of environments



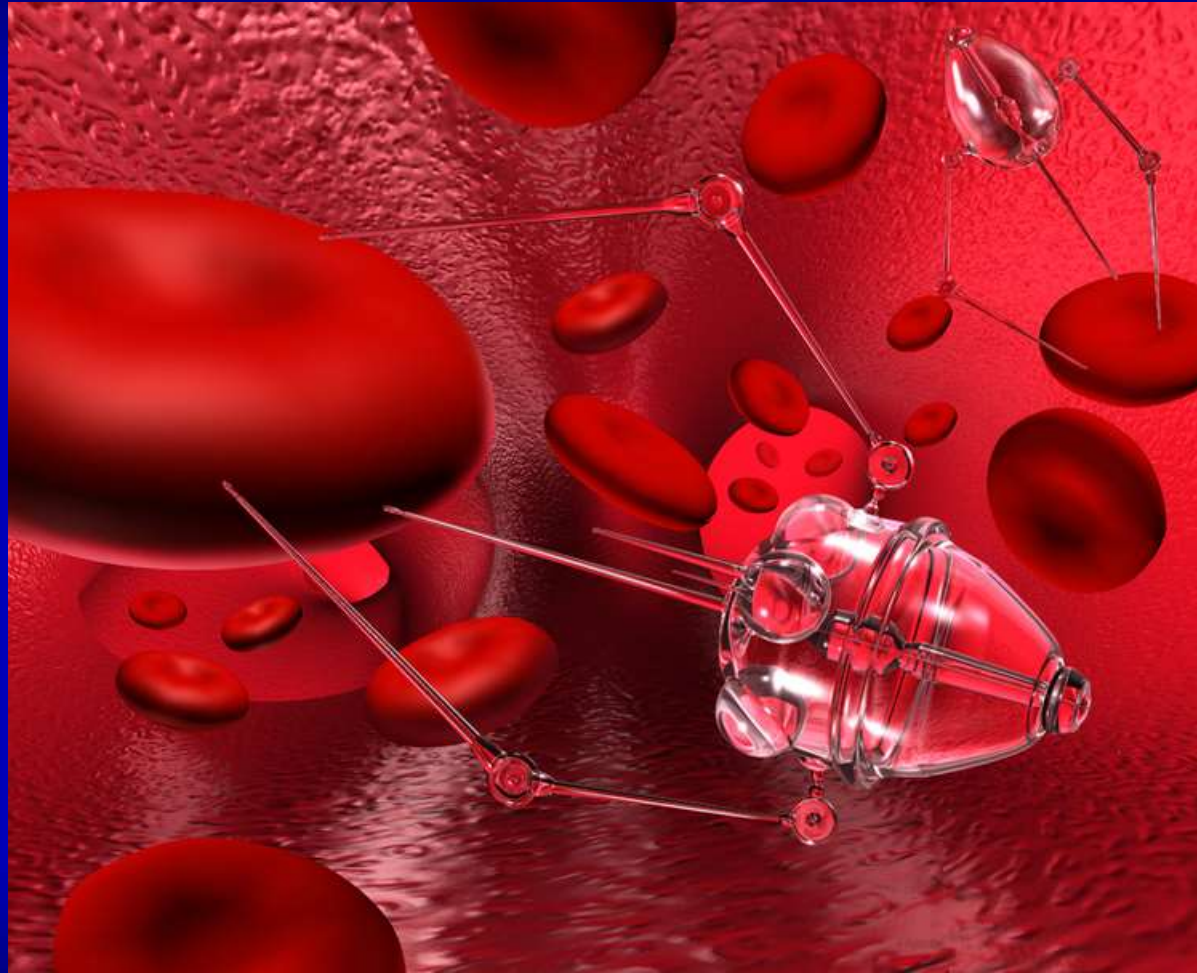
Aerospace Human Factors Considerations Relevant to the Operational Performance of Flight Crews





Some advanced medical technologies are intended to restore normal functions to individuals, but they also have the potential to increase human performance capabilities beyond the range of what is considered normal, or even provide new capabilities that humans do not or cannot possess naturally

Nanomedicine



ClinicalTrials.gov
US National Institutes of Health
185 Studies on Nanomedicine



Current Fields of Coverage and Convergence with Nanomedicine

Biotechnology

Genomics

Gene Therapy

Cell Biology

Stem Cells

Cloning

Prosthetics

Cybernetics

Neural Medicine

Dentistry

Cryonics

Biosensors

Biological Warfare

Diagnostics

Drug Delivery

Cellular Reprogramming

Genetic Engineering

Human Enhancement

Imaging Techniques

Skin Care

Anti-Aging



Examples of Nanomedice Applications

Cancer Diagnosis & Treatment

Chemotherapy

Vaccine Delivery

Antibiotic Delivery

Tissue Healing

Microorganism Detection

Parasite Detection

Nano Artificial Nose for Cancer Detection



Israel Institute of Technology developed a new artificial sniffer called the NA-NOSE—short for Nanoscale Artificial NOSE—which runs software capable of detecting molecule patterns found in the breaths of people with head, neck and lung cancer

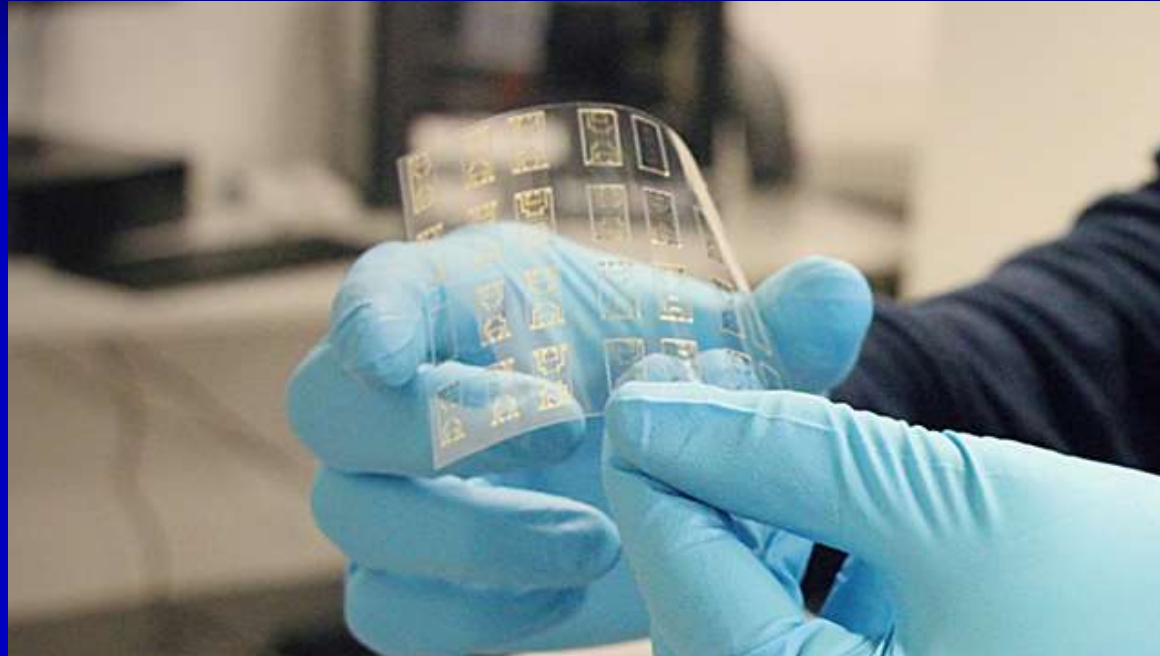
Nanoprobe to Detect Disease Biomarkers in Breath



Stony Brook University is developing a nanoprobe for detecting disease biomarkers in breath

The nanoprobe based technology is currently able to detect acetone, but should be modifiable to detect other compounds

Nanoprobe to Detect Levels of Plasma Glucose in Breath

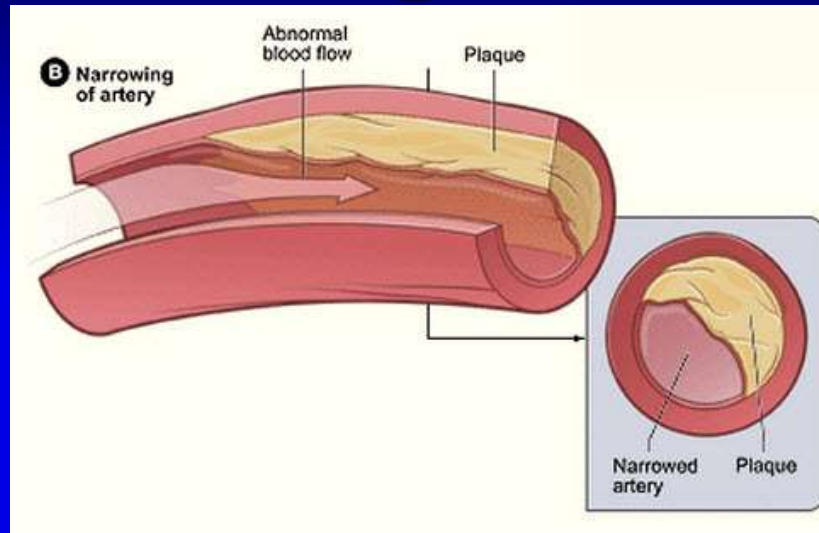


Applied Nanodetectors Ltd. (Middlesex, UK) and the Centre for Process Innovation in the UK are developing a breathalyzer to estimate the levels of glucose in the plasma

Nanoparticles to Diagnose Ebola, Dengue and Fellow Fever



Nanoparticles to Improve Detection of Atherosclerosis Plaques Using MRI



A team of researchers led by scientists at Case Western Reserve University has developed a multifunctional nanoparticle that enables magnetic resonance imaging (MRI) to pinpoint blood vessel plaques caused by atherosclerosis

A nanoparticle built from the rod-shaped tobacco mosaic virus, commonly found on tobacco, locates and illuminates plaque in arteries more effectively and with a tiny fraction of the dye

Postmortem Screening Issues

Non-FDA approved drug delivery nano devices are being used in some countries

FDA approved drug delivery nano devices are being used in the US in clinical trials

What forensic screening methods can be used to look for postmortem evidence of medical nano devices?

What forensic screening methods can be used to look for postmortem evidence of toxicity of medical nano devices?

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"If you increase the magnification another million times you can see the safety regulations."

Genomics



ClinicalTrials.gov
US National Institutes of Health
536 Studies on Genomics

Genome vs Exome

The human genome comprises a sequence of approximately 3 billion nucleotides organized into DNA molecules

The human genome is carried on 23 different chromosomes

Most of the human genome does not contain genes

The parts of the genome that contain genes (20 to 25,000) are called the “exome”

The exome makes up about 1.5% of the genome, and gives the instructions to make all the proteins in the body

© CG4TV.COM



Oxford Nanopore has built the “MinION” a disposable DNA sequencer that's the size of a thumb drive, and powered by a USB port

Capable of sequencing 150 million nucleotides in six hours, and uses the computer's own CPU to perform the analysis

DNA Sequencer for Bacterial Screening



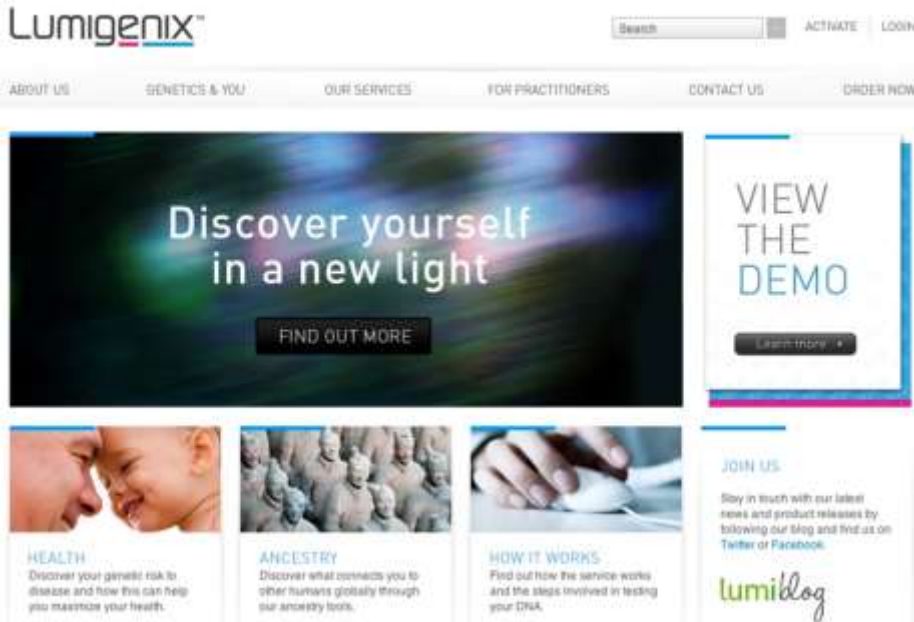
Researchers in Canada and the U.K. have sequenced and assembled from the ground up the full genome of *Escherichia Coli* using Oxford Nanopore's MinION device

DNA Sequencer for Screening of Bacterial Urinary Infections



MinION enables rapid point-of-care bacterial characterization from urine samples four times faster than conventional laboratory culturing methods, as well as detection of antibiotic resistance

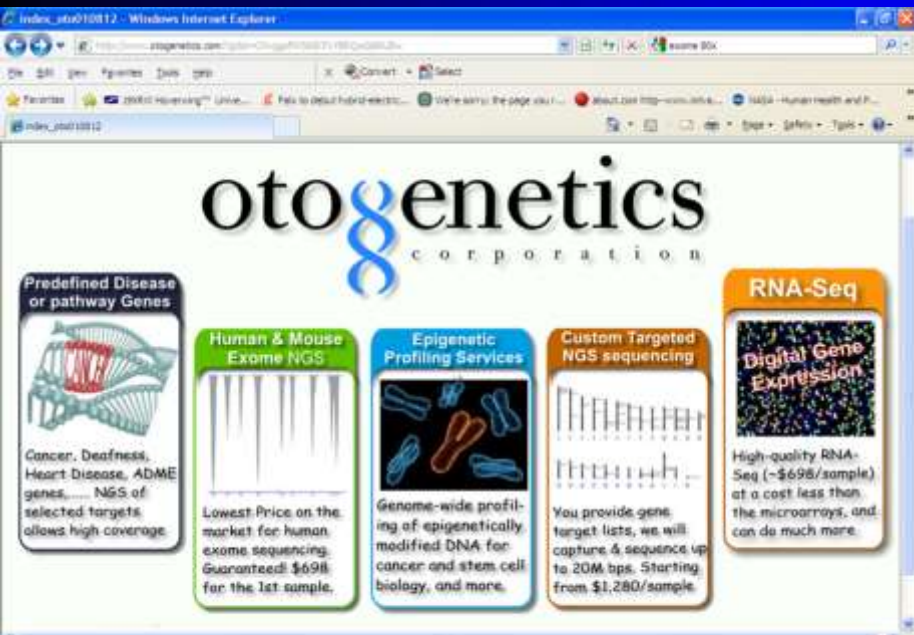
Researchers from the University of East Anglia found that the device detected and provided the DNA sequence of bacteria in heavily infected urine within 12 hours



Human Genetic Screening



Many companies analyze and report different genetic variants to health conditions, traits, and ancestry



Food Intolerance Screening

The screenshot shows a web browser window with the URL <https://allergytest.co/what-you-need-to-know/abo>. The browser's address bar and tabs are visible at the top. The website's navigation bar includes links for [Download Submission Form](#), [Become a Partner](#), [FAQs](#), [My Account](#), [Log In](#), and [0 Items](#). The main header features the Allergy Test logo with the tagline "IMPROVING LIVES SINCE 2008" and a navigation menu with [Our Tests 3](#), [About Us 3](#), [Allergy Info 3](#), and [Case Studies](#). Two prominent buttons, "LET'S CHAT!" and "ORDER NOW", are located in the top right. The main content area is divided into two columns. The left column describes the comprehensive, non-invasive testing process, while the right column lists the five areas covered by the one-step test. Below this, three circular icons represent specific tests: Intolerance Test, Nutritional Test, and Metal Toxicity Test, each with a brief description. A "24hrs LIVE CHAT!" bubble is positioned in the bottom right corner, with a "Chat now" button below it.

info@allergytest.co Download Submission Form Become a Partner FAQs My Account Log In 0 Items

Have a question? Our [FAQs](#) should be able to answer, or you can chat to us... [LET'S CHAT!](#)

[Our Tests 3](#) [About Us 3](#) [Allergy Info 3](#) [Case Studies](#) [ORDER NOW](#)

We have developed the most comprehensive, non-invasive tests available in the world. Using the latest bio-technology, our safe and speedy procedure uses a sample of your hair which we test to get accurate results for you.

We only need one sample of your hair and using our extensive systems, we will email the results to you within just 10 working days. Your test results will include all items which have shown an intolerance of 85% and over. After performing thousands of tests, we have found 85% to be the point at which symptoms begin to develop from an intolerance.

Our innovative one-step test enables us to produce a comprehensive report, divided into five areas:

- Introduction to your results explaining exactly what you need to do
- The items that appear on your results
- Where the items are found (i.e. where a particular tree originates, or what product contains the chemical)
- The nutrients your body is lacking (optional)
- Guidance on your individual results.

Intolerance Test
Our most popular test. Your hair sample is tested against 600 different food and non-food items. Items scoring 85%+ are flagged as a potential source of intolerances.

Nutritional Test
Now includes a **free** nutritional guide. Our test identifies key nutrients potentially missing from your diet. We can currently identify up to 80 nutrients.

Metal Toxicity Test
A hair sample is tested against 24 unique metals. Metals can be ingested or absorbed by the body and are typically overseen as potential catalysts.

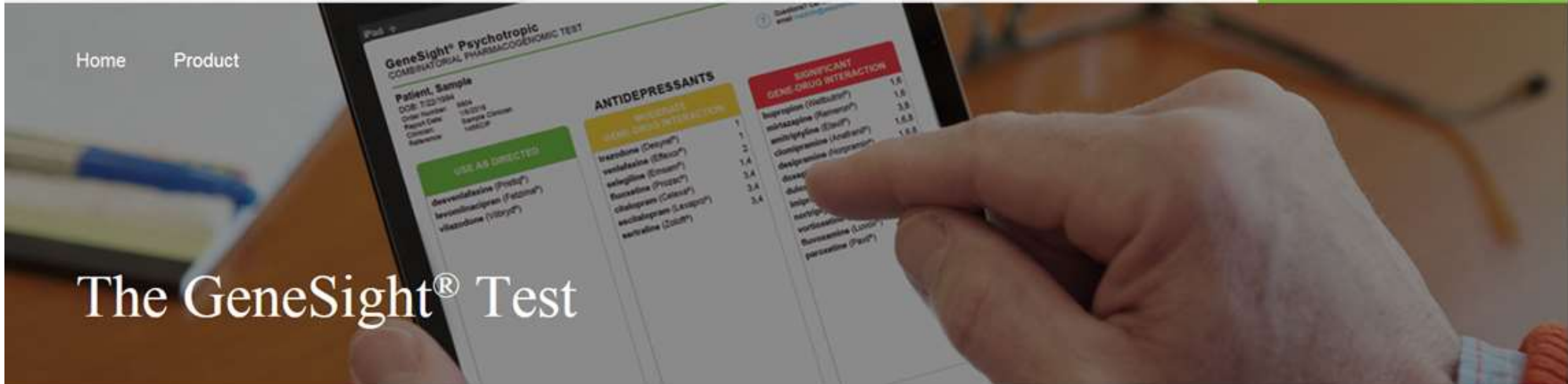
24hrs LIVE CHAT!
Can we help?
[Chat now](#)

Pharmacogenomics

Analyses how genetic makeup affects an individual's response to drugs

Determines the influence of genetic variation on drug response in patients

Provides a tool to optimize drug therapy, with respect to the patients' genotype, to ensure maximum efficacy with minimal adverse effects



Precision medicine. Personal wellness.

Stop wondering which medication is right for you and start on your road to recovery. Treating mental health disorders can often be a long, frustrating process as you and your doctor spend months trying multiple medications for depression and other conditions at different doses to find the medication that works for you. During this time you could end up missing work, paying for multiple doctor visits, or losing hope that you'll ever find a medication that can help you. There's a better way.

U.S. Veterans Administration Large Randomized Trial to Assess GeneSight Test in Depression

\$12 million with 2,000 veterans from 250 healthcare providers across 21 VA medical centers

Around 20% of the 2.6 million veterans deployed to Iraq or Afghanistan experience major depressive disorder or and associated mental health condition.

The purpose of the study is to assess the use of GeneSight for a more effective treatment of depression – The study will end in 2021



The **Spartan RX** is the first sample-to-result one point-of-care FDA Approved DNA testing system that looks for a CYP2C19 mutation that can impair drug metabolism

15% of all prescribed drugs are metabolized by CYP2C19 enzymes, including anti-platelet drugs, anti-depressants and proton pump inhibitors

The CYP2C19 test kit identifies carriers of the CYP2C19 *2 allele

CYP2C19 gene variant is present in 30% of Caucasians, 50% of Asians, and 55% of East Indians, who have enzymes that are unable to activate Plavix

*2 allele carriers have a 42% higher risk of death, stroke, or second heart attack after cardiac stenting and starting Plavix®

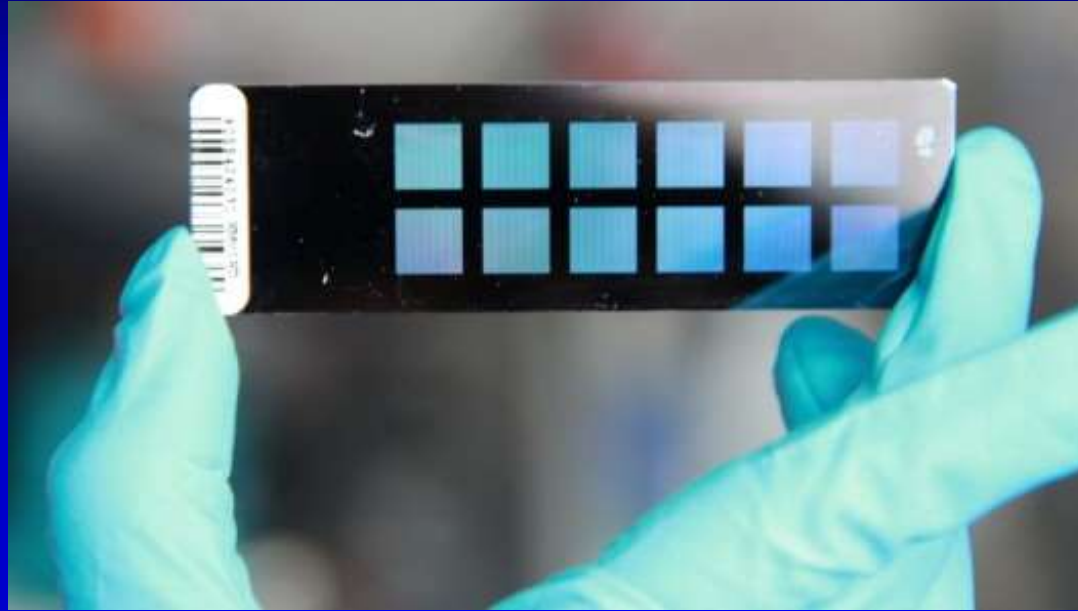
For *2 allele carriers, 40%–50% of Major Adverse Cardiac Events (MACE) occur within the first 24–48 hours

Genome Wide Association Study (GWAS)

Reported evidence for increased arrhythmic Sudden Cardiac Death risk in the setting of CAD due to genetic variation in:

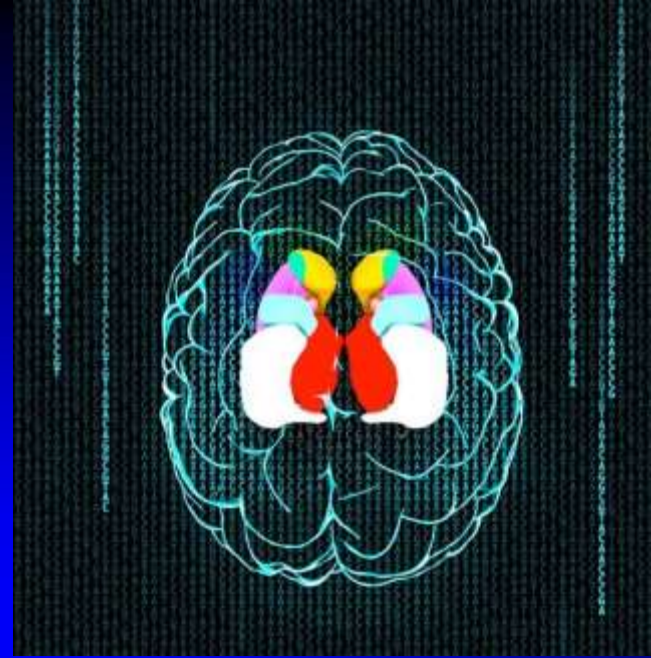
- *Six genes without prior evidence of cardiovascular effect (ACYP2, ZNF385B, GRIA1, AP1G2, DEGS2, KCTD1)*
- *Other genes with strong prior evidence of arrhythmic and/or cardiovascular effects (ESR1, CACNA1C, NOS3, NOS1AP, CSMD2, AGTR1, KCNQ1, KCNE1)*

Biomarkers for Suicide Risk Screening



The Max Planck Institute of Psychiatry in Munich has discovered 79 biomarkers that can help doctors predict risk of suicide in patients on antidepressants

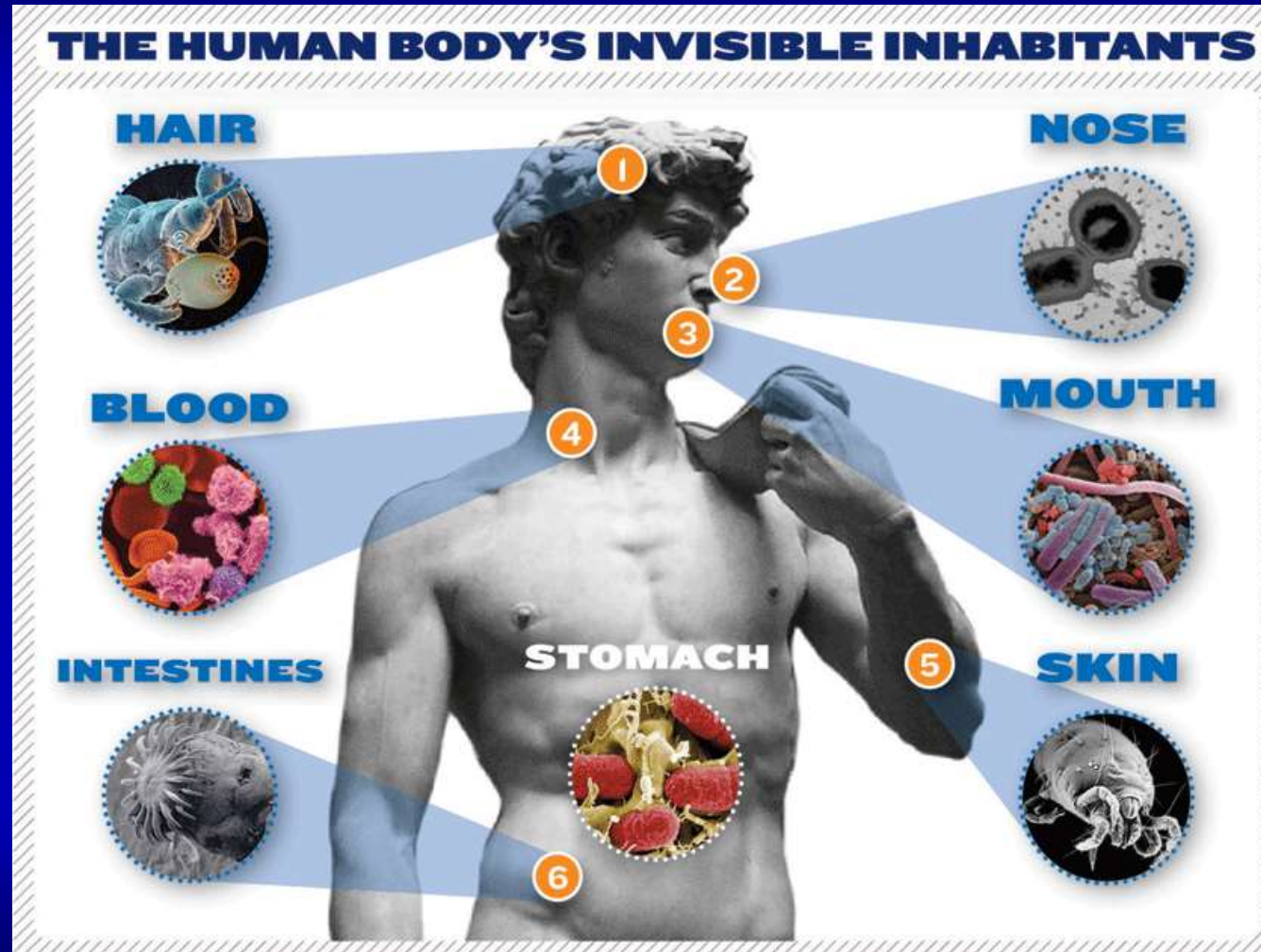
Genetic Mutations & Brain Aging



Global ENIGMA Consortium that involves about 300 researchers from 190 institutions identified 8 common genetic mutations that appear to age the brain an average of 3 years

The discovery could lead to targeted therapies and interventions for Alzheimer's disease, autism, and other neurological conditions

Microbiomics



The Importance of the **MICROBIOME** by the Numbers



90%

Up to 90% of all disease can be traced in some way back to the gut and health of the microbiome

>10,000

Number of different microbe species researchers have identified living in the human body

100 to 1

The genes in our microbiome outnumber the genes in our genome by about 100 to 1

3.3 million

Number of non-redundant genes in the human gut microbiome

99.9%

Percentage individual humans are identical to one another in terms of host genome

10-100 trillion

Number of symbiotic microbial cells harbored by each person, primarily bacteria in the gut, that make up the human microbiota

10X

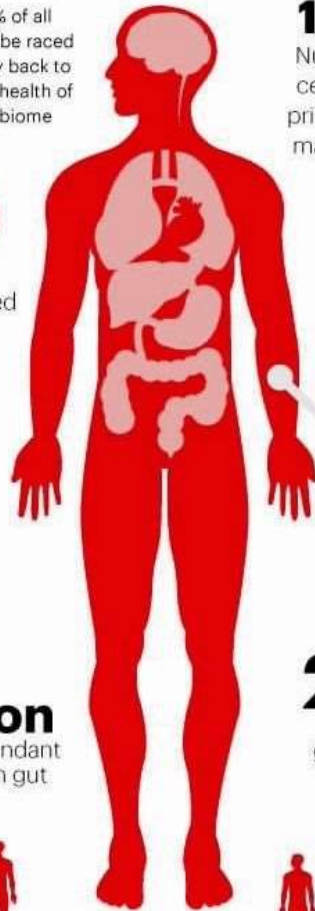
There are 10 times as many outside organisms as there are human cells in the human body

22,000

Approximate number genes in the human gene catalog

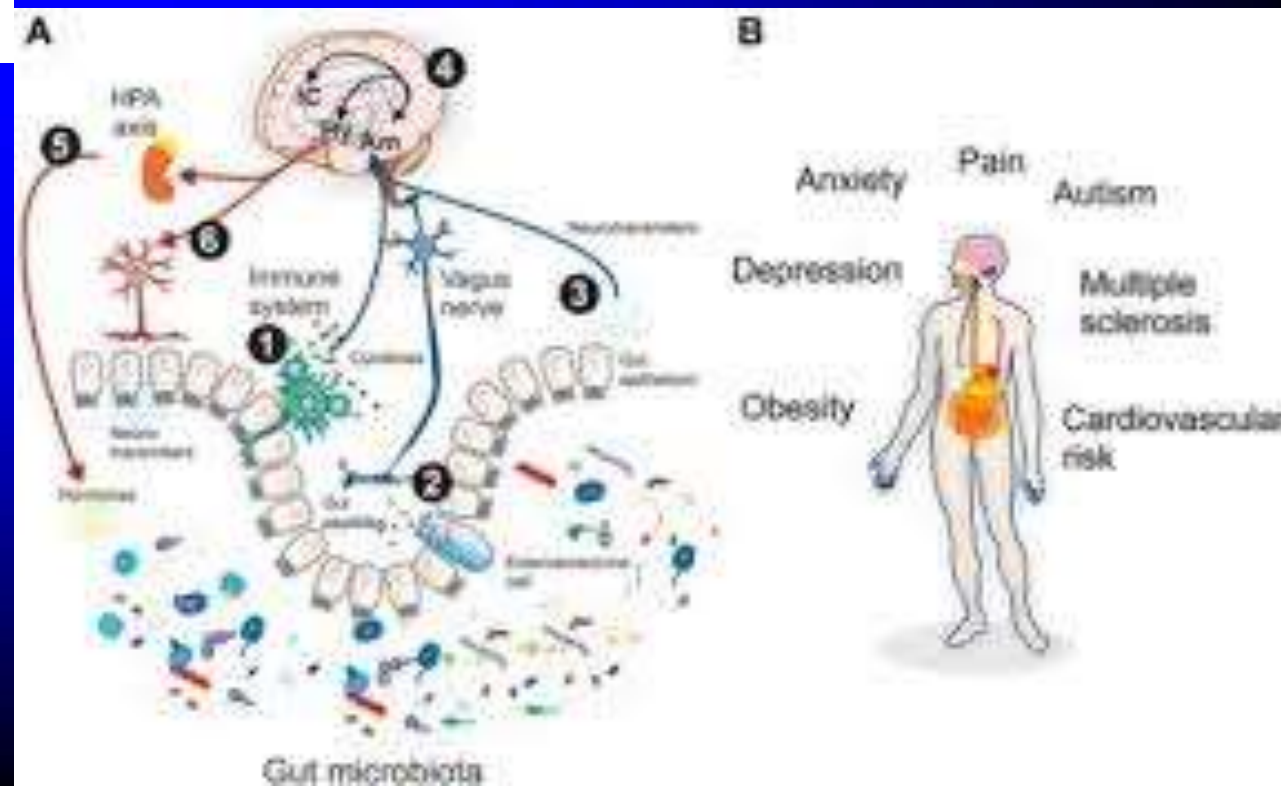
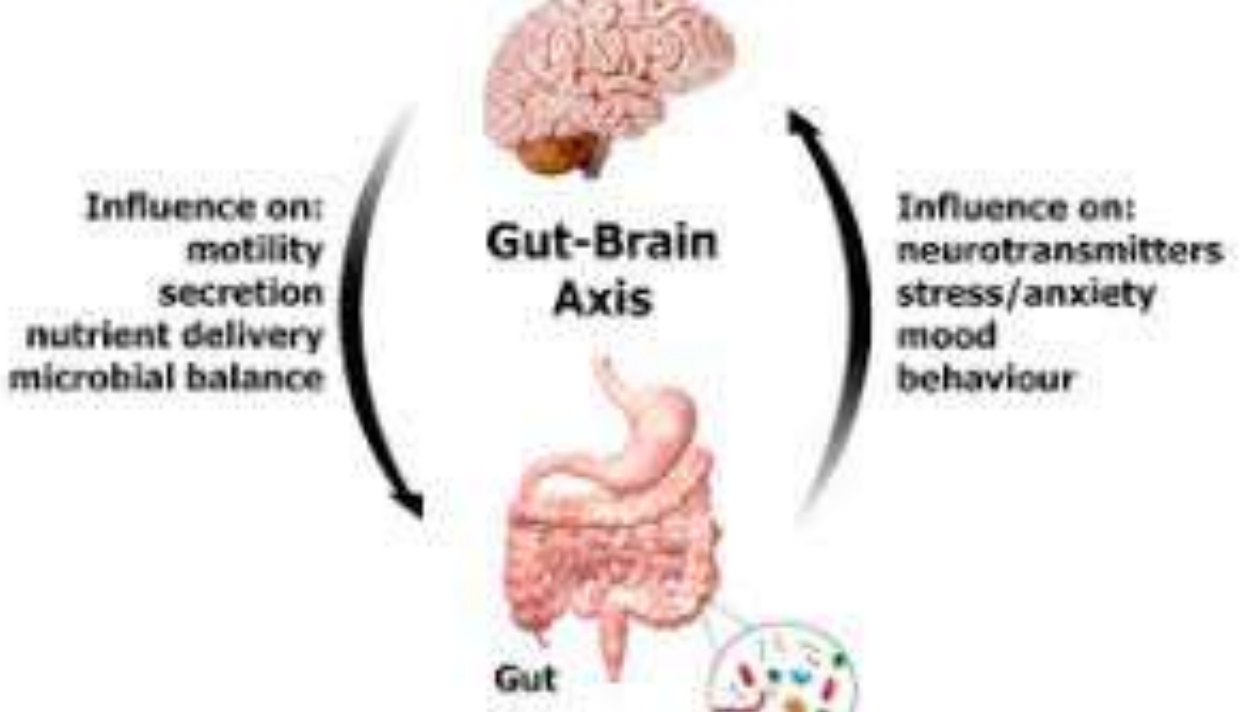
80%-90%

Percentage individual humans are different from one another in terms of the microbiome



How The Gut Affects The Entire Body





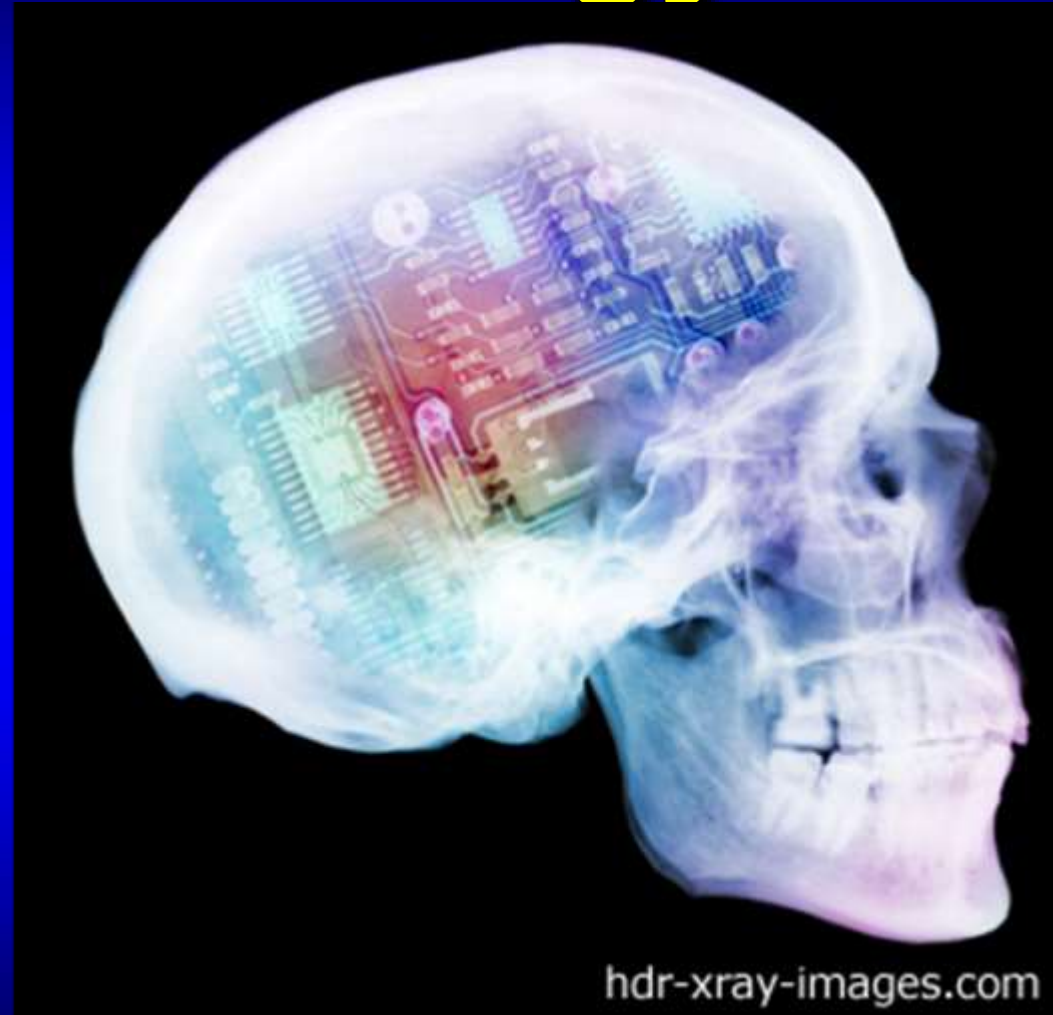
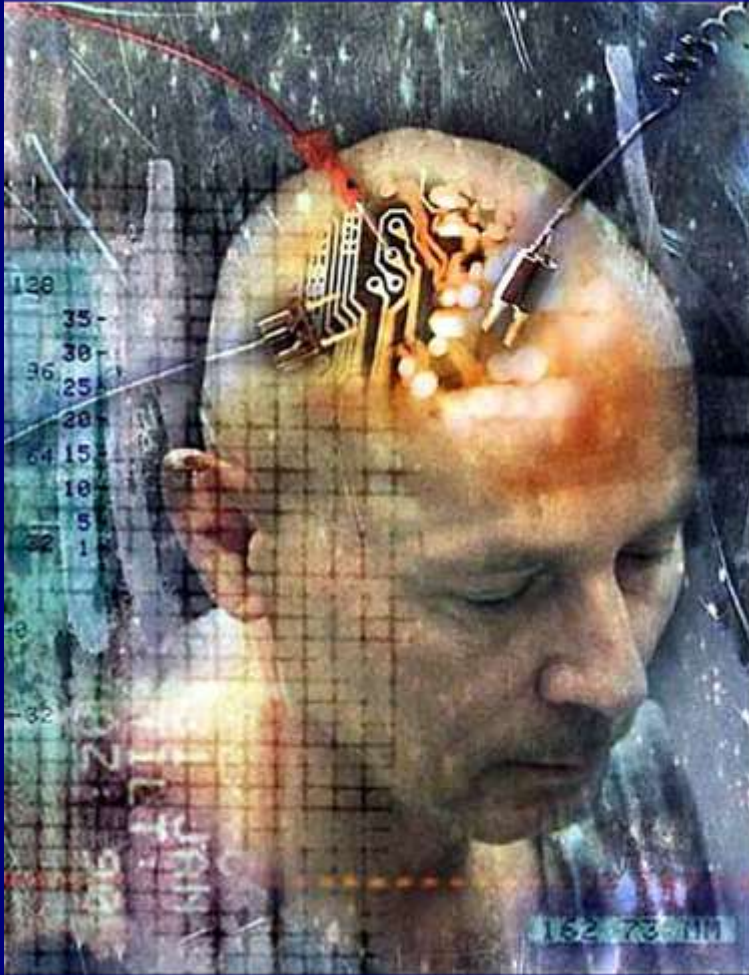
ClinicalTrials.gov
US National Institutes of Health
584 Studies on Microbiome



NASA Twins Study

- The microbiome plays an important role in regulating many physiological and pathological processes in the human body
- NASA is currently sponsoring the “Study of the Impact of Long-Term Space Travel on the Astronaut’s Microbiome.” The goal of this study is to determine how the composition of the human microbiome is altered during long-term space exploration and to evaluate its potential impact on space crew health

Neurotechnology





Researchers at **HRL Laboratories**, a Malibu, CA firm, have shown that their novel transcranial direct current stimulation system successfully helped novice pilots improve their flying skills

Expert pilots well versed in tasks that were to be taught to the fresh aviators had their brain activity recorded during flying exercises

Low Cost EEG System for Neuro-Feedback



A working prototype of a low-cost EEG (less than \$30) device funded by the US Defense Advanced Research Projects Agency (DARPA) is the first step in the agency's effort to jumpstart a do-it-yourself revolution in neuroscience

Brainflight Project



Scientists at the Institute for Flight System Dynamics at Technische Universität München (TUM) and Technische Universität Berlin (TU Berlin) are involved in the EU-funded Brainflight project

The goal of project BRAINFLIGHT is to investigate what are the best approaches and parameters that allow fast learning to control an aircraft using brain signals, while allowing pilots to multitask



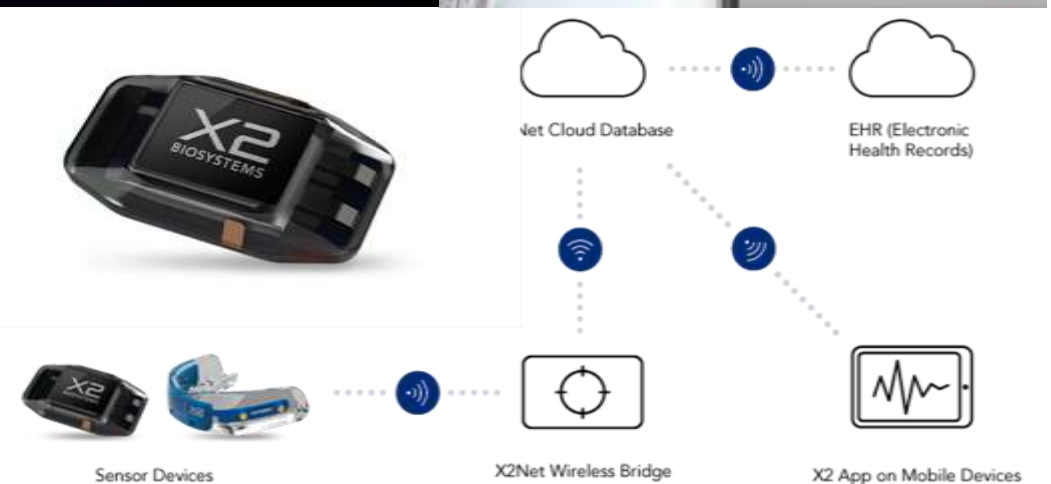
BRAIN CONCUSSION MONITORS



brainBAND



CheckLight



BRAIN CONCUSSION MONITOR



Brightlamp, a startup out of Purdue University, is developing an app that uses machine learning and the smartphone camera to help diagnose a concussion in about five seconds

INTRACREANEAL PRESSURE MONITOR



Third Eye Diagnostics out of Bethlehem, PA has been developing a promising device called Cerepress that measures central retinal venous pressure (CRVP) and how fast blood is flowing through the ophthalmic artery, which together correlate well with intracranial pressure



INTRACREANEAL HEMATOMA DETECTOR

Infrscan has received FDA approval for its Infrascanner 2000, a device for detecting intracranial hematomas

The Infrascanner is an easy-to-use screening tool which can be used to identify high-risk patients which should undergo further work-up including CT

Scanning a patient with the device takes about 2-3 minutes

It can detect hematomas greater than 3.5 cc in volume and up to 2.5 cm deep from the surface of the brain (or 3.5 cm from the skin surface)

INTRACREANEAL HEMATOMA DETECTOR

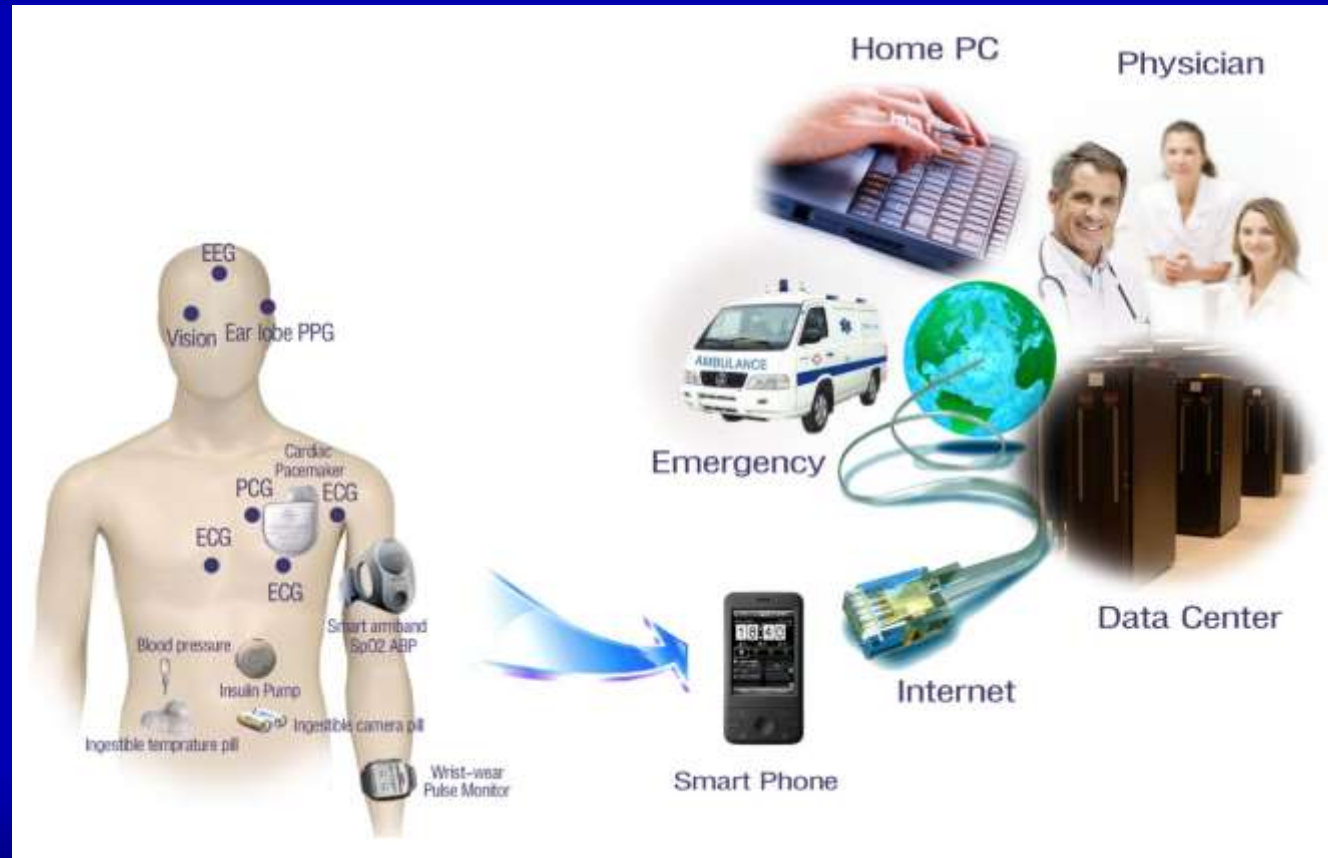


Infrscan received FDA approval of its Infrascanner Model 1000 device for detecting intracranial hematomas

The device uses near infrared light to penetrate the skull and detect intracranial blood collections

By testing different regions on the skull, ER docs can quickly decide whether a follow up CT scan is needed

Body-Worn Medical Sensors & Body Networks for Biomedical Screening



Fitness Monitoring Systems

Sensoria Smart Socks



Fit Core



Airo



Vivofit



Primo 3



iRiver Earbuds



Angel Sensor



Shine



FitBit Ultra, FitBit Flex and FitBit Pro



Fitbit Charge HR and Fitbit Surge



Echo Fit



Larklife

Fitness Monitoring Systems



Jawbone UP™

Withings



Withings Activité



Fitness + Oxymetry Monitoring Systems

Oxitone



FreeWavz



Basis



Smart Contact Lenses



Applications include:

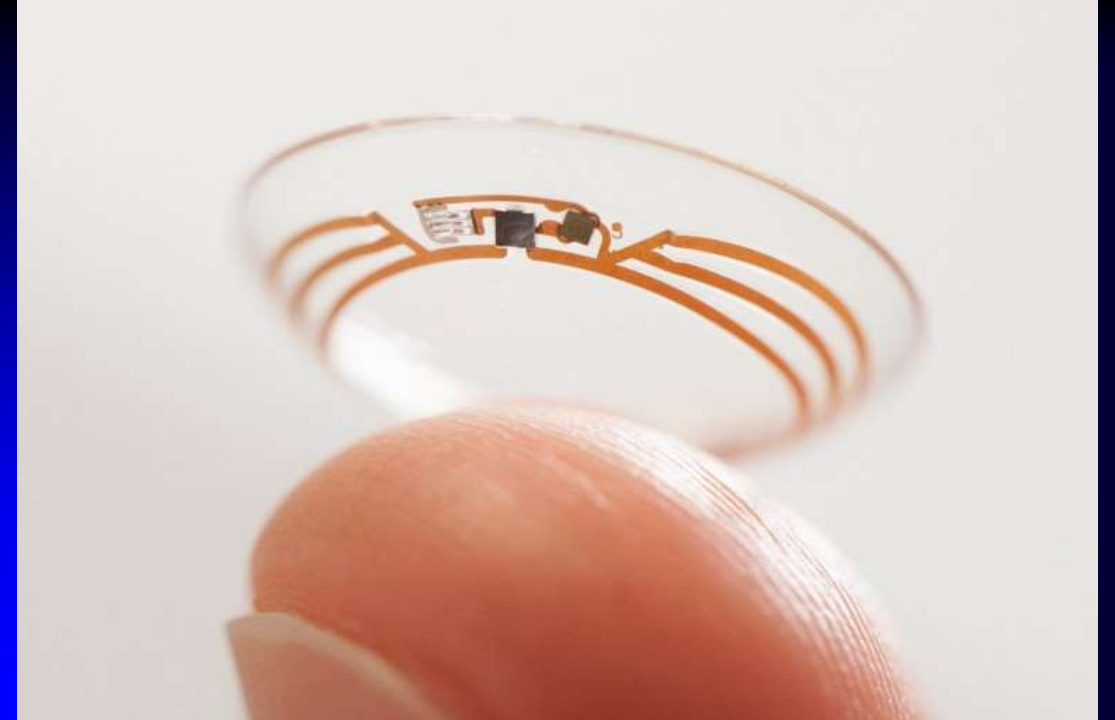
- Zooming in on distant objects
- Get useful facts to pop up in the field of view
- Create virtual cross-hairs
- Holographic driving panels surfing the Web
- Visual aids for vision-impaired people



Smart Contact Lenses to Monitor Intraocular Pressure

The **Sensimed** Triggerfish is a smart contact lens capable of continuous measurement of intra-ocular pressure throughout the day and is currently in clinical trials

Smart Contact Lenses for Glucose Monitoring



Google developed a wireless chip and miniaturized glucose sensor, embedding them between two layers of soft contact lens material

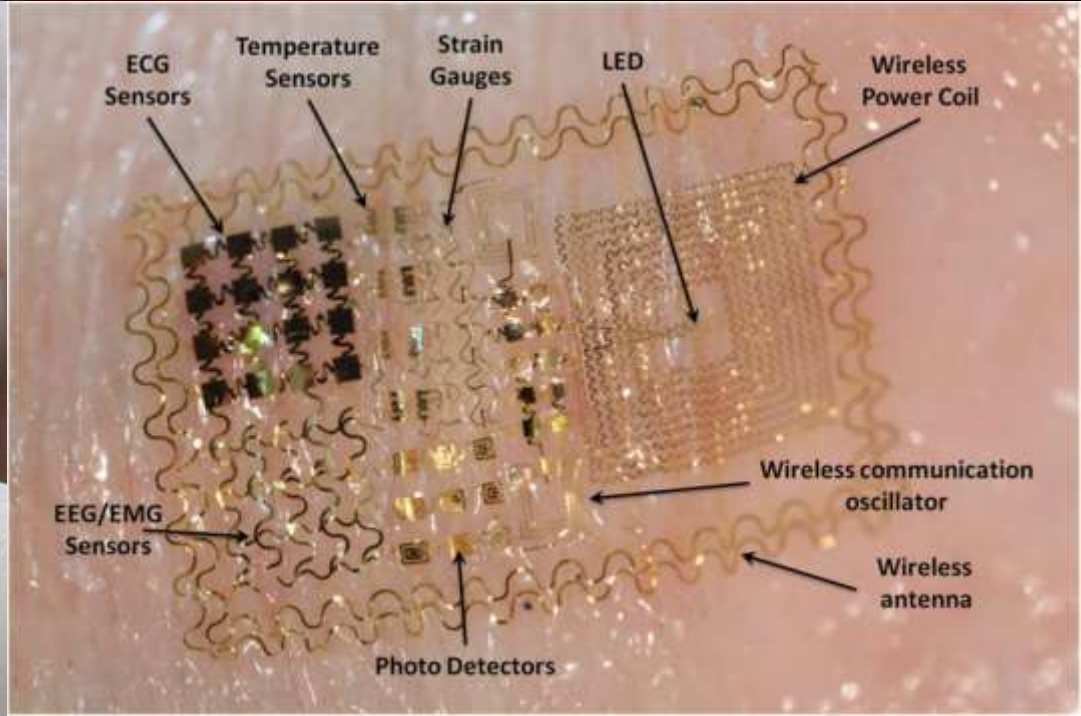
This formed a prototype of a smart contact lens capable of generating one reading of glucose levels per second

Smart Contact Lenses for Drug Delivery

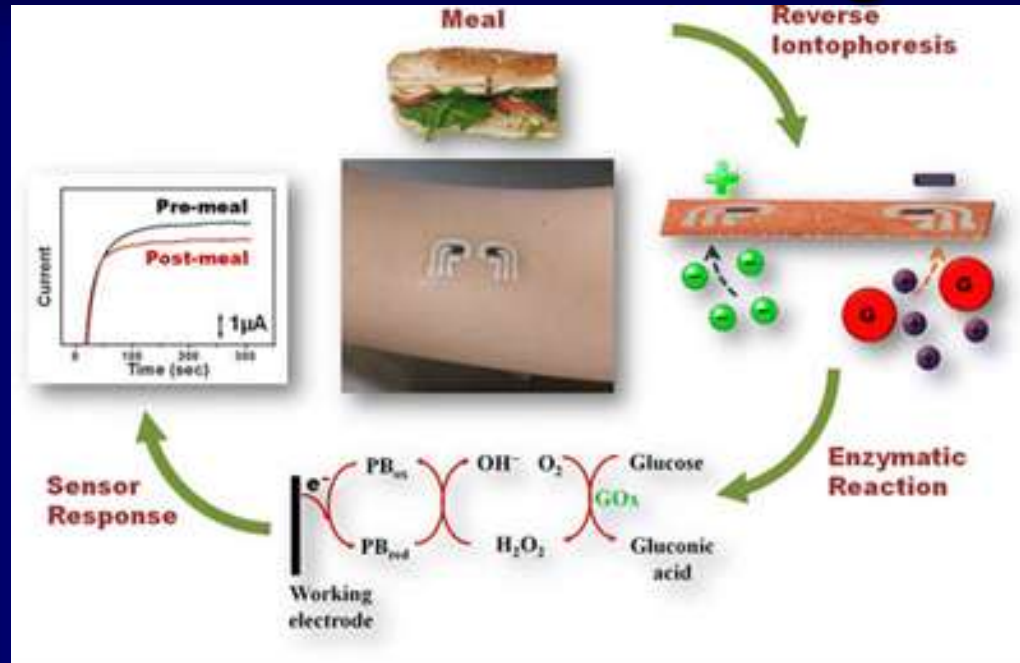


Massachusetts Eye and Ear Institute developed new drug dispensing contact lenses containing encapsulated latanoprost-polymer films that achieve concentrations in the aqueous humor, comparable with daily eye drops

Electronic Skin Patches



Glucose Sensing Skin Patch

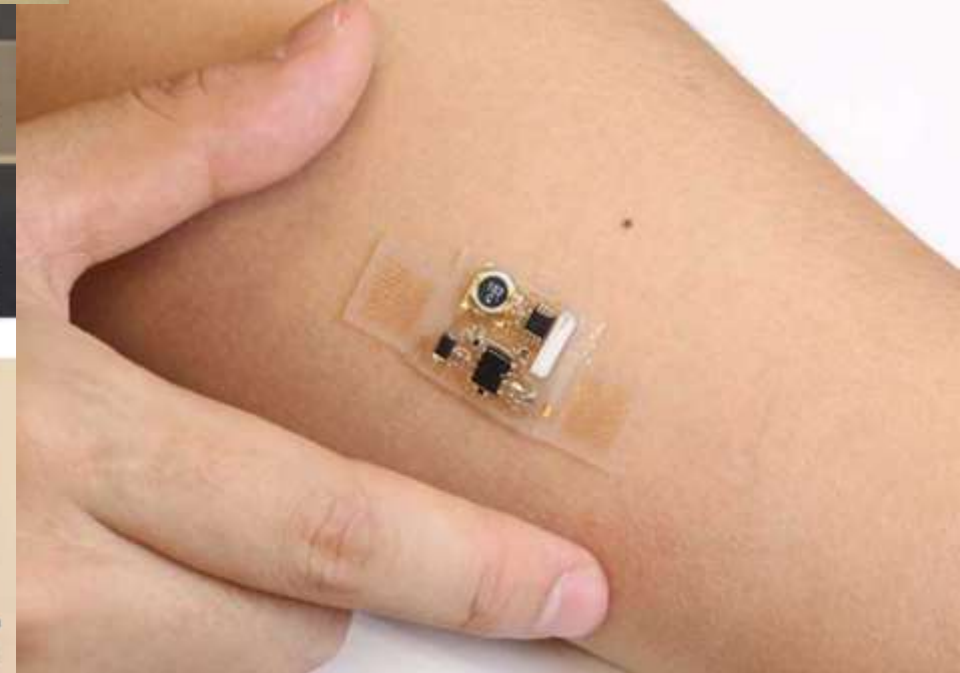
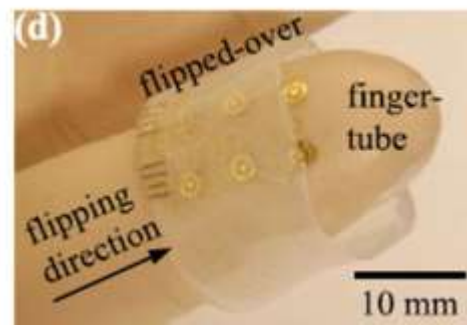
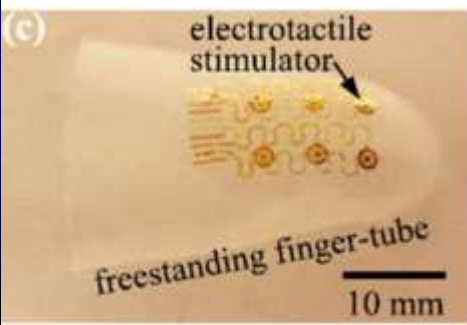
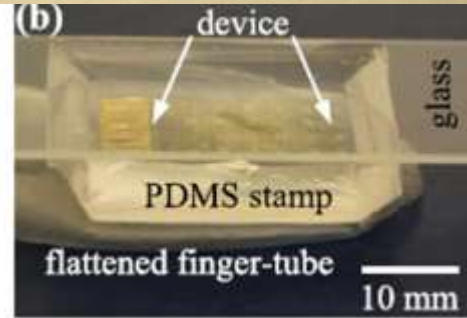
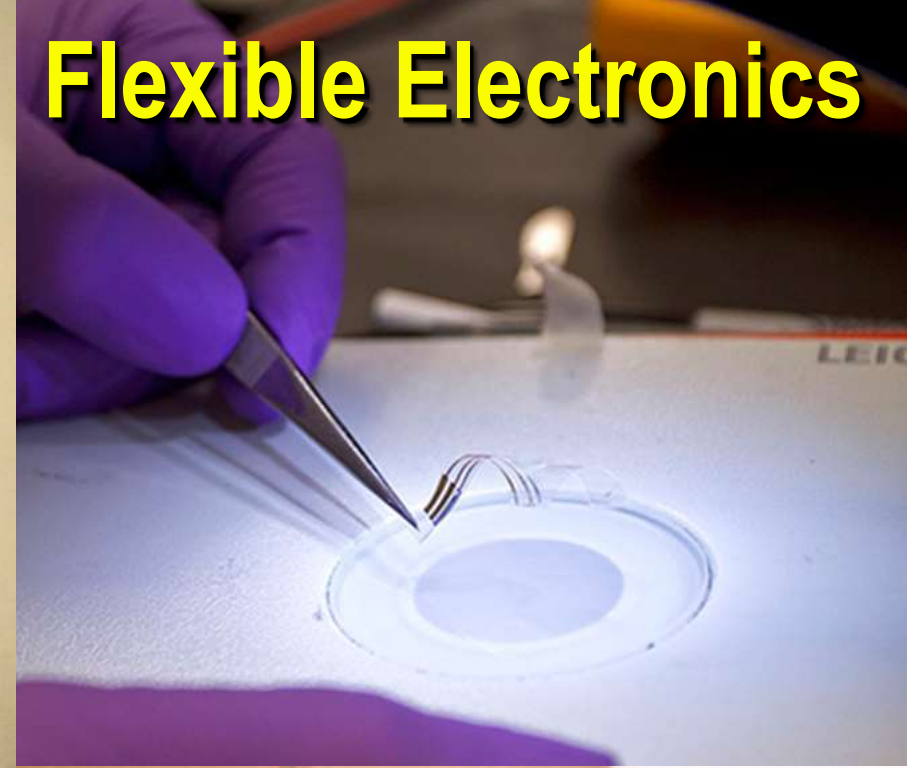
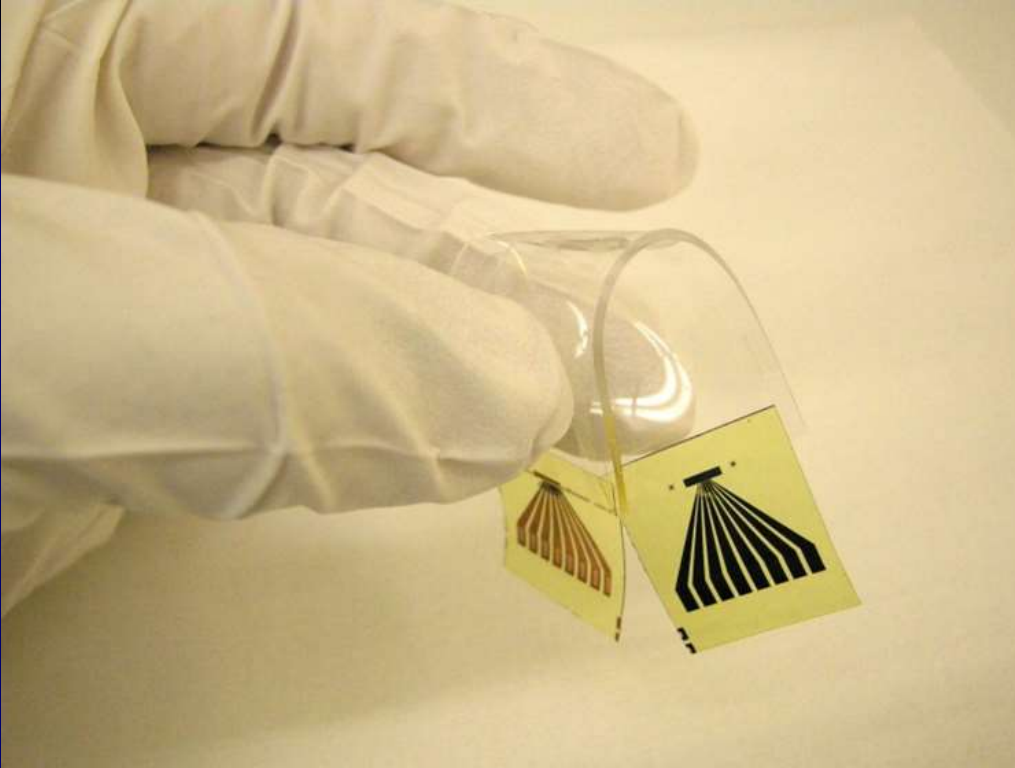


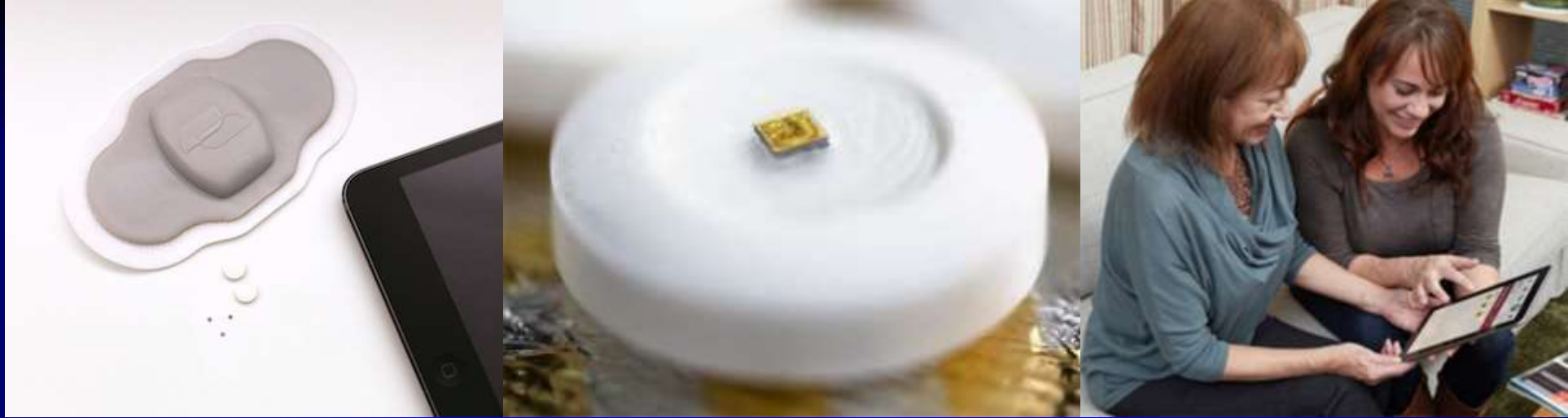
Researchers at University of California, San Diego have demonstrated in a proof-of-concept study a glucose sensing skin patch

The device samples interstitial fluid within the skin that contains glucose, among other analytes

The patch is entirely printed and remains flexible while stuck to the skin

Flexible Electronics





Medication Management Patch

The **Lloydspharmacy** and **Proteus Biomedical** Digital Health medicine platform is a medication management and adherence system that includes sensor-enabled pills, a peel-and-stick biometric sensor patch worn on the body, and companion smartphone apps

The patch records when a pill is ingested and also tracks other things like sleep patterns and physical activity levels



Glowfaster Jacket



Nuubo



OMSignal



FitnessSHIRT



Hexoskin

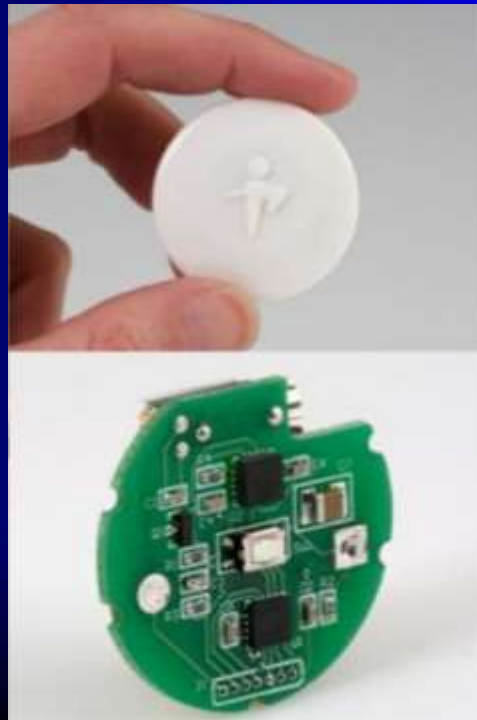
Smart Clothes



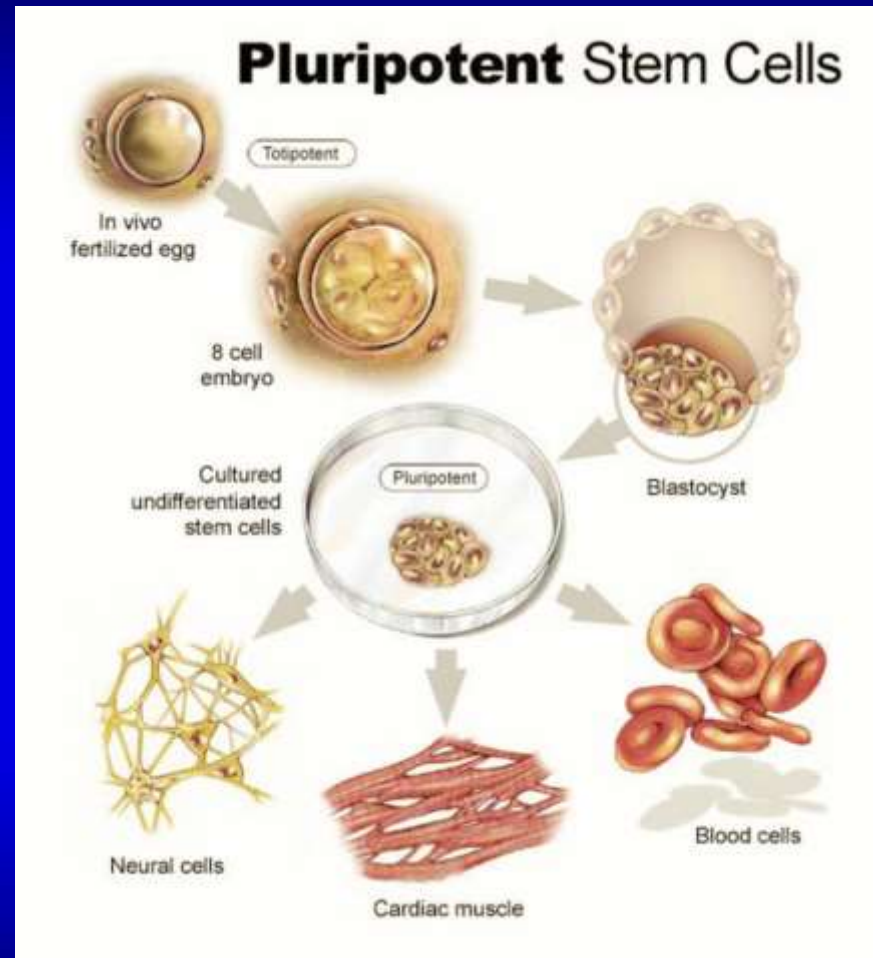
The **Hexoskin System** is a new sensor-fitted T-shirt and companion device that analyzes physical activity, heart rate and variability, respiratory rate and volume, and sleep, then sends the data to an online account via a smartphone



Posture Sensors



Stem Cells & Regenerative Medicine



Medical conditions and diseases where regenerative medicine is being investigated include:

- Cancer
- Diabetes
- Rheumatoid arthritis
- Parkinson's disease
- Blood cell formation
- Alzheimer's disease
- Deafness
- Osteoarthritis
- Stroke and traumatic brain injury
- Infertility
- Learning disability due to congenital disorder
- Spinal cord injury



- Heart infarction
- Anti-cancer treatments
- Baldness
- Replace missing teeth
- Blindness and vision impairment
- Damaged corneas
- Amyotrophic lateral sclerosis
- Crohn's disease
- Wound healing
- Osteoporosis
- Muscle atrophy
- Radiation injury



Types of cells, tissues, and/or organs researchers have grown:

- Auditory hair cells
- Bone
- Bladder
- Blood vessels
- Brain
- Cornea
- Ear lobe
- Esophagus
- Hair follicles
- Heart muscle
- Intestines
- Kidneys
- Larynx
- Liver
- Lung
- Muscle
- Myelin-producing cells
- Neurons
- Pancreas
- Retinal cells
- Teeth
- Skin
- Spleen
- Stomach
- Trachea

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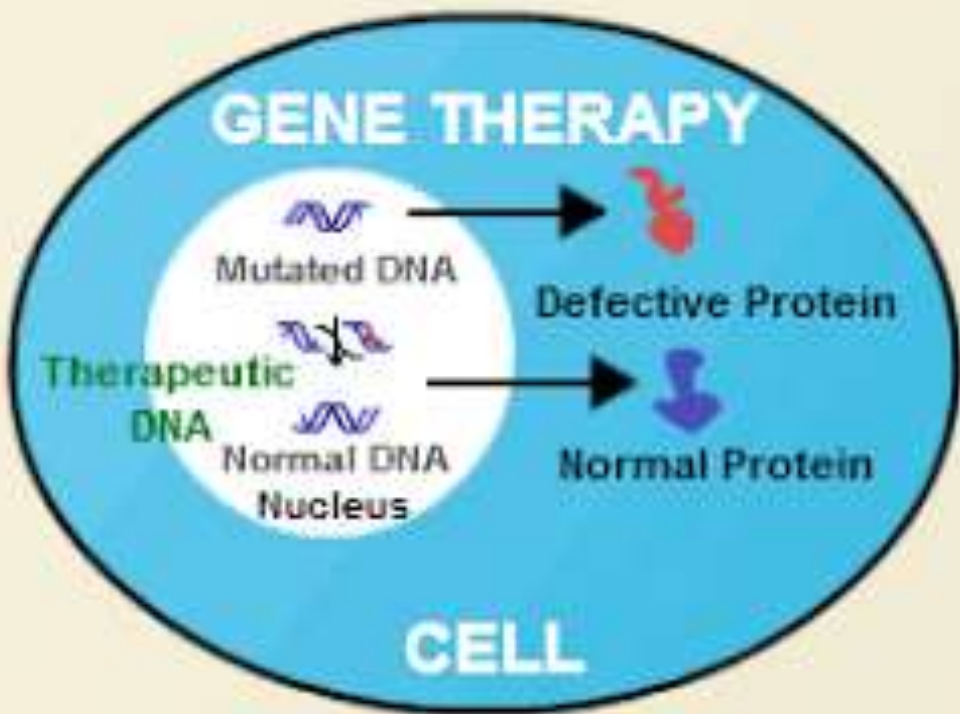


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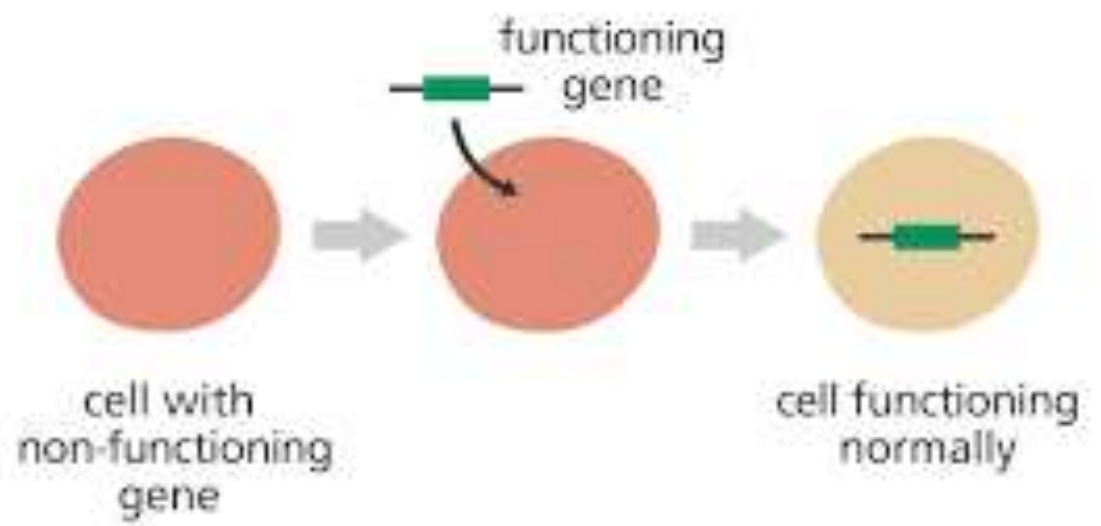
I'VE BEEN TRIALLING THAT NEW STEM CELL
RUB ON HAIR RESTORER.
THE GOOD NEWS IS, IT WORKS....



Gene Therapy



Gene augmentation therapy

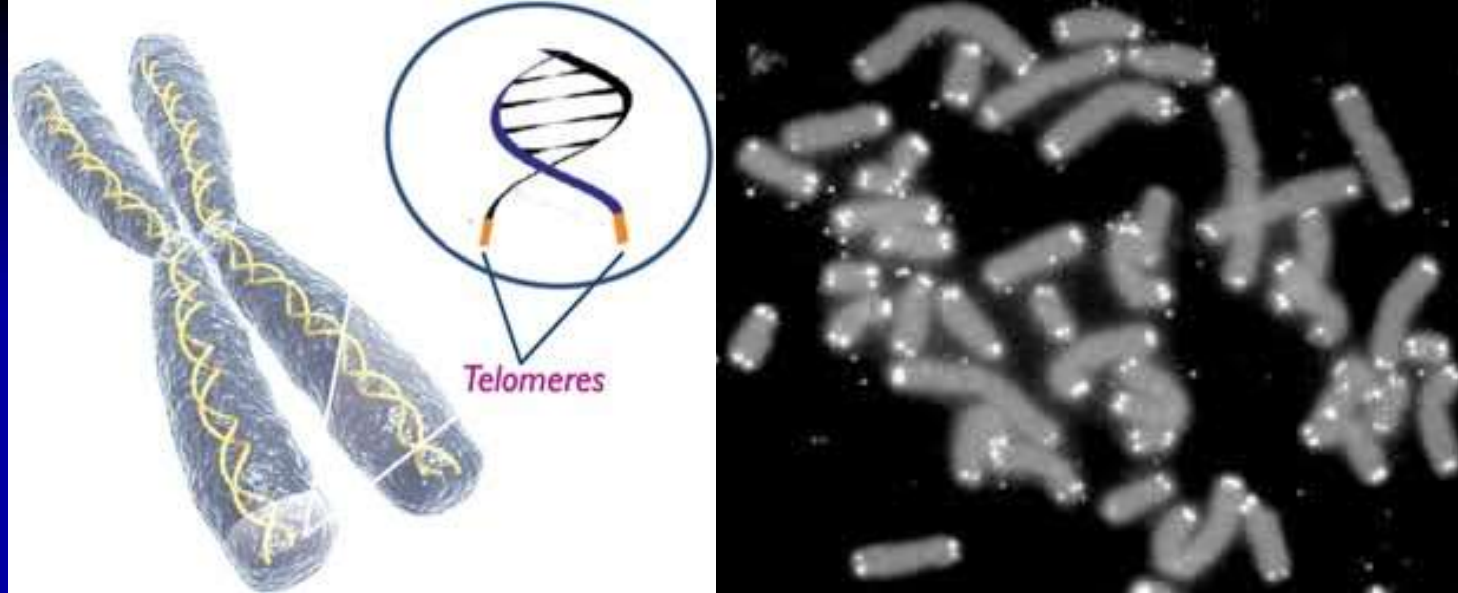


ClinicalTrials.gov
US National Institutes of Health
515 Studies on Gene Therapy



- Blood Cell Diseases
- Cancer
- Cardiovascular Diseases
- Congenital Blindness and Vision Disorders
- Type 1 Diabetes
- Hemophilia
- Inherited Immune Deficiencies
- Infectious Diseases
- Lysosomal Storage Diseases
- Musculoskeletal Disorders
- Neurodegenerative and Movement Disorders
- Respiratory Diseases



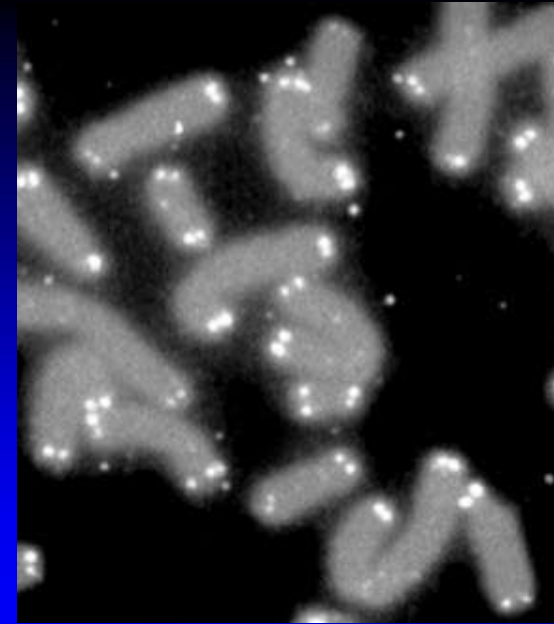


Telomers & Cancer Risk

University of Copenhagen and an international team have for the first time mapped telomerase, an enzyme capable of creating telomeres (new ends on cellular chromosomes)

They discovered that differences in the telomeric gene are associated both with the risk of various cancers and with the length of the telomeres

Increasing Length of Telomers



Scientists at the Stanford University School of Medicine have developed a new procedure that uses modified messenger RNA to increase the length of human telomeres, that are associated with aging and disease

Treated cells behave as if they are much younger than untreated cells, multiplying (up to 40 more times than untreated cells) in the laboratory dish rather than stagnating or dying

GENETIC TOXICOLOGY

The American Society of Gene Therapy and the FDA's Center for Biologics Evaluation and Research recommended studies of chronic toxicity, mutagenesis and genotoxicity of gene therapy vectors based on the class of vector, any known toxicities of the vector, the transgene product, the delivery system, the clinical indication, and the patient population for which the product is intended

GENETIC TOXICOLOGY

The National Gene Vector Biorepository offers an informational toxicology database as a resource to gene therapy investigators

Studies within the database have been submitted to the US FDA in support of gene therapy clinical trials

Postmortem Screening Issues

Should the results of pre-mortem genetic screening be used to expand the scope of autopsies to look for evidence of certain pathologies?

Non-FDA approved gene therapies are readily available in other countries

What forensic methods can be used to look for postmortem evidence of gene therapies?

What forensic methods can be used to look for postmortem evidence of genotoxicity?

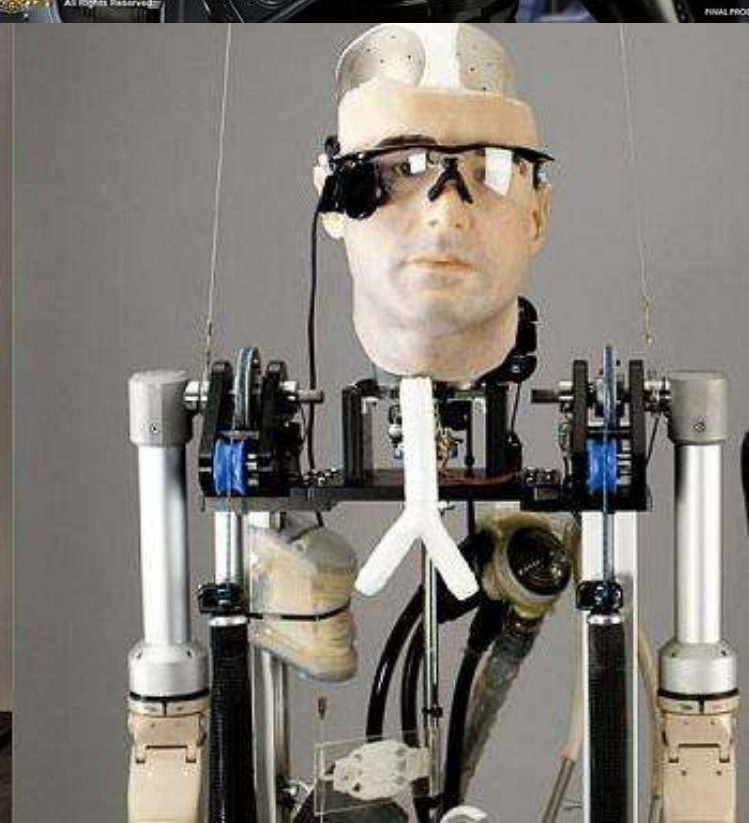
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"ON SECOND THOUGHT, LET'S
GO WITH GENE THERAPY."

Artificial Tissues & Organs





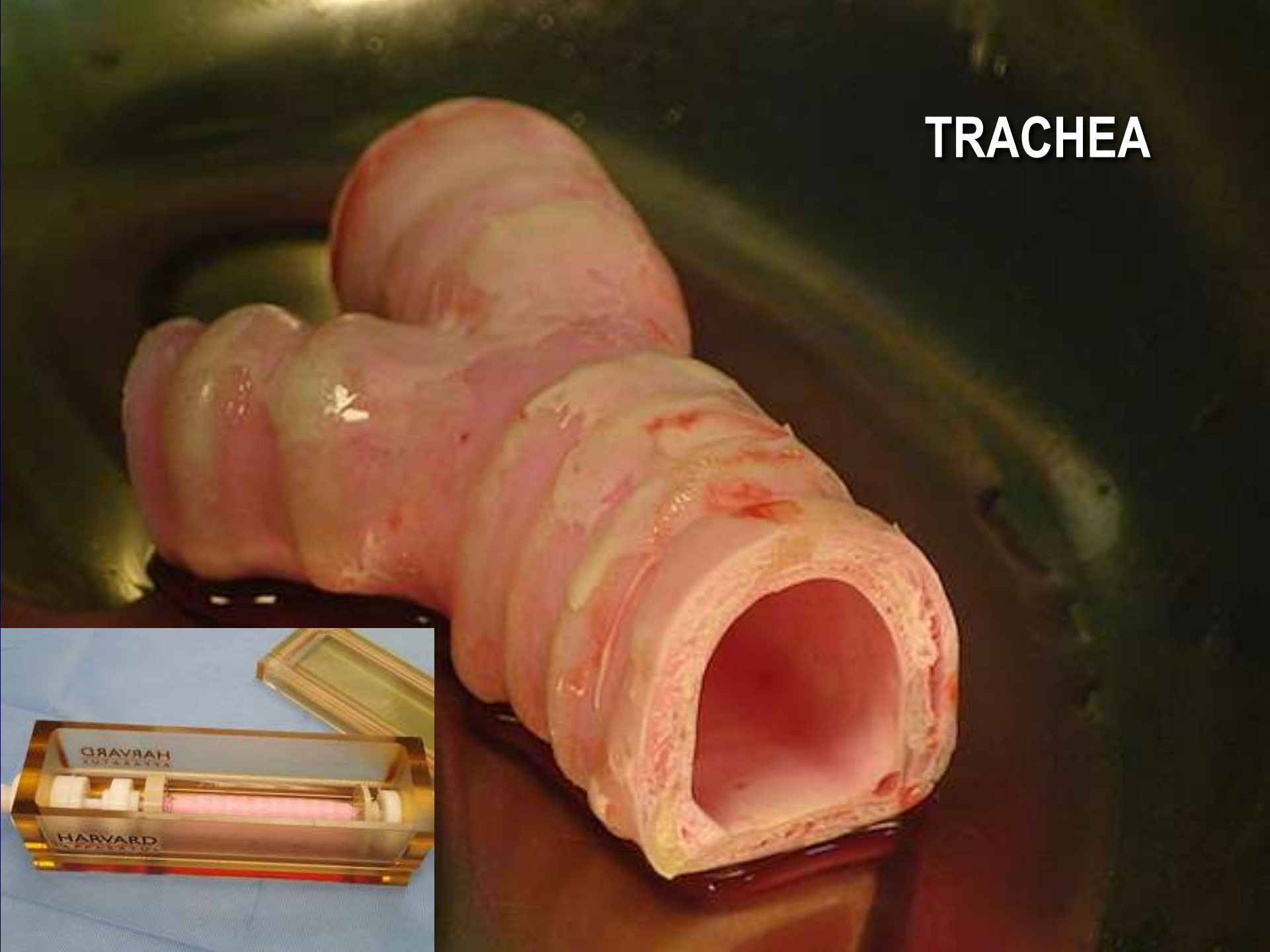
U of Iowa, 2009

6/13/2008

EAR LOBE



TRACHEA



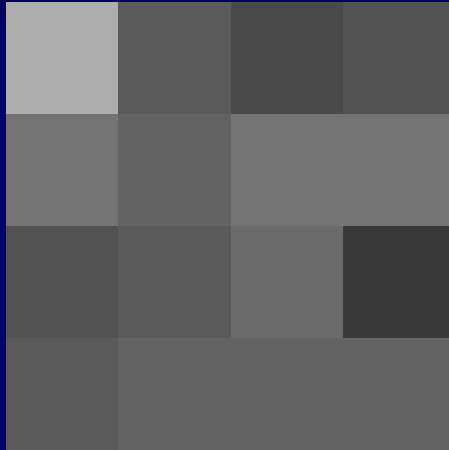
Artificial Retina



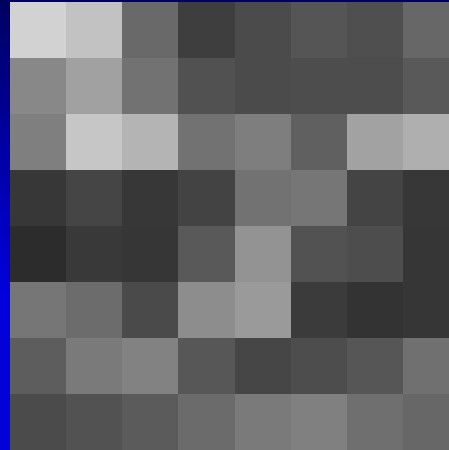
Funded by the US DOE and lead by Lawrence Livermore National Labs the **Argus I and II Epiretinal Prosthesis** have had success with implants in more than 30 blind patients with degenerative eye diseases like macular degeneration and retinitis pigmentosa

Approved by the FDA in February 2013 it has a 200+ pixels resolution to see areas of high contrast, such as curbs and crosswalks

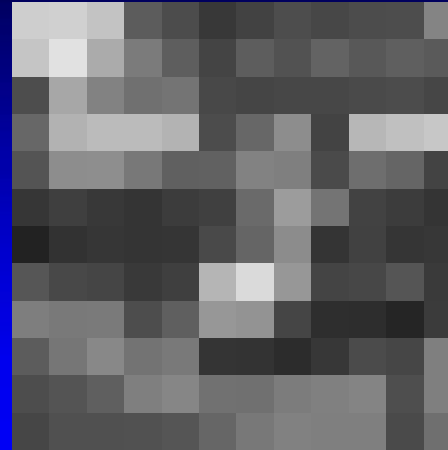
16 pixels



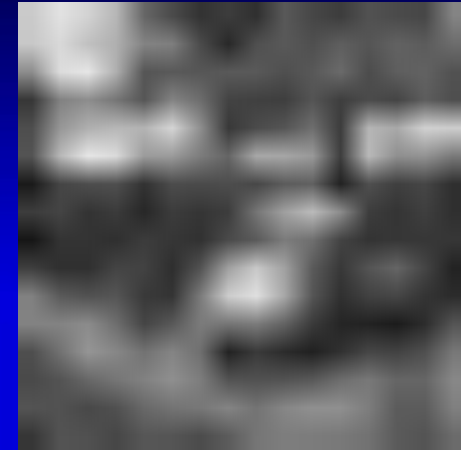
64 pixels



144 pixels



256 pixels



1,024 pixels

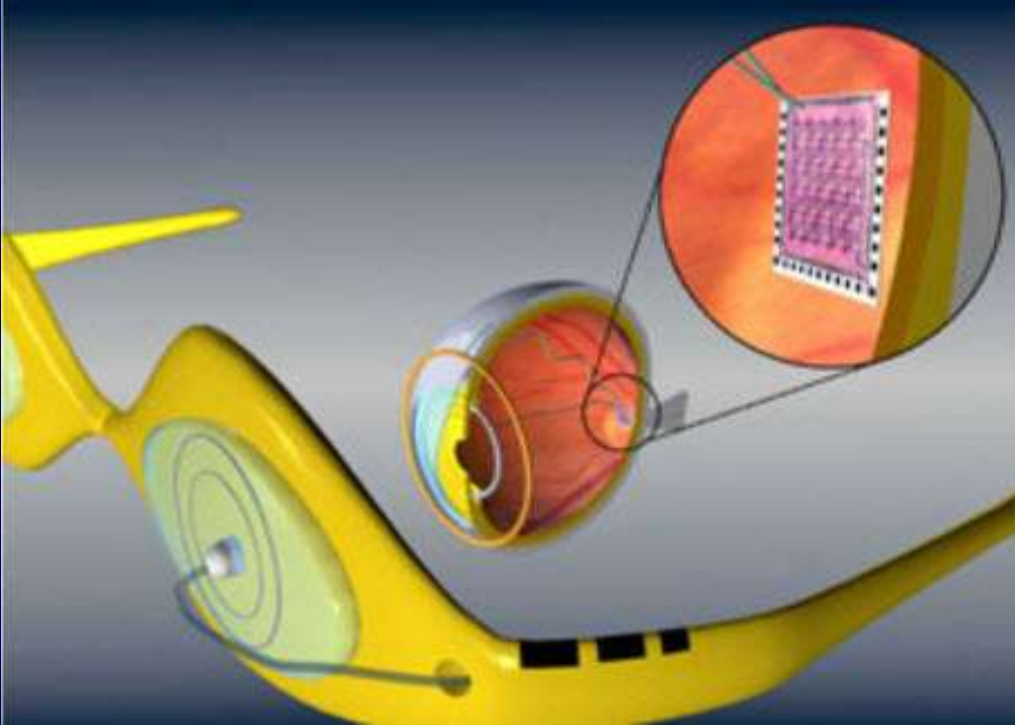
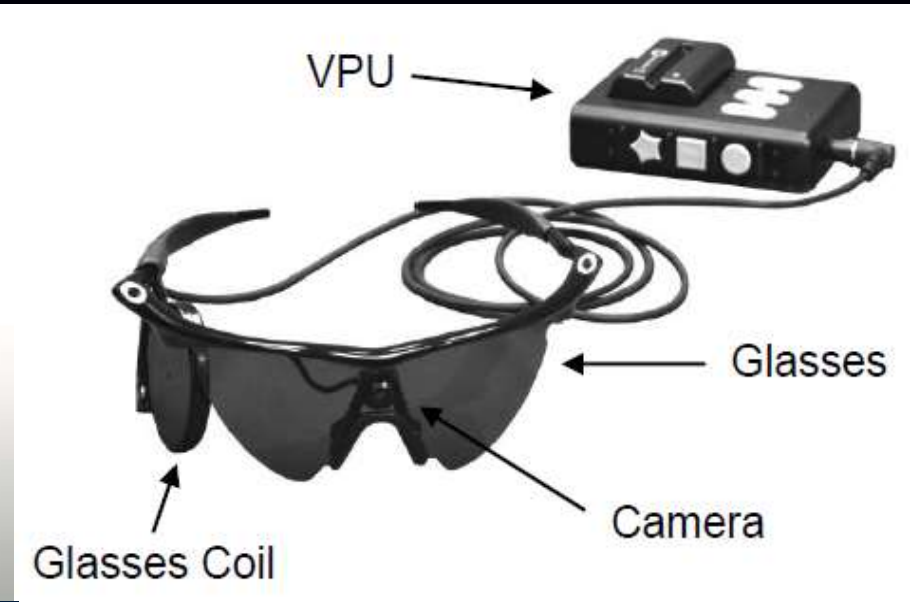


4,096 pixels



16,384 pixels





Artificial retina device, consisting of a glasses-mounted camera and a microchip surgically implanted on the retina (credit: Dr. Wentai Liu)

The FDA approval currently applies to individuals who have lost sight as a result of severe to profound Retinitis Pigmentosa

The implant allows some individuals to locate objects, detect movement, improve orientation and mobility skills and discern shapes such as large letters

Table 1: Engineering Characteristics and Current Status of Major Retinal Prosthesis Initiatives

Device	Description
Argus II ^{11,18} Second Sight (Sylmar, Calif.)	<ul style="list-style-type: none"> • glasses-mounted camera with inductive power and data transfer to external electronics unit strapped around the eye • 60-electrode array implanted into the epiretinal space • currently the only FDA (2013)- and CE (2011)-approved retinal prosthesis
IMI GmbH Learning Prosthesis ^{19,20} Intelligent Medical Implants (Bonn, Germany)	<ul style="list-style-type: none"> • uses a learning encoder to analyze and account for natural retinal processing • 49-electrode array implanted in the epiretinal space • completed safety and charge threshold trials for temporary implantation in humans • acquired by Pixium (now "Pixium IRIS"); undergoing trials for a 150-electrode device
Epi-RET3 Intraocular Prosthesis ^{21,22} Aachen University (Aachen, Germany)	<ul style="list-style-type: none"> • uses an artificial lens implanted in the anterior chamber of the eye (lens capsule); responds to extraocular movements • 25-electrode array implanted in the epiretinal space • completed clinical trials in six patients implanted over 28 days
Artificial Silicon Retina ^{23,24} Optobionics (Chicago)	<ul style="list-style-type: none"> • uses light-powered photodiodes without an external power source or other electronics • 5,000 microelectrode-tipped photodiodes implanted in the subretinal space • completed multicenter clinical trial but was unable to provide adequate stimulation current for vision restoration
Alpha-IMS ^{25,26} University of Tübingen (Tübingen, Germany)	<ul style="list-style-type: none"> • uses a microphotodiode array with an external power amplifier • 1,500 microphotodiodes and microelectrodes implanted in the subretinal space • currently conducting a long-term multicenter clinical trial (started in 2010) • CE-approved; has attained the highest restored visual acuity to date (20/549)
Boston Retinal Implant ^{14,27} Boston Retinal Implant Project (Boston)	<ul style="list-style-type: none"> • glasses-mounted camera with inductive power and data transfer to external electronics unit strapped around the eye • 100-electrode array implanted in the subretinal space • currently undergoing preclinical trials in nonhuman primates; recently completed trials in Yucatan minipigs
Photovoltaic Retinal Prosthesis ²⁸⁻³⁰ Stanford University (Stanford, Calif.)	<ul style="list-style-type: none"> • uses photovoltaic cells and an infrared headset to wirelessly stimulate the retina • 143 hexagonal pixel cells (three microphotodiodes each) implanted in the subretinal space • acquired by Pixium ("Pixium Prima"); currently conducting preclinical testing in mice
Liquid Crystal Polymer Prosthesis ³¹ Seoul National University (Seoul, Korea)	<ul style="list-style-type: none"> • uses liquid-crystal polymer to provide a lightweight and durable alternative to traditional electrode substrate and casing materials • 16-electrode array implanted in the subretinal space • currently undergoing preclinical trials in rabbits
Bionic Vision Australia ³² University of Melbourne	<ul style="list-style-type: none"> • developing a suprachoroidal and an epiretinal "Wide View" stimulator • 33-electrode array implanted in the suprachoroidal space (pilot studies in three patients) • 99-electrode array implanted in the epiretinal space (early development)
NIDEK Visual Prosthesis ^{33,34} NIDEK (Gamagori, Japan)	<ul style="list-style-type: none"> • uses 3D electrodes instead of traditional contact microelectrodes • 49-electrode array implanted in the suprachoroidal space • completed pilot studies of two patients implanted over four weeks in 2011

Other retinal prostheses projects are under way in the United States and world-wide, including Germany, Japan, Ireland, Australia, Korea, China, and Belgium



Sound to Visual Converter



It has a 1,000+ pixels resolution

The **vOICe Learning Edition** translates video images from a regular PC camera into sounds

Some blind people wear it daily with a wearable setup to see/hear their environment as they go around, while other blind people (blind from birth) use it to experience for the very first time what vision is like

Hearing is seeing is believing

By converting images into a series of sounds, the vOICe system can restore "vision" to the blind

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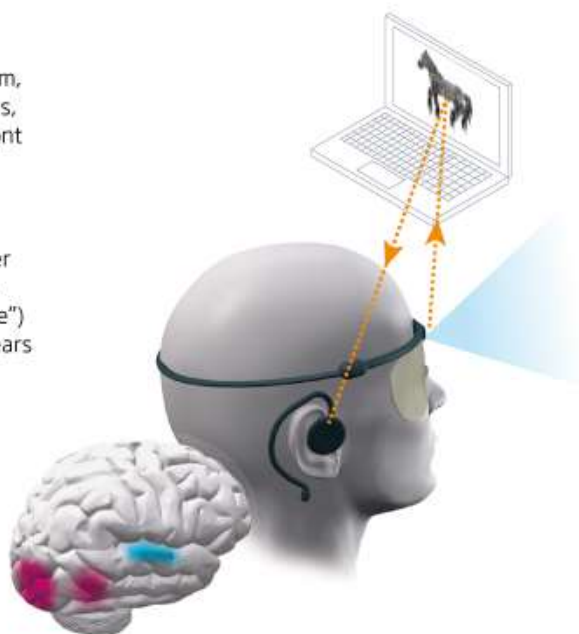
The vOICe device uses a webcam, mounted on a pair of sunglasses, which captures the scene in front of the user

This image is sent to a computer that converts the picture into a series of sounds (a "soundscape") that are played into the user's ears

The user's brain initially tries to decode this information in the auditory cortex ●

After 10-15 hours of training, however, regions of the visual cortex ● begin to "light up". This shows a very rapid redirecting of pathways in the brain

Around the time that the visual cortex becomes active, the users become more adept at understanding the soundscapes and recognising objects



The vOICe software scans across the image from left to right, converting each pixel into a beep, with the frequency representing its vertical position. The volume of each beep represents the brightness of the pixel





Heart

VAD Size Comparison

Older Technology

New Technology



Heartmate
170mm x 55mm
1150g



Novacor
145mm x 60mm
1000g



DuraHeart
73mm x 48mm
540g



Levacor
440g



VentrAssist
298g



Heart Mate II
81mm x 43mm
281g



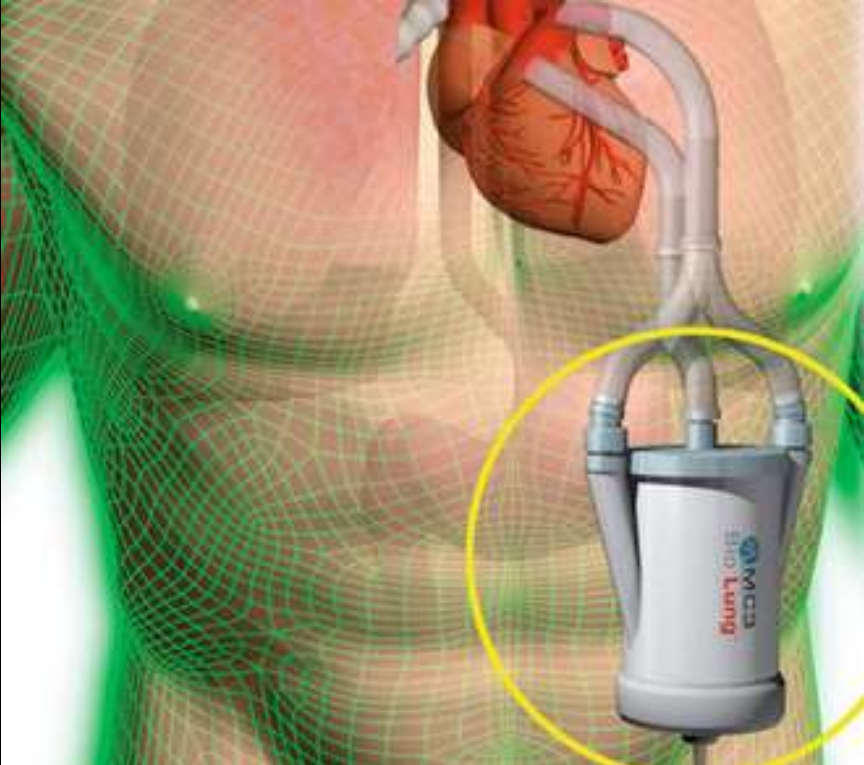
INCOR
120mm x 30mm
200g



HVAD
145g



HeartAssist5
92g



Lung





University of Pittsburgh researchers reported the design and testing of the new Paracorporeal Ambulatory Assist Lung (PAAL), a prototype of a device that may lead to a wearable lung for patients waiting for or recovering from a lung transplant



Kidney



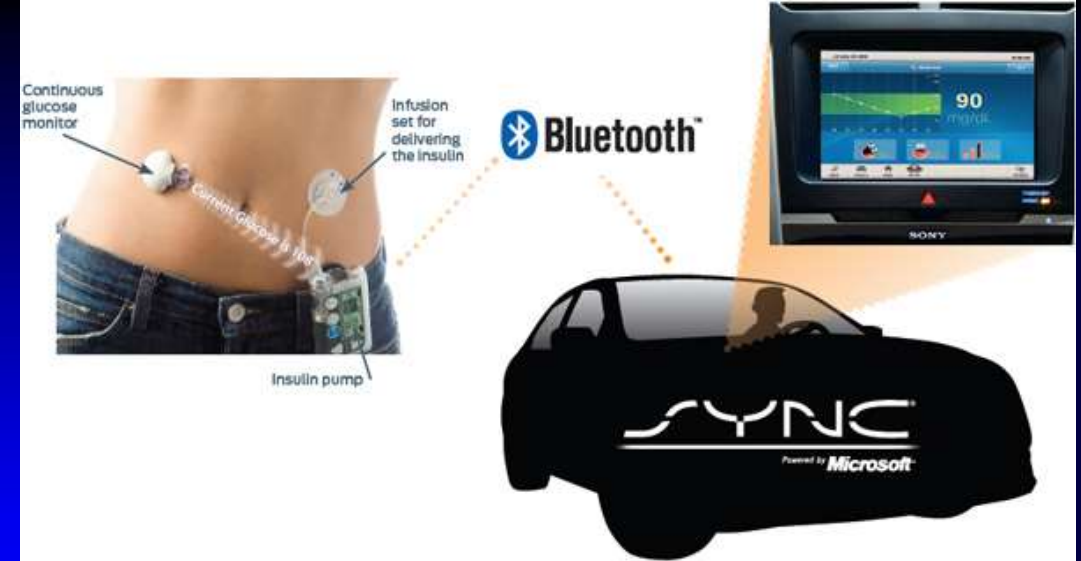
photo: SPH



Pancreas



In-Car Health Management System



Ford partnered with **Medtronic** and others to develop a complete In-Car Health-Management System

The system comprises of a Bluetooth-enabled continuous glucose monitor that connects to Ford's Sync hands-free control system

WellDoc's disease management platform where patients can document asthma attacks, glucose levels, and allergic reactions, all without letting go of the steering wheel, and access to data from SDI Health's Allergy Alert app that can provides local allergy related information

The convergence of medical developments in genomics, regenerative medicine, bioengineering of artificial materials and nanomedicine are creating unique opportunities to produce new types of tissues and organs that combine artificial and natural components for better physiological integration in the human body



Artificial Blood Substitute



Scientists at the University of Essex are developing an artificial blood substitute that would be able to be stored at room temperatures for up to two years, which would allow it to be distributed worldwide without the need for refrigeration and make it immediately accessible at the site of natural disasters

As a claimed universal blood replacement it could be administered to anyone, regardless of blood type

Artificial Platelets



Georgia Tech and Chapman University researchers have developed platelet-like particles (PLPs) that are able to move toward sites where clotting is occurring and contracting the clots much like natural platelets do

Postmortem Analysis Issues

Are current postmortem analysis protocols appropriate to look for evidence of bioengineered tissues and organs?

Are current forensic methods appropriate to look for postmortem evidence of biomaterial toxicity?

Should available digital data recorded by some bioengineered organs be used for post-mortem forensic purposes?

Forensic protocols are needed to identify pre-mortem malfunctioning of bioengineered organs following a fatal aviation accident where only fragmented body remains are found

BIOMATERIAL TOXICITY

