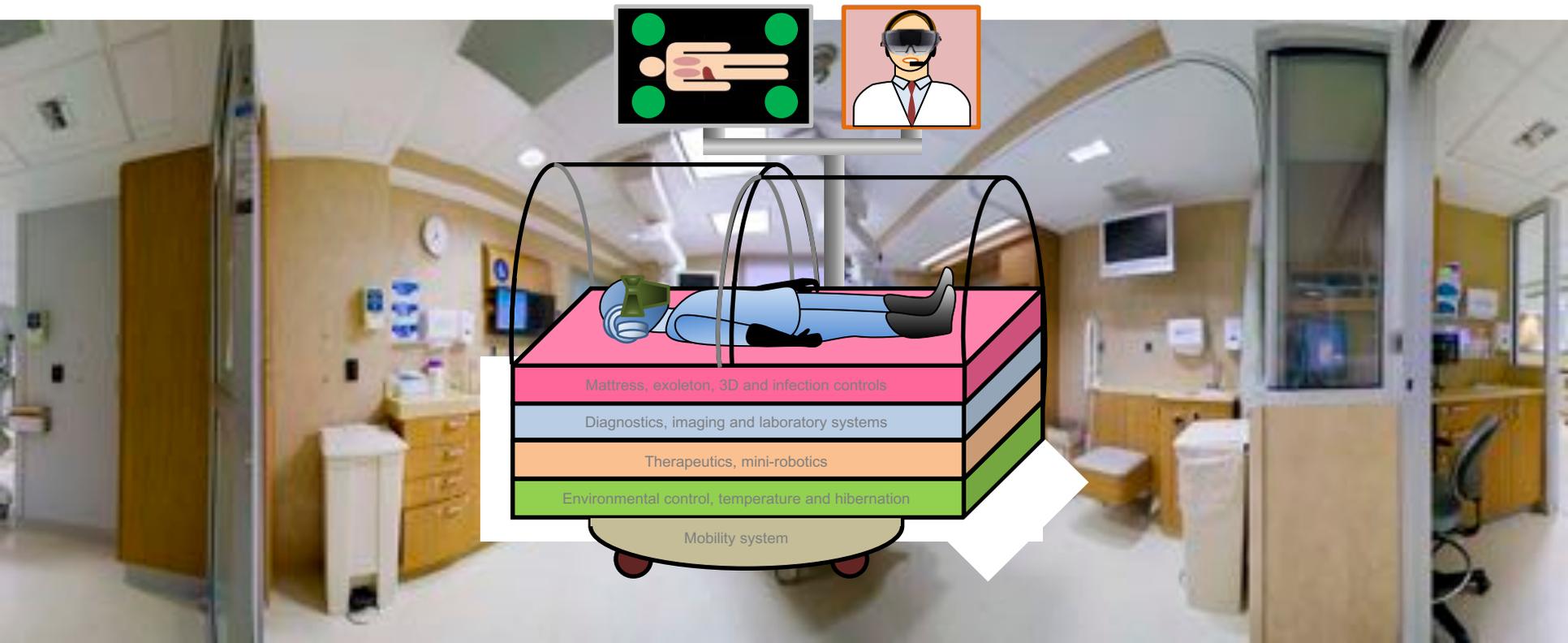
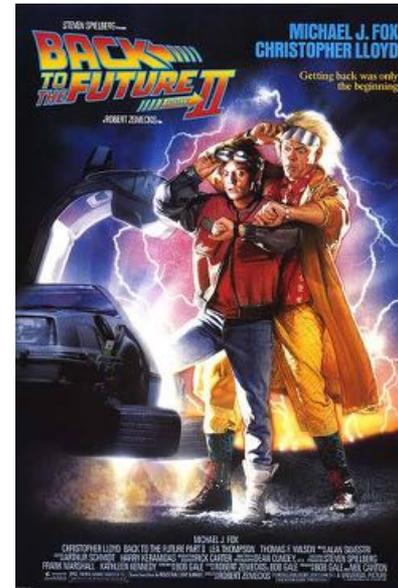
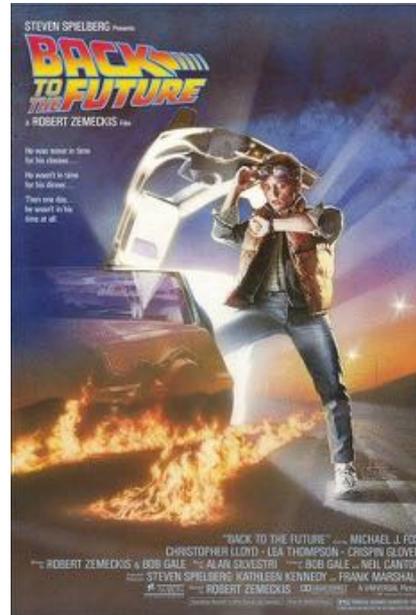
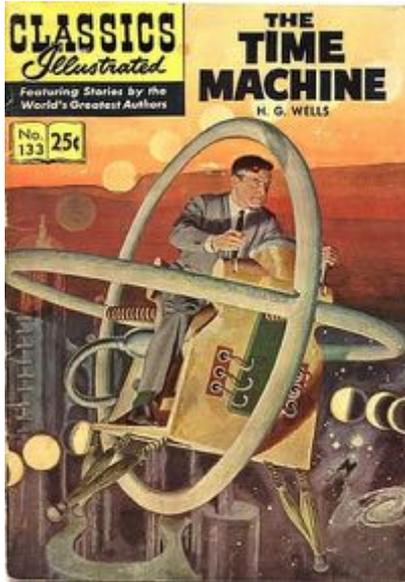


# Intensive Care Unit design in 2050: Merging the future with the present

Neil A Halpern MD, MCCM, FCCP, FACP  
Director, Critical Care Center  
Memorial Sloan Kettering Cancer Center, NYC



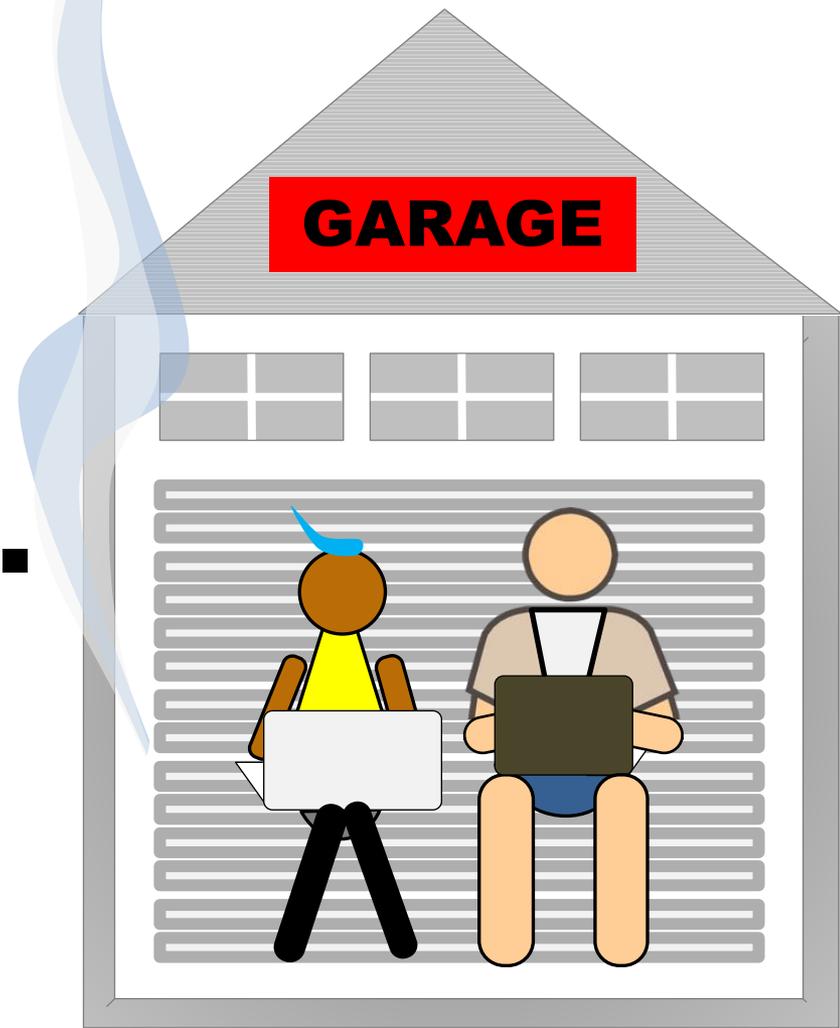
# We are all fascinated by the future



# Where does innovation for future happen?



**vs.**



# Competing approaches to the future

## Forecasting (Predicting):

- Looking forward
- Predict the future based upon current trend analysis

## Backcasting (Visualizing):

- Envision a desirable future & look backward
- Figure out what actions are needed to get to the visualized future

# Predicting the future

- Sorcerers
- Mystics
- Spiritualists
- Tarot card readers
- Stock brokers



# Visualizing the future

- Present a picture of what the future should look like
- Build to the vision



*JPL*



WHAT'S NEW IN INTENSIVE CARE

# ICU design in 2050: looking into the crystal ball!

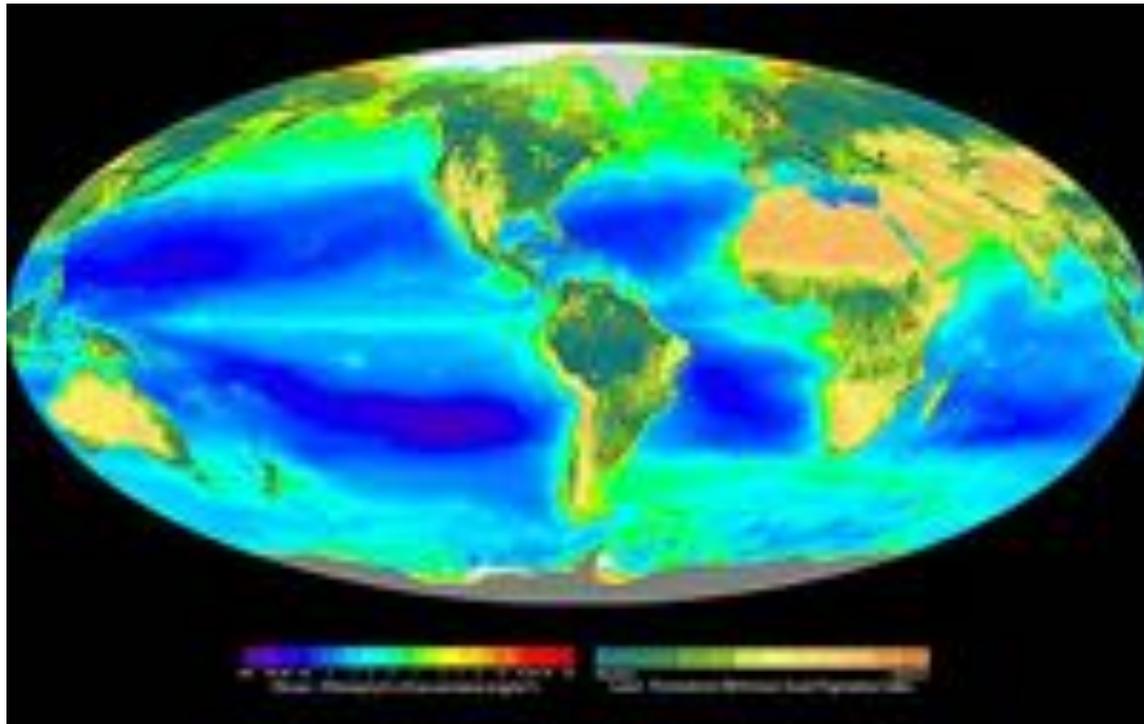


Neil A. Halperin<sup>1,2,3\*</sup>, Dana C. Anderson<sup>3</sup> and Josef Kesecioglu<sup>4</sup>

© 2011 Springer-Verlag Berlin Heidelberg and ICM

# New ICU bed concept

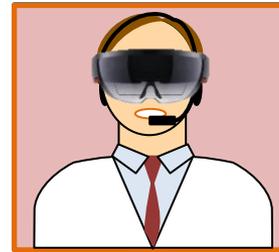
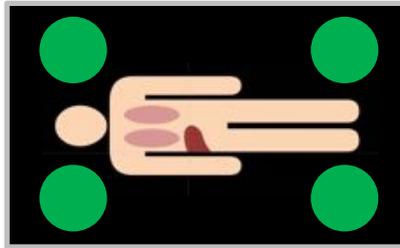
## Biospheric capsule



Worldwide critical care diagnostics and therapeutics center (WWCCDTC)

Environmental sensors

Biometrics Display



Holographic Interactive Display

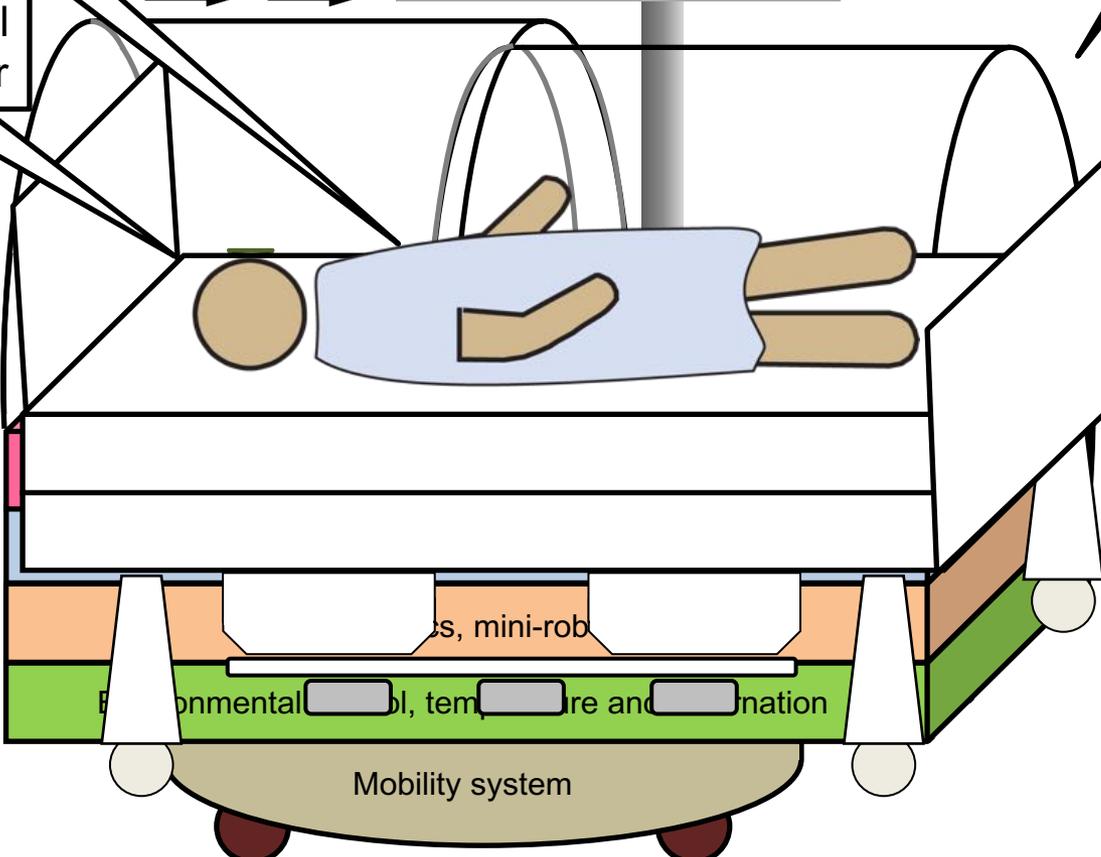
Biosphere/capsule

Data outbound

Sensors

Bidirectional helmet/visor

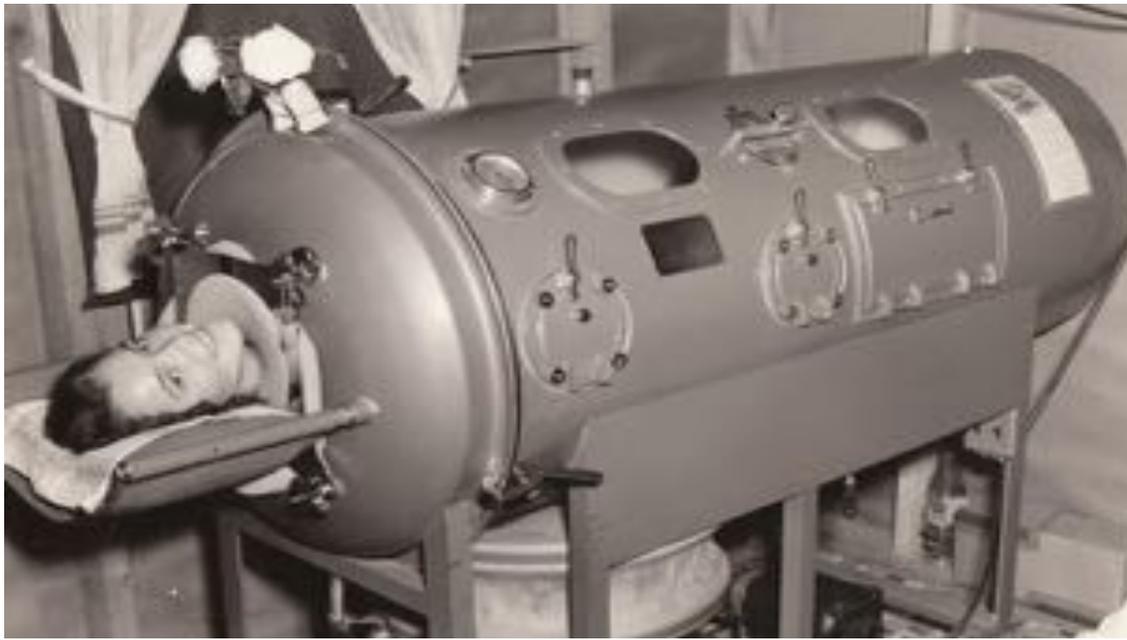
Instructions inbound



s, mini-rob

Environmental bl, tem, ure and nation

Mobility system



Polio biosphere  
IRON LUNG  
Circa 1950s



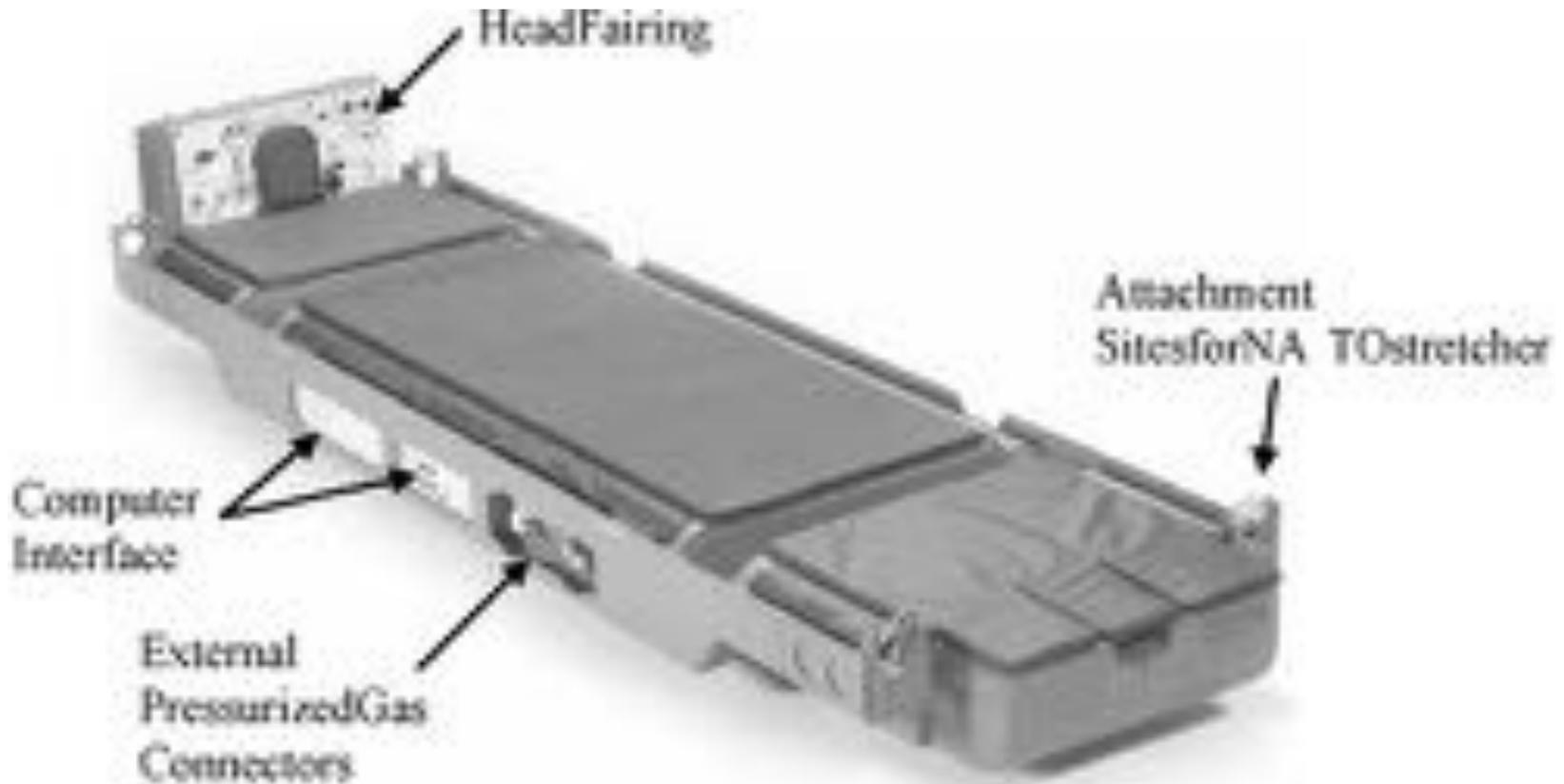
# Space prep biospheres

- Biosphere 2 (opened 1990) Oracle, AZ
  - Study multiple earth biomes
  - **U Arizona** (2007 on)
- BIOS -3 (Opened 1972 ) Krasnoyarsk, Russia
  - 4 zone underground ecosystem
  - Analyze microflora for spacecraft
  - **BIOSMHARS - BIO**contamination  
Specific **M**odelling in **H**abitats **R**elated to  
**S**pace (Russia & EU - FP7)



# Military biosphere

## Life Support for Trauma & Transport (LSTAT) Mobile ICU 1990-2000s



Integrated Medical Systems, Signal Hill, CA

Critical Care

# ICU 2050 Biosphere Capsule - Features

- Neuro systems
  - Bidirectional thought processing
  - Neuro/Psych stability system
  - Virtual visitors
- New care model
  - Holographic intensivists / consultants
  - Critical care cloud
- Specialty systems
  - Suspended hibernation

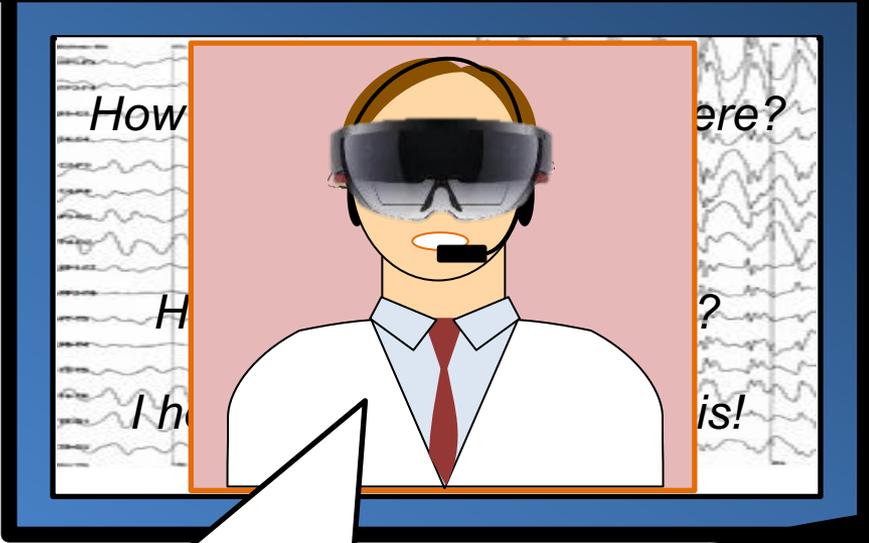
# ICU biosphere

Neuro systems: Bi-directional thoughts,  
Psych stabilizers & Virtual visitors



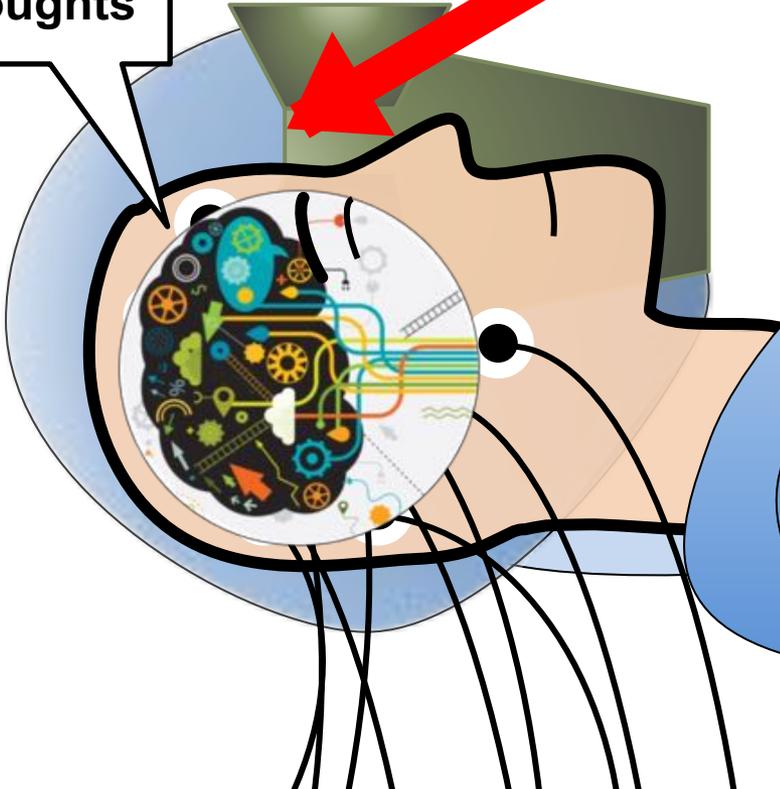
# Bidirectional thought processing

Thoughts are transferred back into the brain as meaningful thoughts



Thoughts

You are getting better & will  
You are a great reader!  
become a successful student!



# A new way of seeing

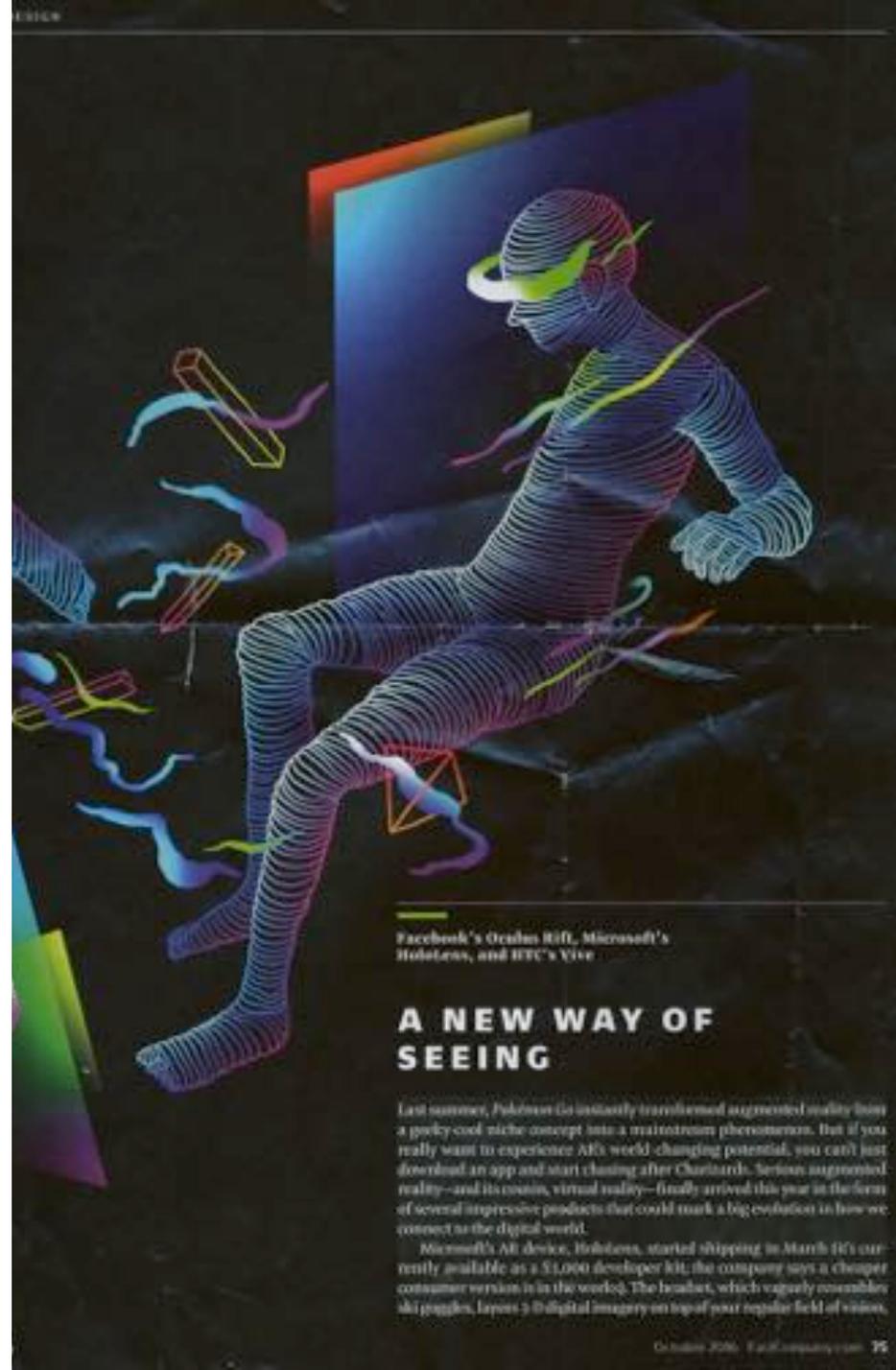
(Fast Company, OCT 2016)

## *Augmented reality (AR):*

- 3D imagery layered on regular field of vision
- Blends real world & computer generated content

## *Virtual reality (VR):*

- Computer generated simulation of 3D image or environment
- Allows interaction in seemingly real or physical way



Facebook's Oculus Rift, Microsoft's HoloLens, and HTC's Vive

## A NEW WAY OF SEEING

Last summer, Pokémon Go instantly transformed augmented reality from a geeky-cool niche concept into a mainstream phenomenon. But if you really want to experience AR's world-changing potential, you can't just download an app and start chasing after Charizards. Serious augmented reality—and its cousin, virtual reality—finally arrived this year in the form of several impressive products that could mark a big evolution in how we connect to the digital world.

Microsoft's AR device, HoloLens, started shipping in March (it's currently available as a \$1,000 developer kit; the company says a cheaper consumer version is in the works). The headset, which vaguely resembles ski goggles, layers 3-D digital imagery on top of your regular field of vision.

# The see-everything GEN III helmet designed for F35 pilots

- Displays AR
- Synthesizes all feeds from exterior cameras & sensors
- Sees “through” the plane
- Reacts to head position
- Targets weapons by looking at target



*Vendor: Rockwell Collins, Popular Mechanics, Nov 2016*

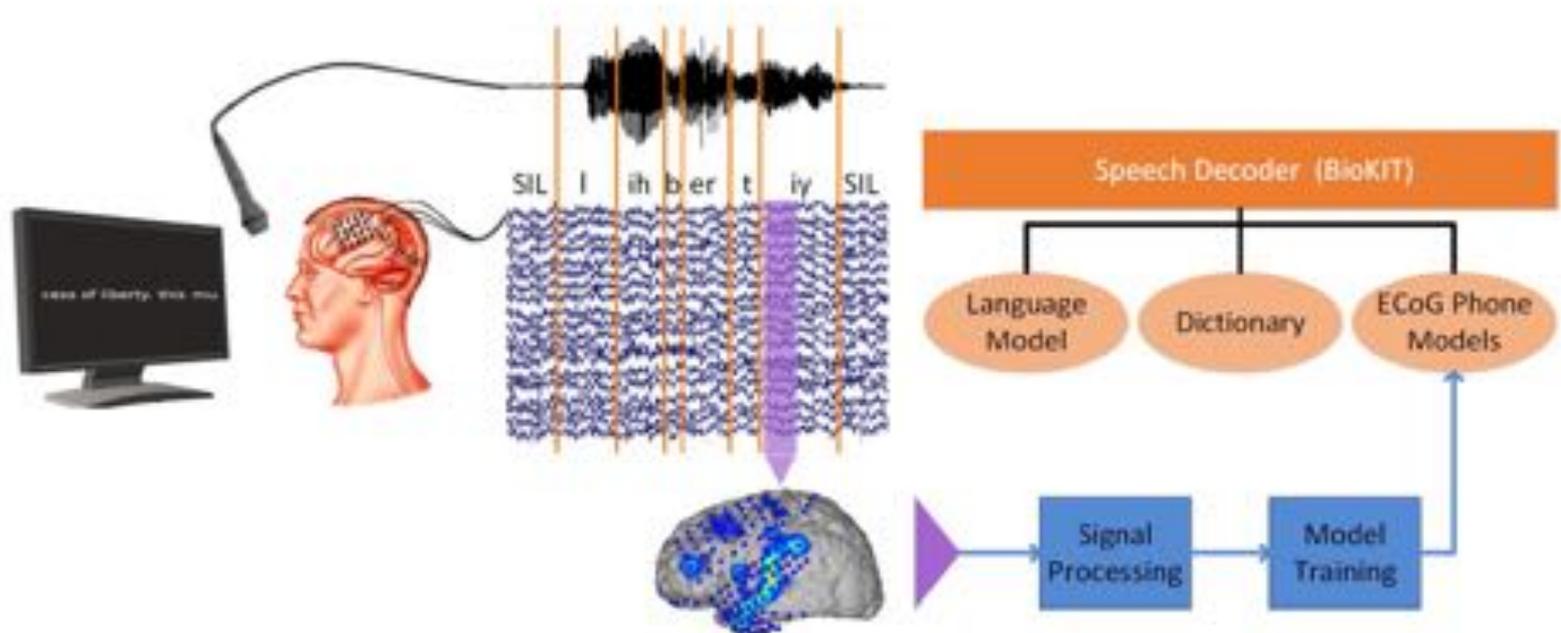
# Mind/brain reading machines?

- Goal: translate/decode brain signals, unspoken thoughts, intent, or silent speech to speech
  - Uses sensors on brain surface
    - Electrocorticogram (ECoG)
    - Intracranial EEG (iEEG)
  - Then communicates with external device
- Used for paralyzed, ALS, motor impairments, & “locked-in”

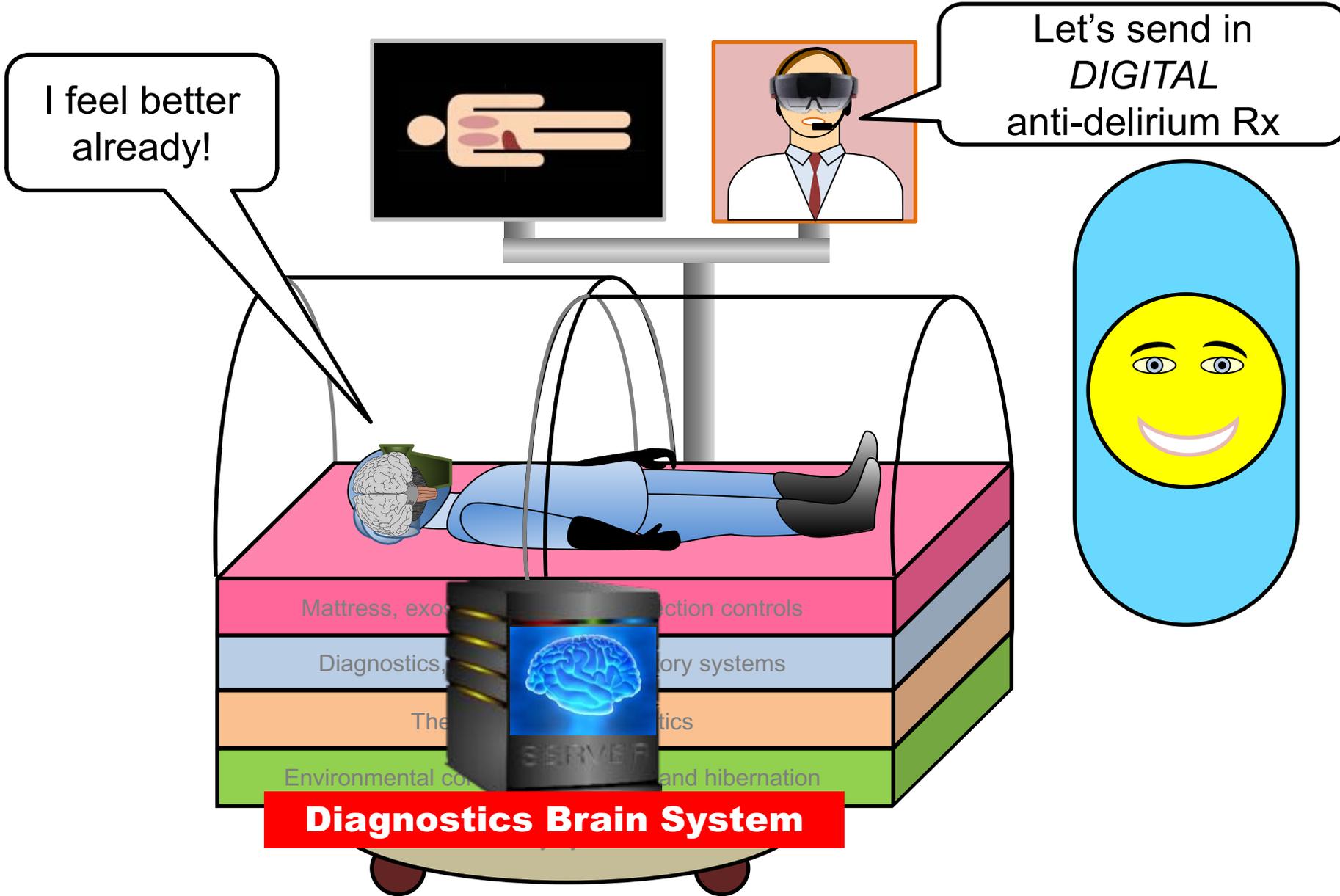
# Brain reading patents

- 1976: Apparatus & method for remotely monitoring & *altering* brain waves
  - Sensing brain waves remotely
  - EM signals sent to brain
- 2004: Brain Computer Interface (BCI)
  - Generate outputs from raw brain signals

# National Center for Adaptive Neuro technologies (State U Albany) Continuous Speech Recognition from ECoG



# Neuro/Psych Stability System



# FDA Digital Health Software Precertification Pilot Program

- Sept 26, 2017: part of new FDA Digital Health Innovation Action Plan
- Modernize regulatory framework
- FDA selects vendors with focus on vendor/developer rather than product
- Pre-certify companies
- Dec time / avoid submission of software

# Prescription Digital Therapeutics “Digiceuticals”

DTA: Digital Therapeutics Alliance

AKILI Interactive Labs

- Digital Rx delivered through high-quality action video game experience to selectively target & activate cognitive neural systems with deficiencies
- ADHD-Attention Deficit/Hyperactivity Disorder
- ASD-Autism Spectrum Disorder
- Major Depressive disorder
- Multiple Sclerosis

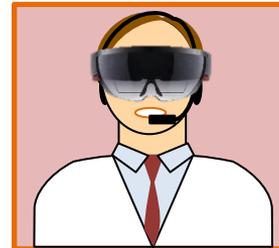
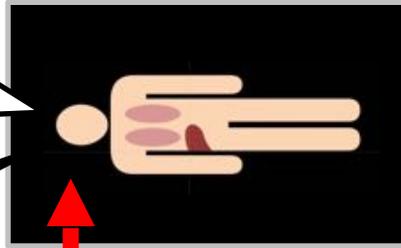
<https://www.akiliinteractive.com/>



# Virtual Visitors

Where is my family?  
I need to feel  
their touch.

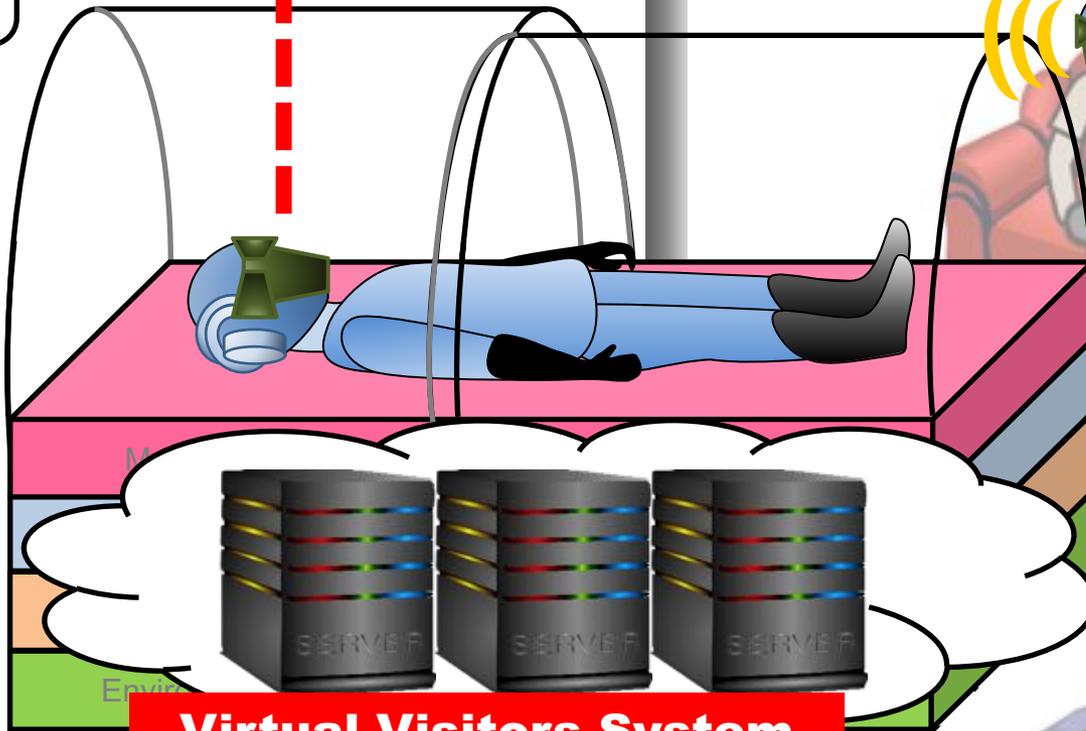
I see you  
and feel you.



Holograph  
Interactive  
Display

We love you!

Can you  
feel our  
touch?



**Virtual Visitors System**

Mobility System

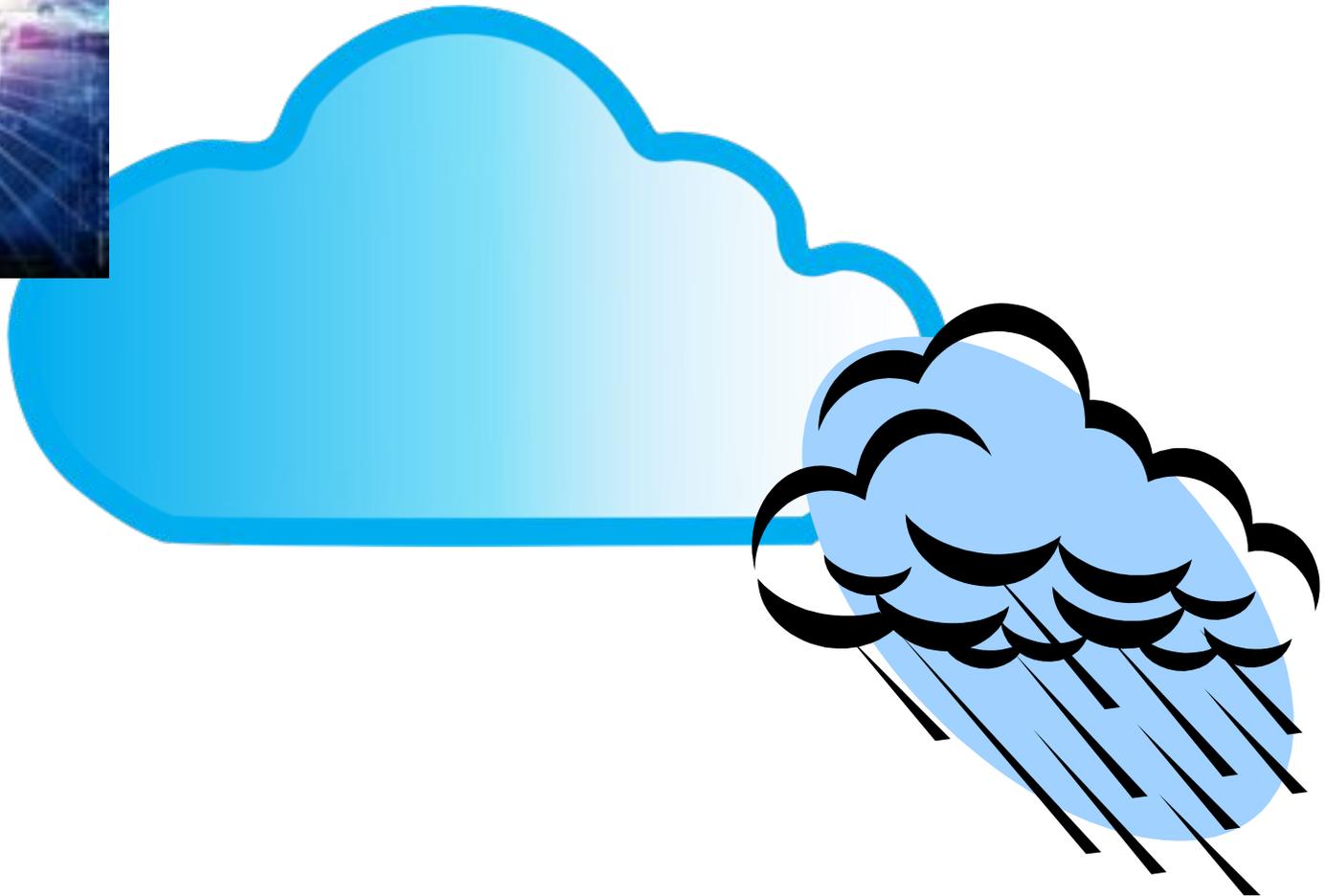


# Oculus Rift: Touch VR System

- Functional hands
- Feel & make gestures
- Sense reach & grasp
- Detect fingers
- Track hand position



# ICU biosphere Holographic & Cloud Care Models



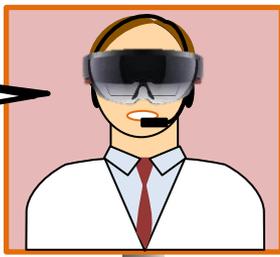
# The Holographic Consultant

Worldwide critical care diagnostics and therapeutics center (WWCCDTC)

Instructions

Tough case, lets get the WWCCDTC  
Thanks

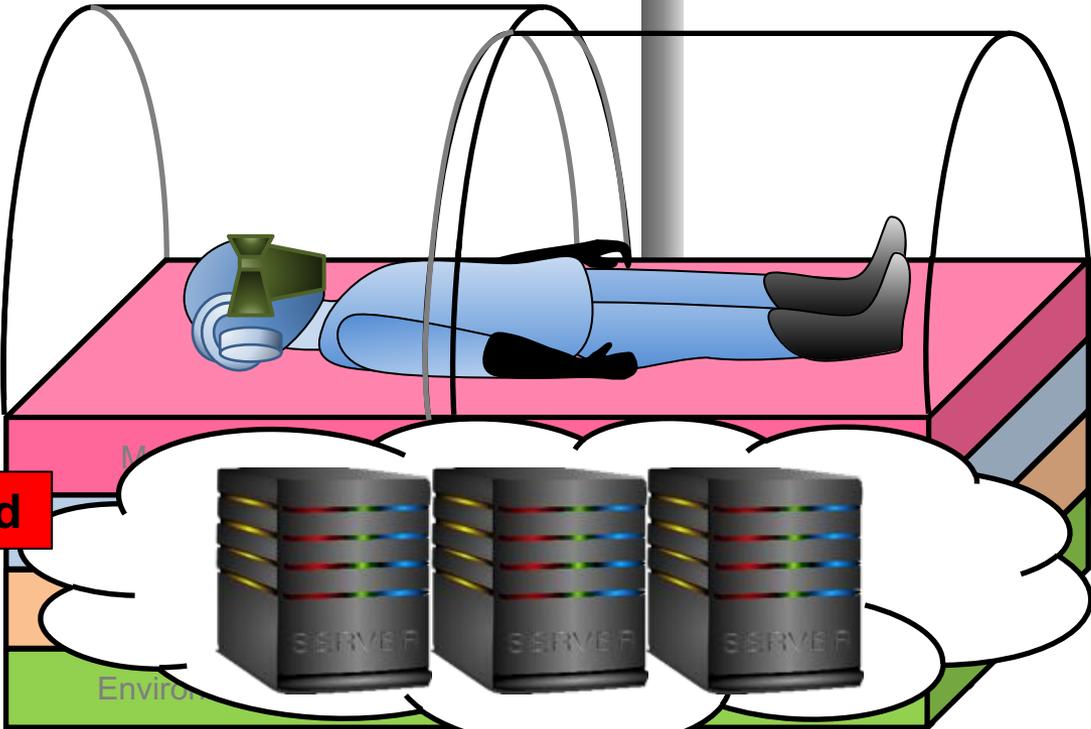
This is what we need to do . . .



Data outbound

Instructions inbound

Data Upload



Environment

Mobility system

# Current virtual assistants

Echo (Alexa), Google Assistant, Homepod/Siri

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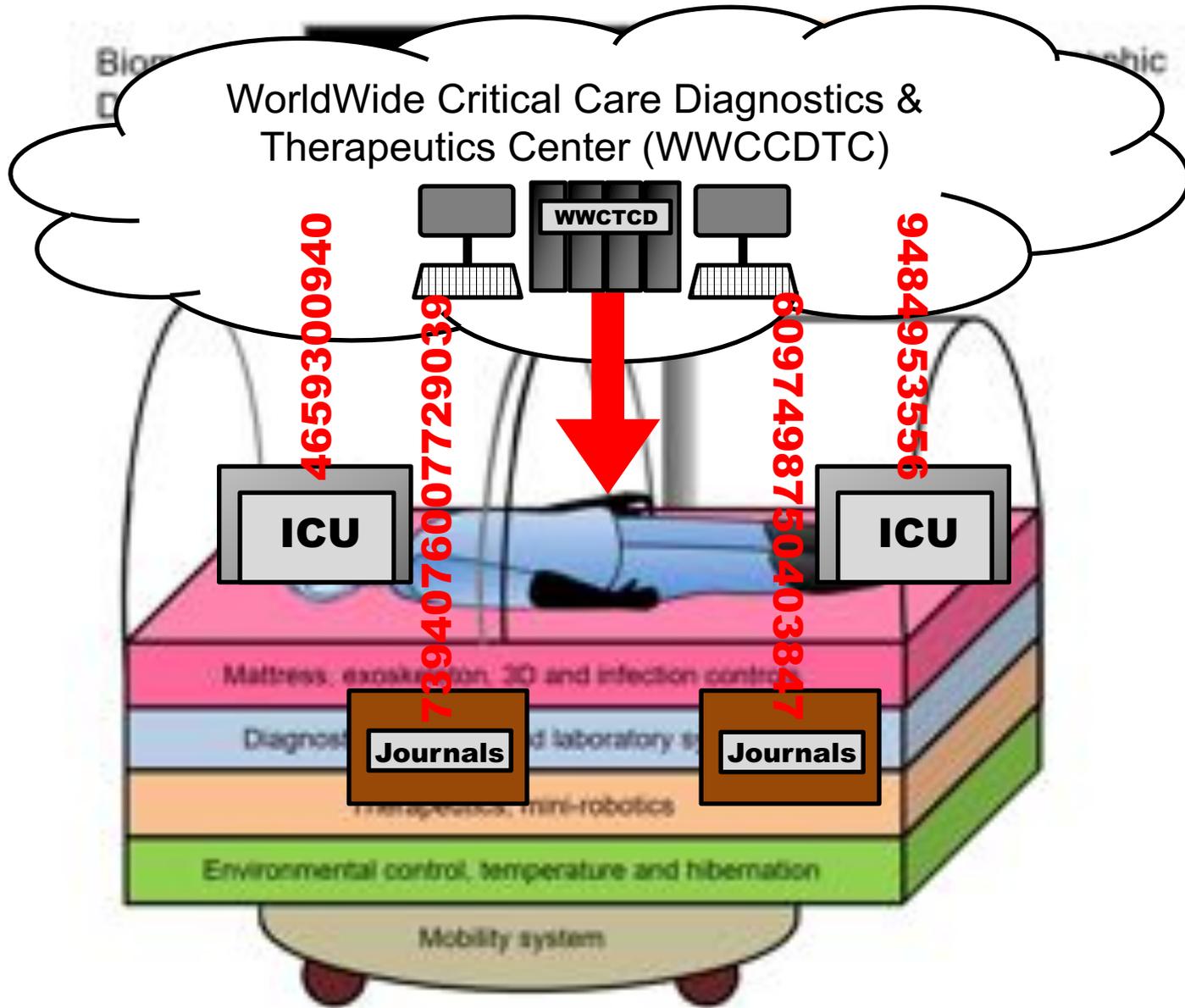
# The Holographic Consultant

## Viewpoint: Is It Time for a New Medical Specialty? The Medical Virtualist

Nochomovitz & Sharma. JAMA Nov 27, 2017

- Formalize new specialty
- Define core competencies & curriculum
- Develop “webside” manner

# What is the WWCCDTC?



# ICU Telemedicine Bunker with Decision Support Systems



# Everyone is already in the cloud



# Early Medical Clouds

**An International Human Cell Atlas Consortium Takes Shape.** Abbasi J.

JAMA Aug 22/29, 2017

**The Evolution of Patient Diagnosis: From Art to Digital Driven Science.** Mandl & Bourgeois.

JAMA Nov 21, 2017

From: **The Evolution of Patient Diagnosis From Art to Digital Data-Driven Science**

JAMA. 2017;318(19):1859-1860. doi:10.1001/jama.2017.15028

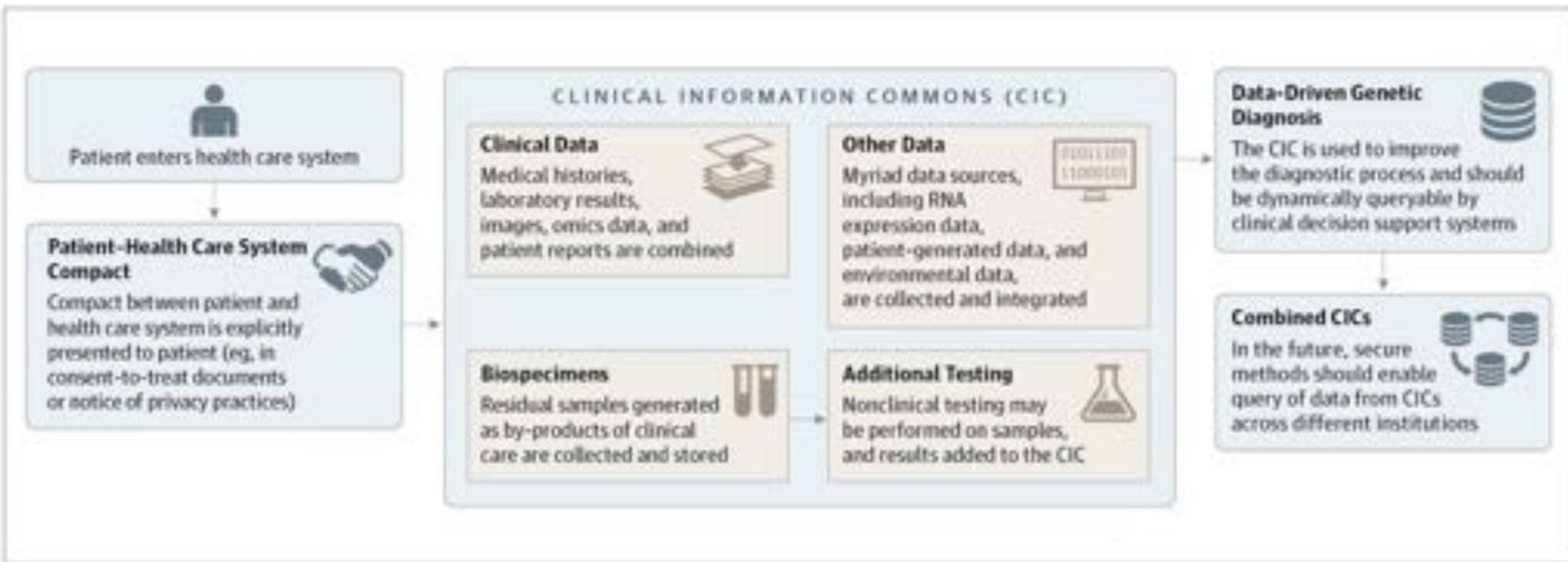
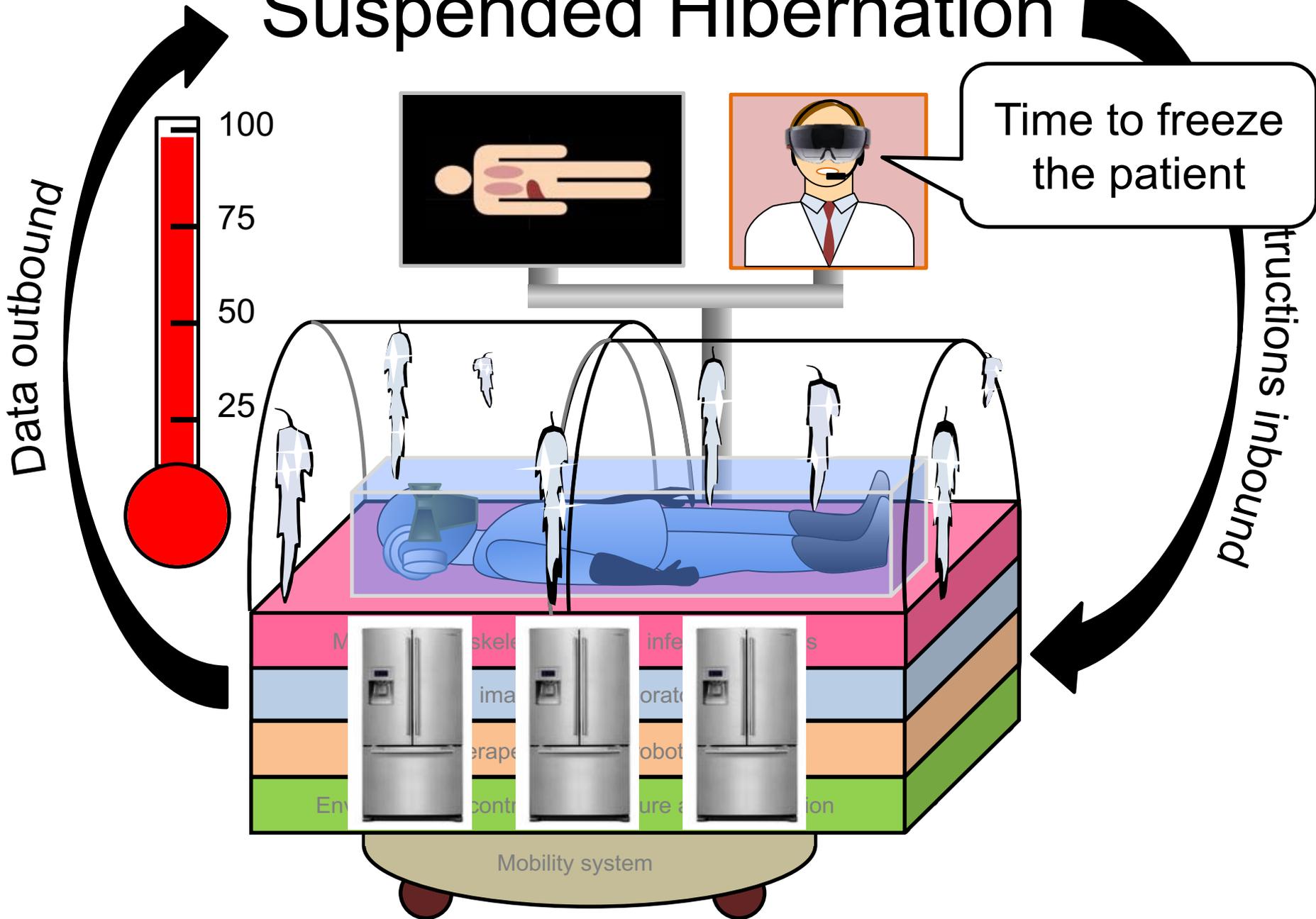


Figure Legend:

The Clinical Information Commons to Support Data-Driven Diagnosis Patients are engaged in a compact with the health system whereby clinical data and biological samples derived from routine clinical care are aggregated to support innovation and improvement in diagnosis. Data and samples are collected across visits, accumulating over time for individual patients. Institutional data could also be combined across care sites to broaden the patient population and clinical data represented.

# Suspended Hibernation

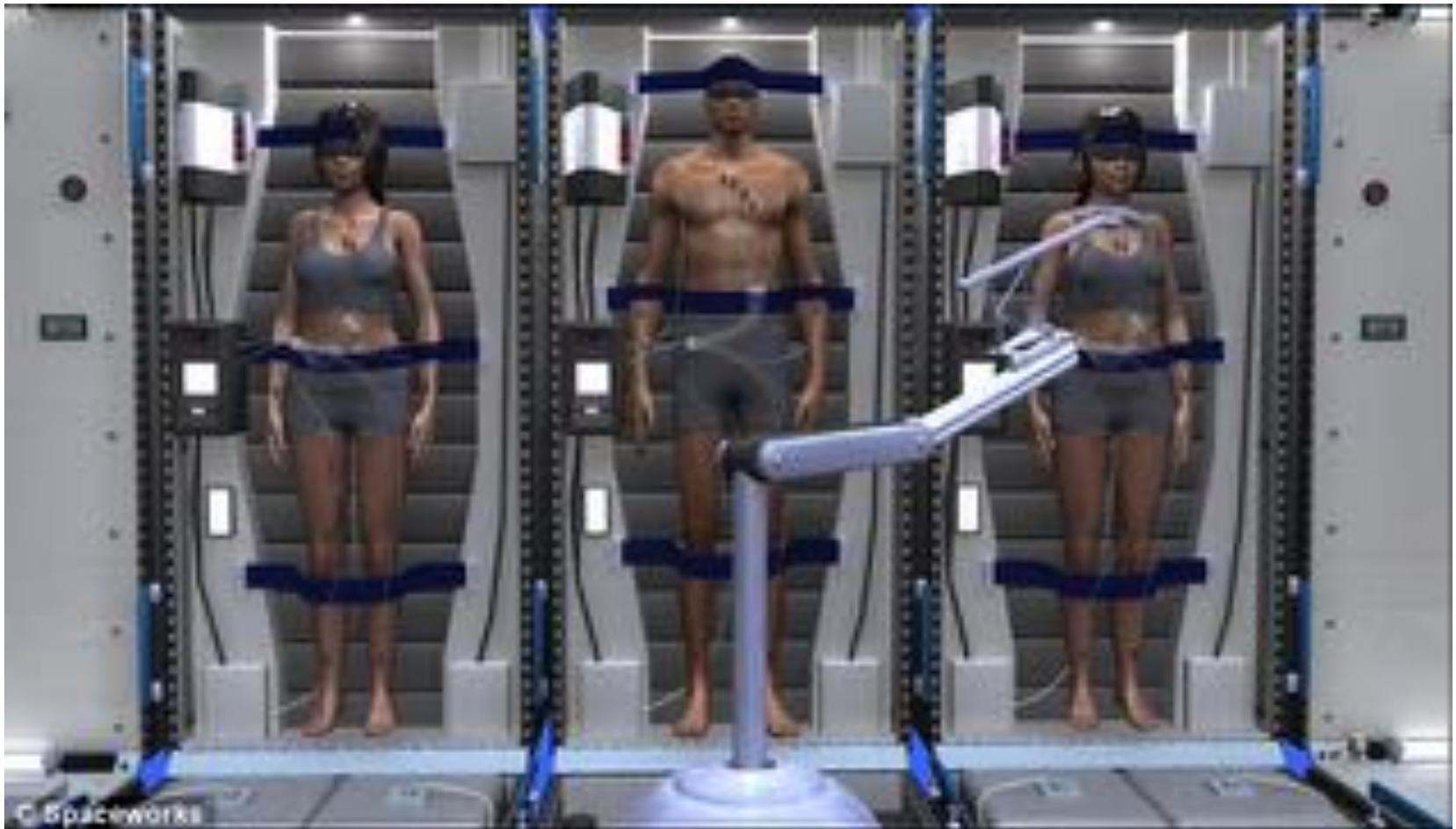


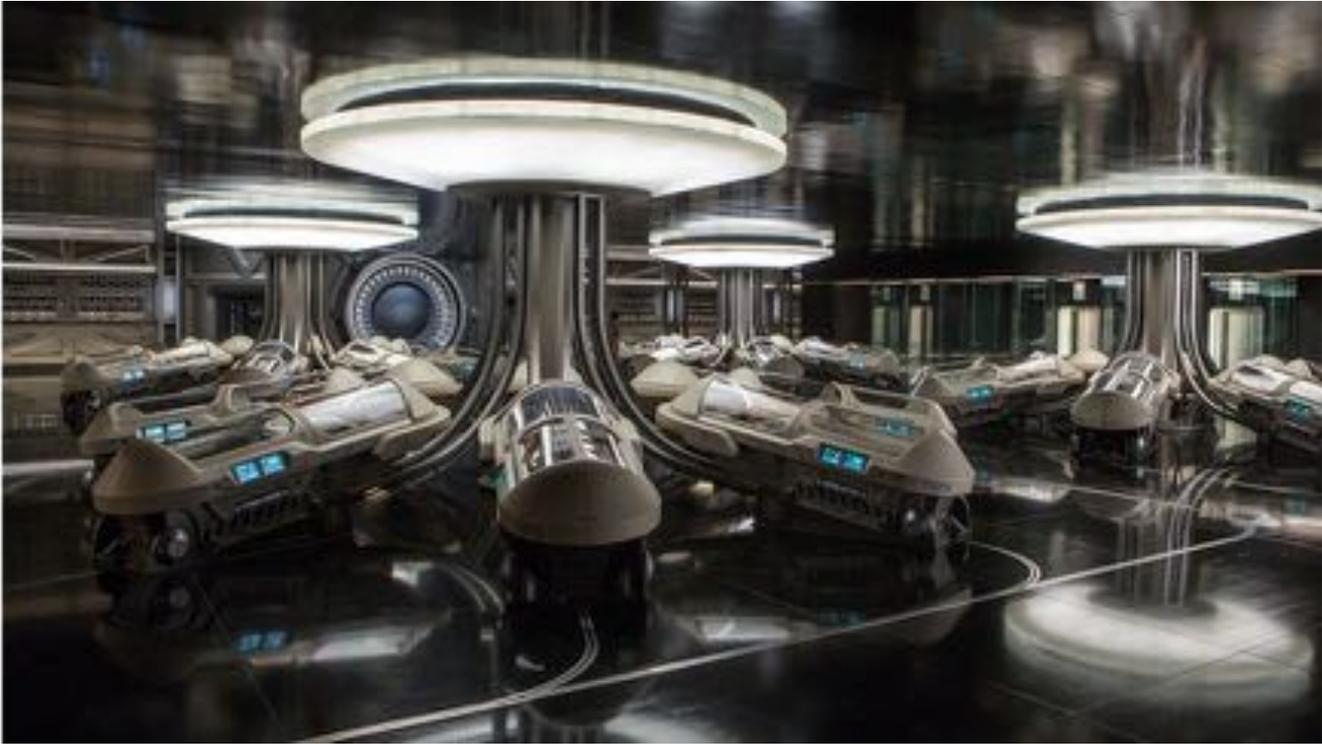
# Cryogenic preservation

- Alcor Life Extension Foundation, Scottsdale, AZ
  - “Cryonics is an extension of critical care medicine”
  - Preserve body upon legal death declaration
  - Freeze you **into the future** with medical antifreeze to -320F
  - Thaw and reanimate when cure is available



# NASA project: Develop Cryosleep chamber for suspended animation for deep space journeys





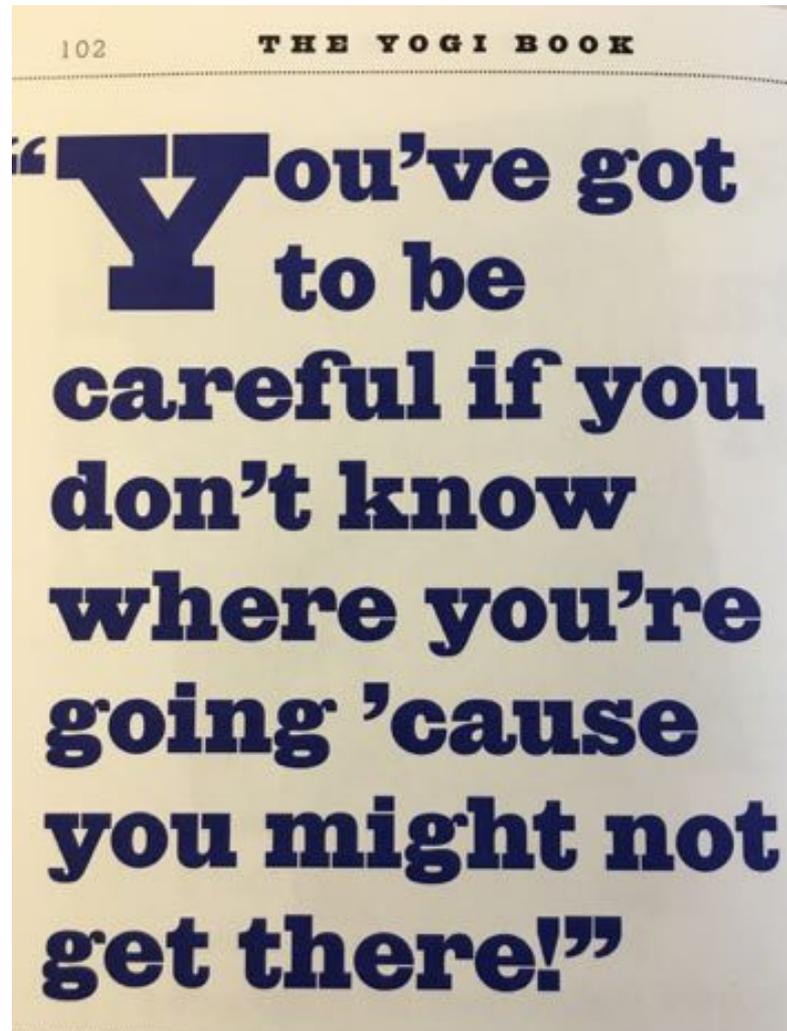
# Passengers



# Conclusions

- Exploring the possible future of ICU care in 2050 is quite compelling
- Concepts for ICU 2050 vision are in early stages today
- But still, why put time & thought into the future?

Because Yogi Berra, former NY  
Yankee great, says:



# **Intensive Care Unit design in 2050: Merging the future with the present**

However, there are things  
we don't know, we don't know!



# Thank You!

