A case for People-in-the-Loop to improve Knowledge Translation: Implications for patient safety

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Disclosures

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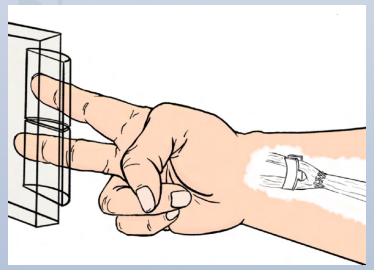
Neuromuscular Dynamics

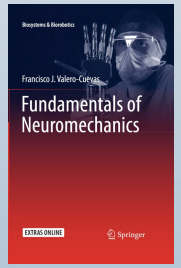
Born in Mexico City, I am an engineer, neuroscientist and inventor with a passion to combine engineering with biology

In my USC lab, students come from multiple backgrounds to solve problems at the interface of engineering, AI, physical therapy, robotics, biology, neuroscience and medicine

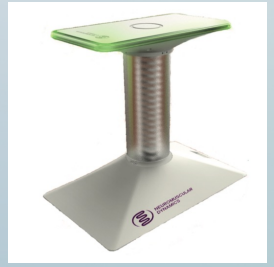


Surgical procedures

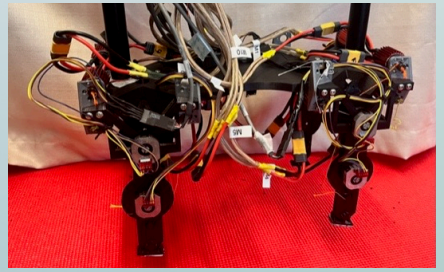
Surgical implants



Computational neuroscience



Medical devices



Bio-inspired robots

17 years

"An alarming and frequently quoted statement about the total attrition in the funnel and the lapse between **research** and **practice** is that 'It takes **17 years** to turn 14%of original research to the benefit of patient care'." Balas and Boren 2000, Green 2008, Graham et al. 2001

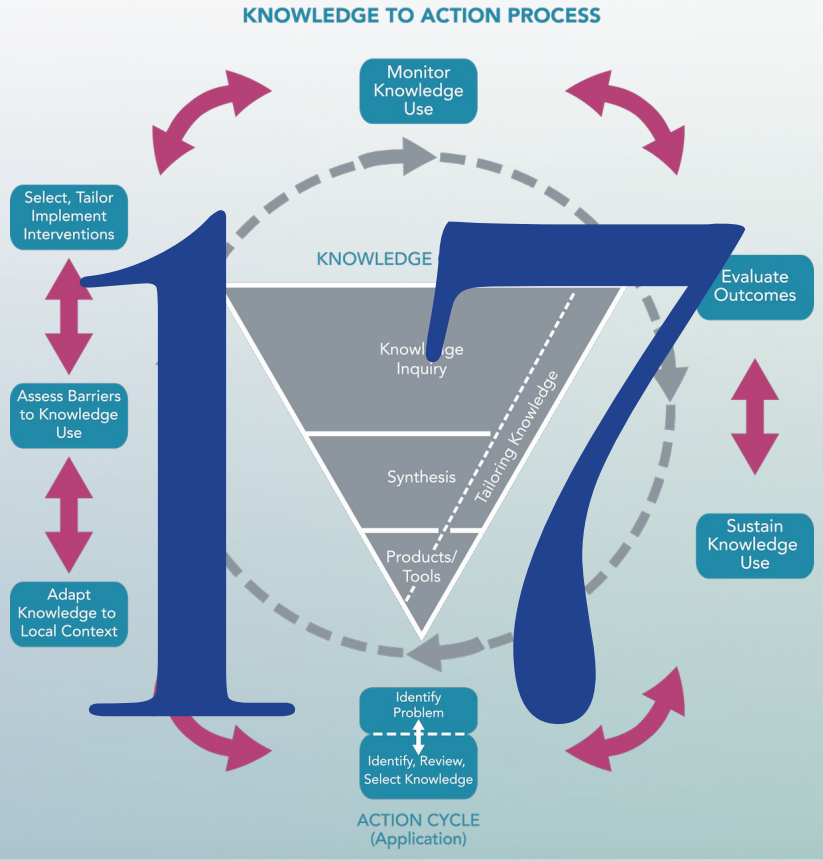
17

Can we shorten these 17 years in light of current technology?
How can we apply recent knowledge and technology to reduce harm and deaths sooner than that,
and reach ZERO unnecessary deaths by 2030?

“Knowledge-to-Action” translation

Creating Standard of Care is driven by a **diffusion-dissemination-implementation** continuum:

- **Diffusion:** passive, untargeted and un-planned spread of new practices
- **Dissemination:** planned active spread of new practices to the target audience
- **Implementation:** putting to use or integrating new practices within a setting



Nilsen *Implementation Science* (2015)
Figure adapted from Graham et al. *Journal of Continuing Education in the Health Professions* (2006)

The translation of “Knowledge-to-Action” challenge

- **Diffusion:** passive, untargeted and un-planned spread of new practices
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- **Implementation:** putting to use or integrating new practices within a setting

Impediments

The **funnel fallacy** endorses time-intensive reduction of many options to a single “best practice”

The **empty-vessel fallacy** considers practitioners, patients and caregivers as passive recipients of best practices

Skepticism
Cost
Time
Training
Technology

Nilsen *Implementation Science* (2015)
Figure adapted from Graham et al. *Journal of Continuing Education in the Health Professions* (2006)

However, these lengthy translation times need not be the case for simple, **low-risk rehabilitation devices that bring immediate benefits**

The problem and solution are known, and it is the **implementation** that is the main challenge

Green LW. Making research relevant: if it is an evidence-based practice, where's the practice- based evidence? Family Practice 2008

Case in point:
FDA Class I medical devices suitable for in-clinic, at-home and Remote Therapeutic Monitoring (RTM)

Minimal risk devices for “pre-habilitation,” and rehabilitation to improve and accelerate recovery, monitor participation, etc.

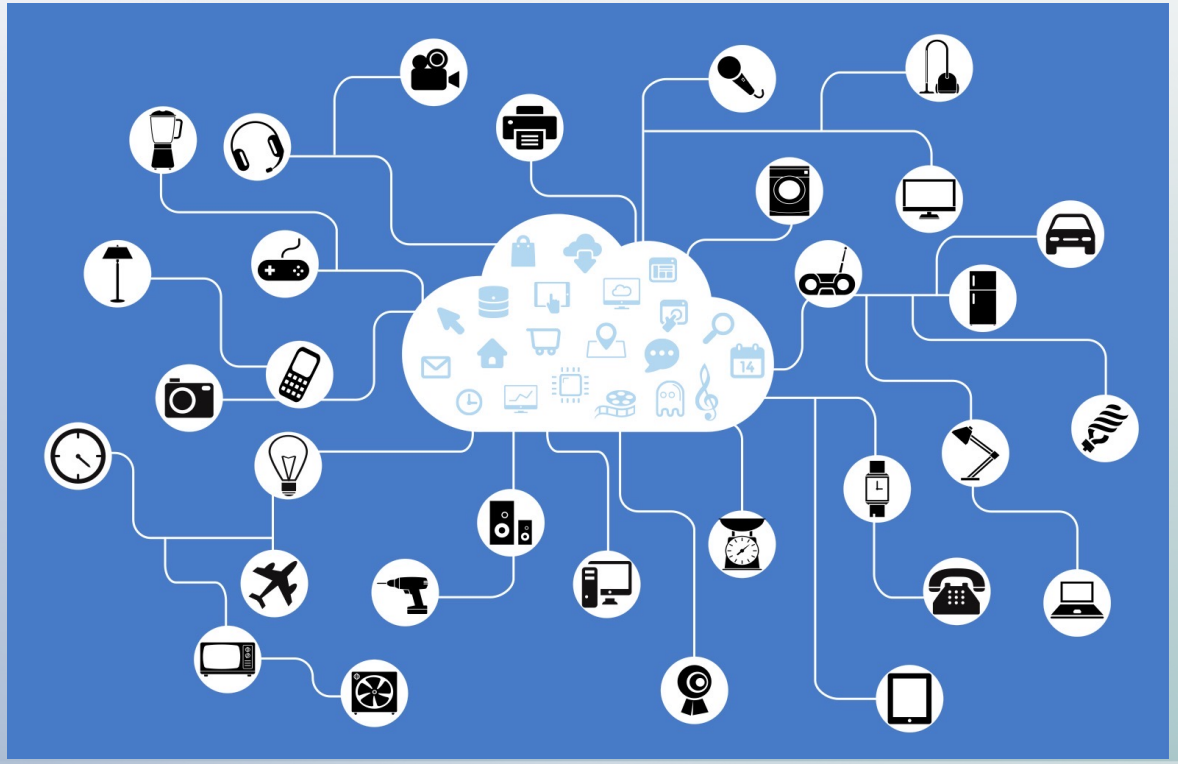
These devices can be both “medical devices” and consumer products, but can they become “Standard of Care” in under 17 years?

How could we leverage recent sensors, communications and AI developments to engage stakeholders?

From the outset, Balas and Boren (2000) recognized the impossibility of "General physicians…examining 19 articles a day."

For them, "computerized information systems hold the promise of better connecting clinical research and patient care practices."

We can leverage the **Internet-of-Things (IoT)** to easily connect practitioners, patients and caregivers



IoT Image by jeferrb from Pixabay

For **low-risk medical devices**, we could and should greatly reduce implementation time to improve patient safety

Clients/yr., USA

200,000

800,000

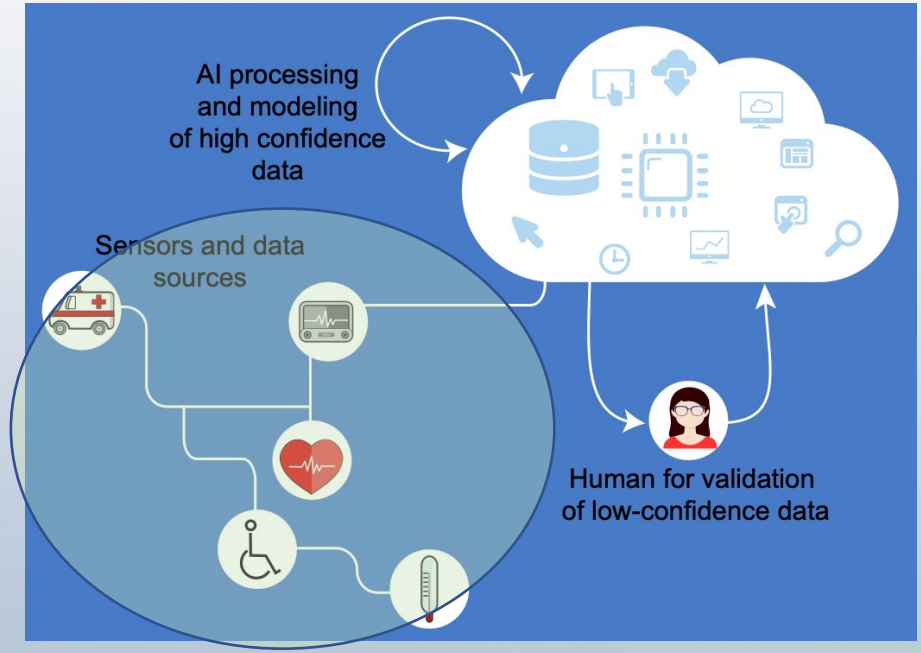
2 million

I have experience taking a Class I, cloud-enabled device to the clinic, home and gym to enhance the ability to walk and return to sport after, say, **knee injuries/replacements or chemotherapy-induced peripheral neuropathies**

Photos Credits: Cleveland Clinic Sports Medicine, HSS, UPenn

Why not extend the existing Human-in-the-Loop AI architecture?

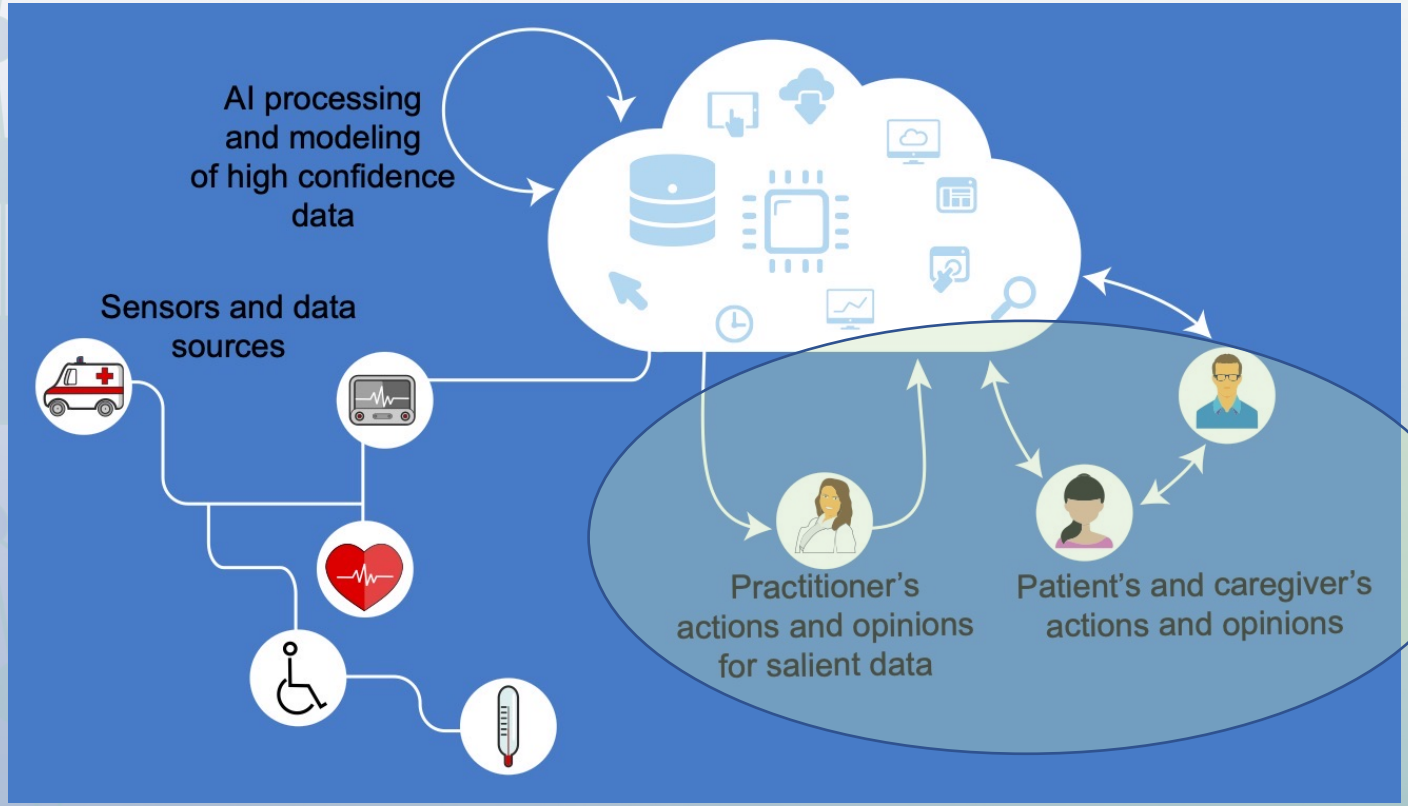
Promote the acceptance of Internet-of-Medical-Things (**IoMT**)



In the traditional model:
the human annotates, curates and validates data

*Hajiheydari, Skepticism and Resistance to IoMT in Healthcare: Application of Behavioural Reasoning Theory with Configurational Perspective (2021)

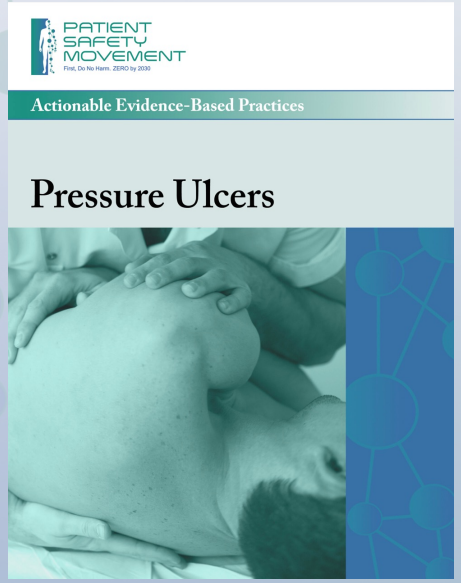
In the **People**-in-the-Loop architecture…

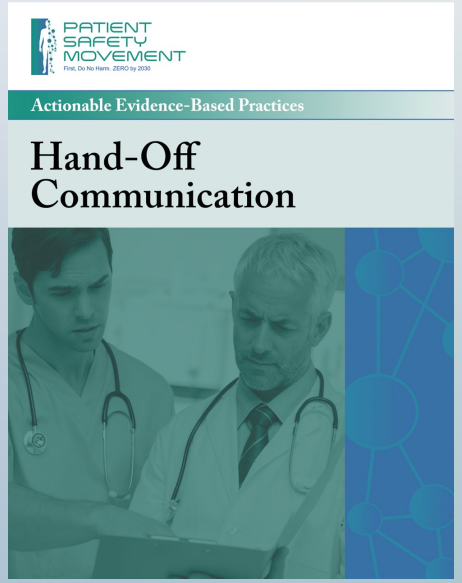


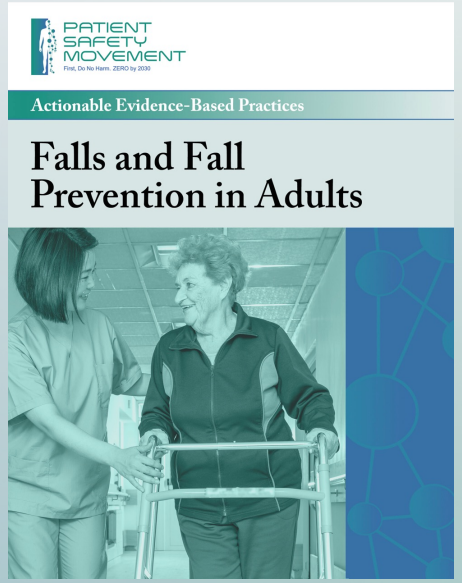
Augment the architecture to close the loop via multiple, active, engaged participants

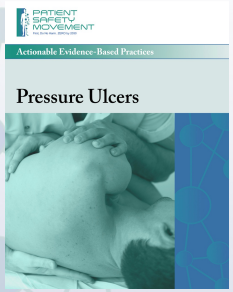
Adapted from Gordon Johnson Pixabay

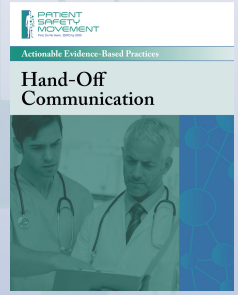
Opportunities to use People-in-the-Loop for **Patient Safety** in the Actionable Evidence-Based Practices

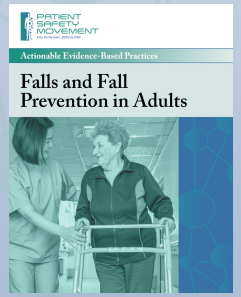












Improve patient safety individually and as a process by:

- Inviting patients, caregivers and practitioners into a **collaborative** network of sensors + data + AI for salience and messaging among participants
- Improving real-time reminding, reporting and detection of relevant events to help **implement** the Actionable Evidence-Based Practices
- Distributing **responsibility and benefits** across stakeholders

Wearables, sensors, edge-computing algorithms, pattern detectors, networks, messaging apps, etc. are all available

Conclusion: Leverage IoMT + People-in-the-Loop architecture to implement practical solutions to end preventable patient harm

- Reduce unnecessary deaths by accelerating the implementation of Knowledge-to-Practice
- Enable patients, caregivers and practitioners to go from recipients of best practices to full partners
- Mitigate skepticism and promote collaboration among patients, caregivers and practitioners
- Transform Remote Therapeutic Monitoring (RTM) to include *Patient Safety Monitoring (PSM) via a People-in-the-Loop architecture*
- Thereby reduce implementation time from **17 years to zero to improve outcomes, and help reach ZERO unnecessary deaths by 2030**

Thank you