RCPsych Digital SIG
Annual Conference - 2022

Can a Technology-monitored Treatment Order (TTO) provide an alternative to CTO and improve treatment adherence?

Amitkumar Chougule
ST-5 Speciality Registrar
Cambridgeshire and Peterborough NHS Foundation Trust


Best Interest
Decision

What problems are we trying to solve?

Medication non-adherence an "invisible epidemic"

Limited objective methods to monitor medication concordance

A prolonged in-patient stay and delays in granting section 17 leave

Use of MHA sections and CTO as a defensive clinical practice

CATEGORIES OF PATIENTS ENCOUNTERED IN CLINICAL PRACTICE

- Not willing to take medications
- High risk

Willing to take oral medications
Treating team has concerns
High risk – depot?

- Willing to take medications
- Make frequent errors with medication
- Compromised cognitive ability

- Willing to take medications as self-administration
- Do not want to take it from staff or under monitoring

CATEGORIES OF PATIENTS ENCOUNTERED IN CLINICAL PRACTICE

Are restrictive measures justified ?

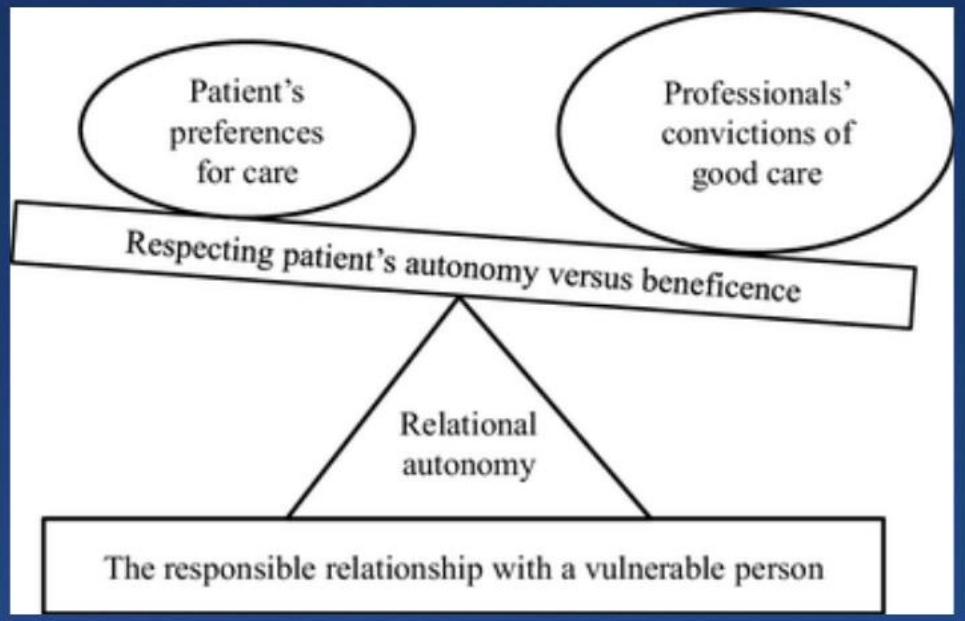
- Not willing to take medications
- High risk

Willing to take oral medications
Treating team has concerns
High risk – depot?

- Willing to take medications
- Make frequent errors with medication
- Compromised cognitive ability

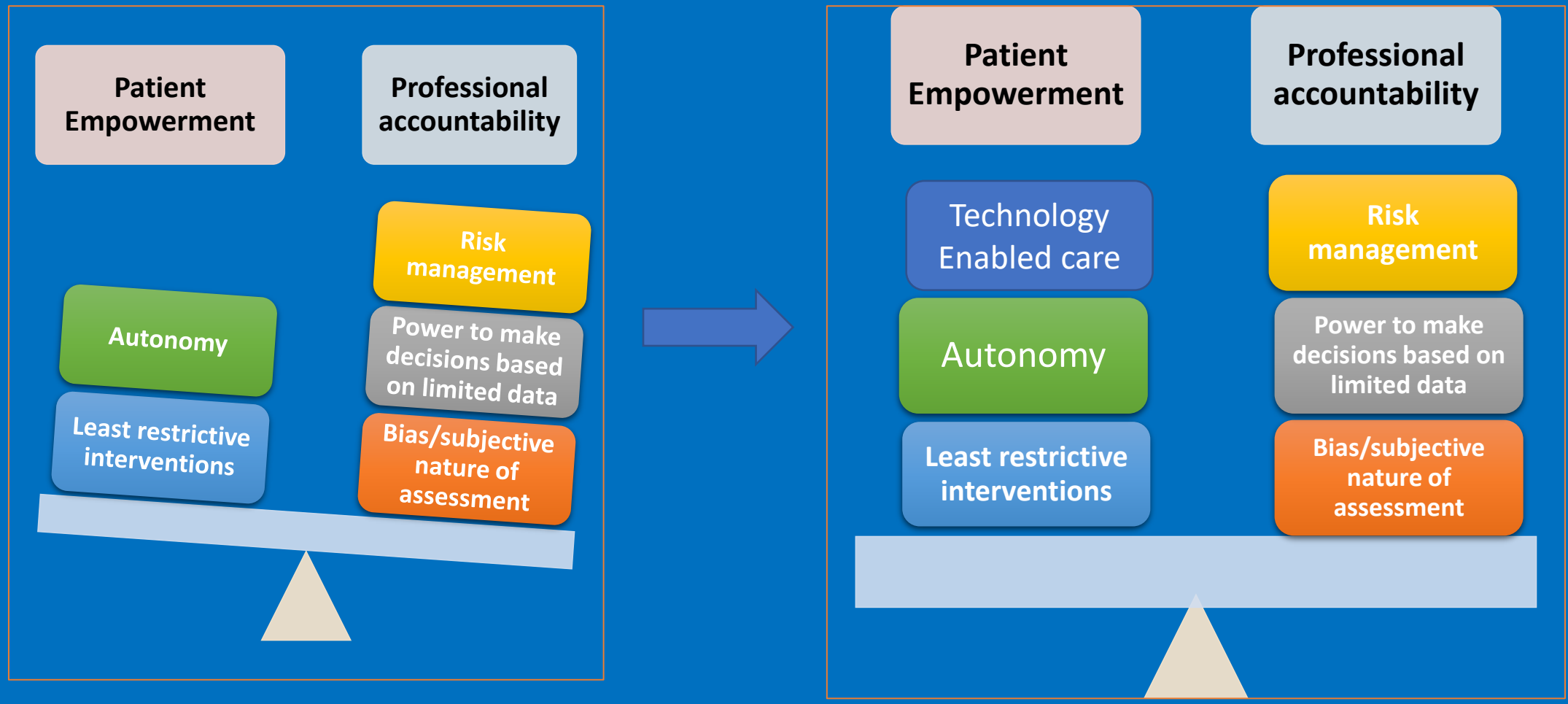
- Willing to take medications as self-administration
- Do not want to take it from staff or under monitoring

The Most Elusive Dilemma for a Psychiatrist

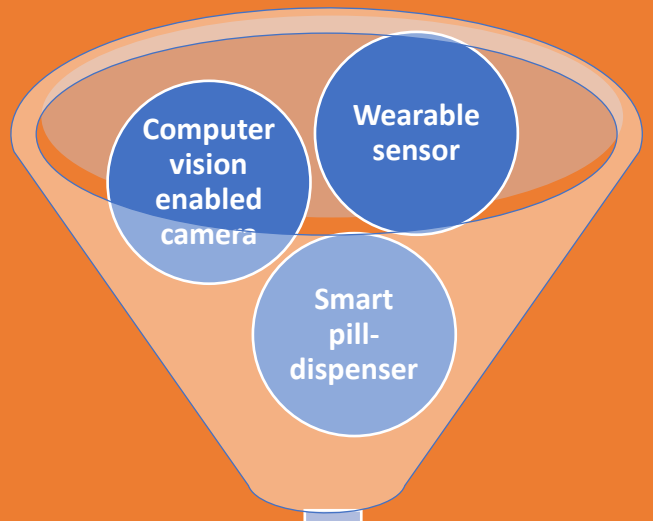


Heidenreich, K., Bremer, A., Materstvedt, L.J. et al. Relational autonomy in the care of the vulnerable: health care professionals' reasoning in Moral Case Deliberation (MCD). Med Health Care and Philos 21, 467–477 (2018)

Innovative Technology Enabled Solution



What is the Proposed Solution ?



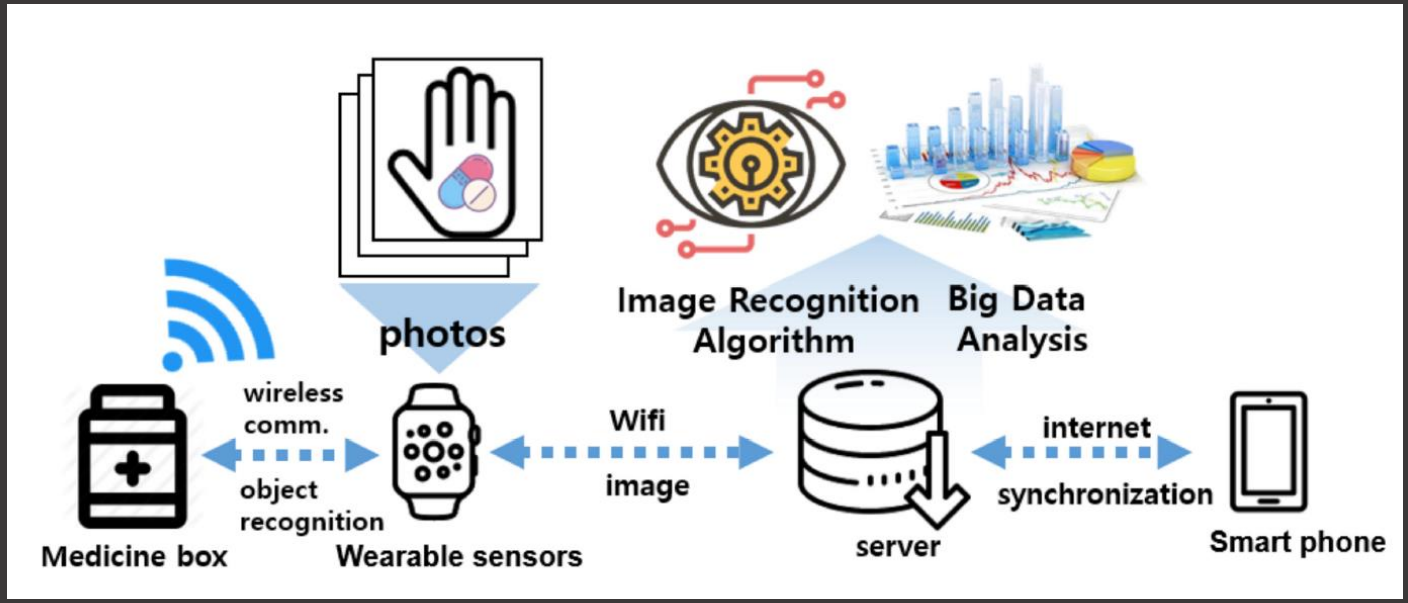
Innovative digital health solution

Table 1. A taxonomy of the technology-based approaches for medication adherence monitoring.

Reference	Main Technology	Secondary Technology	Monitored Activities and/or Subjects
Hayes et al., 2006 [61]	Smart pillbox	–	Lid opening
Aldeer et al., 2018 [62]	Smart pill bottle	–	Lid opening and closure, bottle picking and flipping/shaking, bottle weight
Lee and Dey, 2015 [63]	Smart pillbox	–	Lid opening and closure, box manipulation
Kalantraian et al., 2016 [64]	Wearable sensors	Smart pill bottle	Pill bottle pick up and pill swallowing
Wu et al., 2015 [65]	Wearable sensors	Ingestible biosensors	Pill swallowing
Putthaprasart et al., 2012 [66]	Wearable sensors	–	Drinking water, picking pills by one hand, holding pills using both hands, hand(s) to mouth motion
Kalantraian et al., 2015 [67]	Wearable sensors	–	pill bottle opening, pill removal, pill pouring into the secondary hands, water bottle handling
Hezarjaribi et al., 2016 [68]	Wearable sensors	–	Hand-to-mouth motion
Wang et al., 2014 [69]	Wearable sensors	–	Taking a pill, drinking water and wiping mouth
Chen et al., 2014 [70]	Wearable sensors	–	Cap twisting and hand-to-mouth actions
Serdaroglu et al., 2015 [71]	Wearable sensors	–	open-pill-box, put-glass-back, put-pill-in-mouth, drink water
Mondol et al., 2016 [72]	Wearable sensors	–	User's response in the form of voice commands
Abdullah and Lim, 2017 [73]	Wearable sensors	–	Hands movement
Hafezi et al., 2015 [74]	Ingestible biosensors	–	Medication ingestion
Chai et al., 2016 [24]	Ingestible biosensors	–	Medication ingestion
Agarawala et al., 2004 [75]	RFID	–	Pill bottle pick up
Becker et al., 2009 [76]	RFID	–	Pill removal
McCall et al., 2010 [77]	RFID	–	Pill bottle removal
Morak et al., 2012 [78]	NFC	–	Pill removal
Batz et al., 2005 [79]	Computer vision	–	Pill bottle opening, hand over mouth motion, bottle closing
Valin et al., 2006 [80]	Computer vision	–	Pill bottle opening, pill picking, pill swallowing, bottle closing
Dauphin and Khanfir, 2011 [81]	Computer vision	–	Pill bottle picking, drinking a glass of water, putting glass back
Huynh et al., 2009 [82]	Computer vision	–	Tracking the face, the mouth, the hands, a glass of water, and the medication bottle
Bilodeau and Ammouri, 2011 [83]	Computer vision	–	Occlusion of hands, occlusion of a hand and the face, medication bottle recognition
Sohn et al., 2015 [84]	Computer vision	–	Bottle weight
Tucker et al., 2015 [85]	Computer vision	–	Patient gait
Li et al., 2014 [86]	RFID	Sensor networks	Pill removal, hand motion
Hasanuzzaman et al., 2013 [87]	RFID	Computer vision	Pill bottle removal, tracking hands and medication bottle
Suzuki and Nakauchi, 2011 [88]	Computer vision	Sensor networks	Pill bottle removal, user behavior prediction
Moshnyaga et al., 2016 [89]	Computer vision	Smart pillbox	Pillbox opening and closing, hand-to-mouth motion
Abbey et al., 2012 [90]	Smart pillbox	Mobile application	Pill removal
Boonnuddar and Wuttidittachotti, 2017 [91]	Smart pillbox	Mobile application	Bottle weight

How does this technology work?

Lee, H.; Youm, S. Development of a Wearable Camera and AI Algorithm for Medication Behavior Recognition. Sensors 2021, 21, 3594.



How does this technology work?

- **Lee, H.; Youm, S. Development of a Wearable Camera and AI Algorithm for Medication Behavior Recognition. Sensors 2021, 21, 3594.**

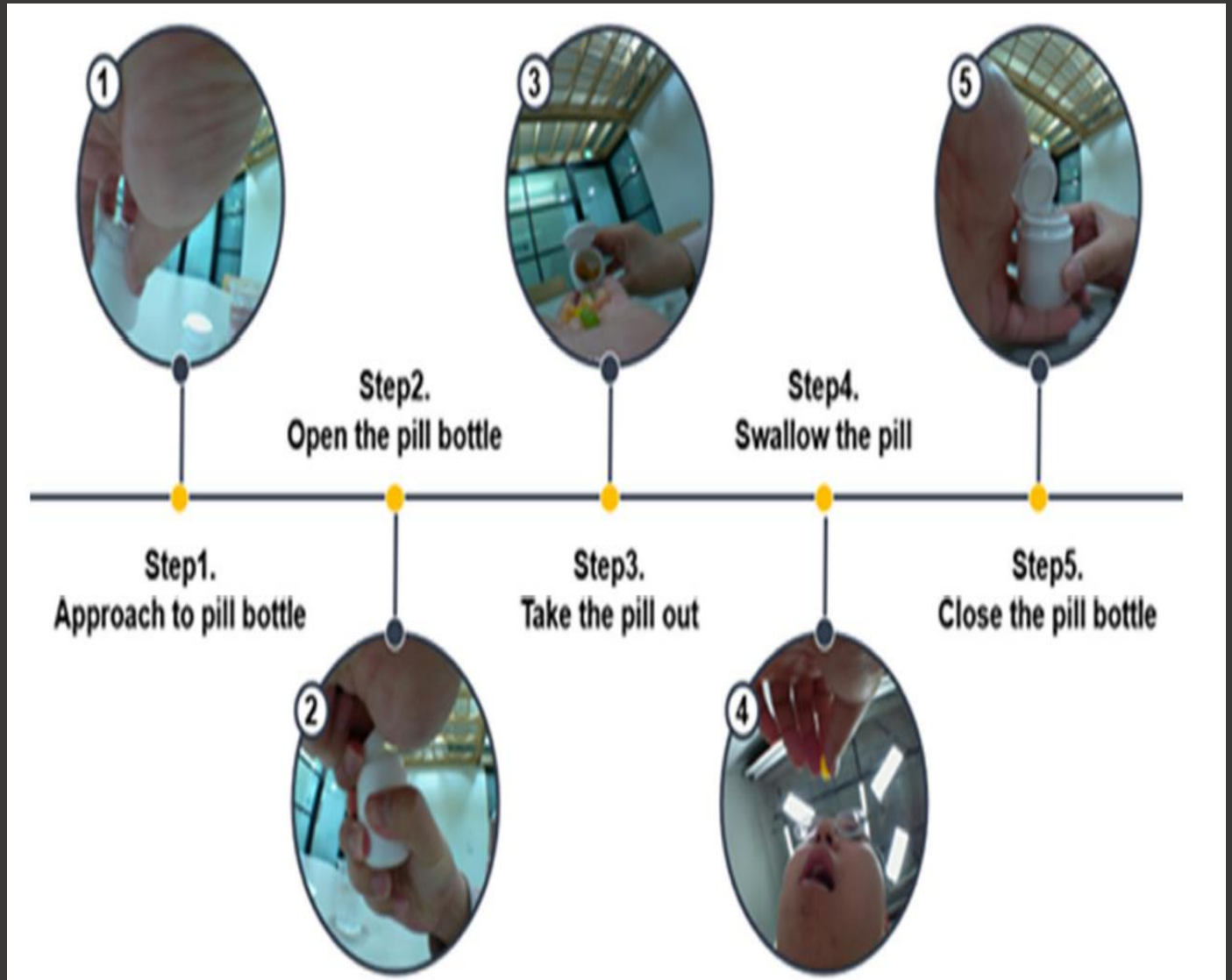
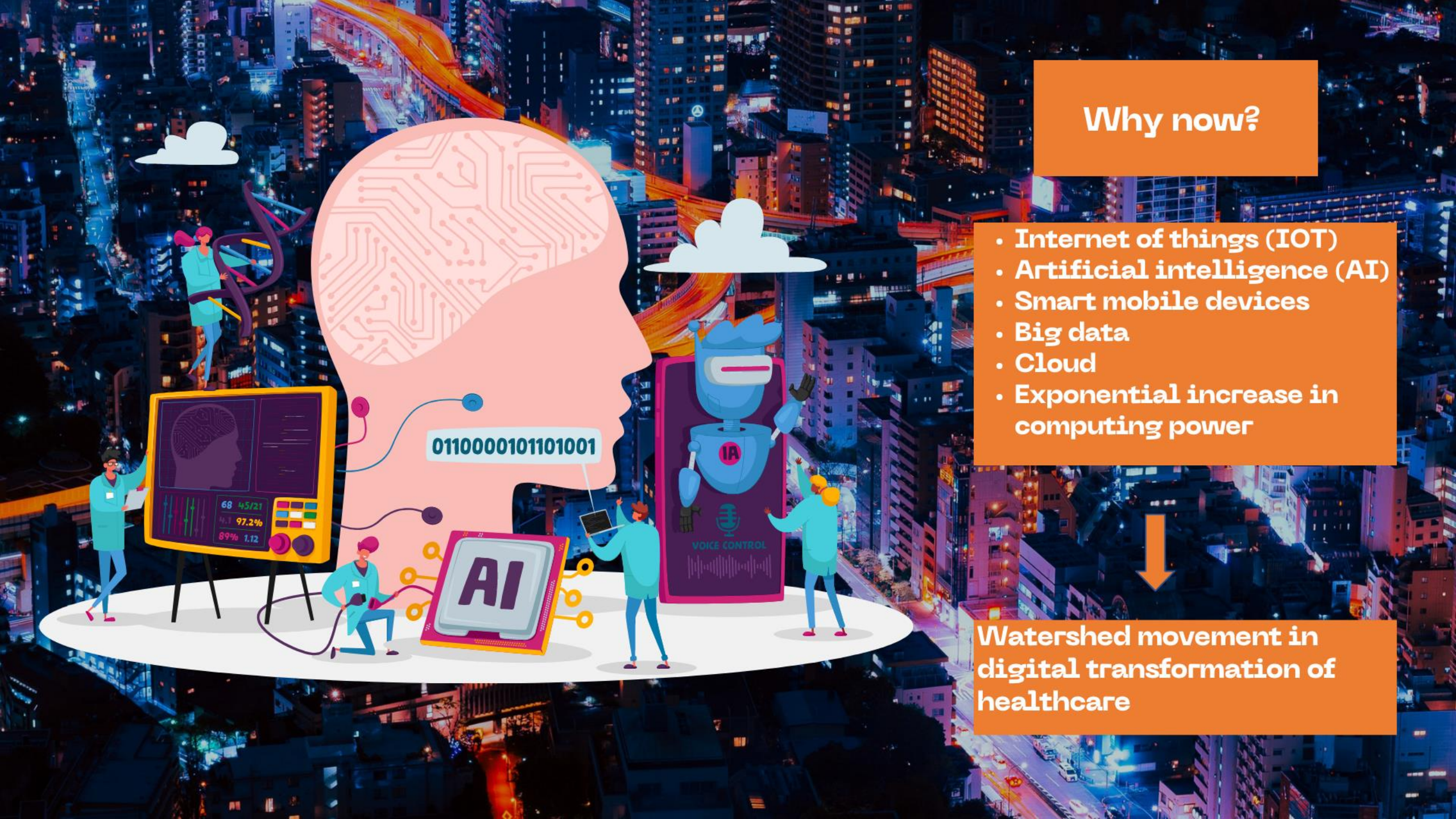


Figure 5. Example steps of the medication behavior recorded by the smartwatch.



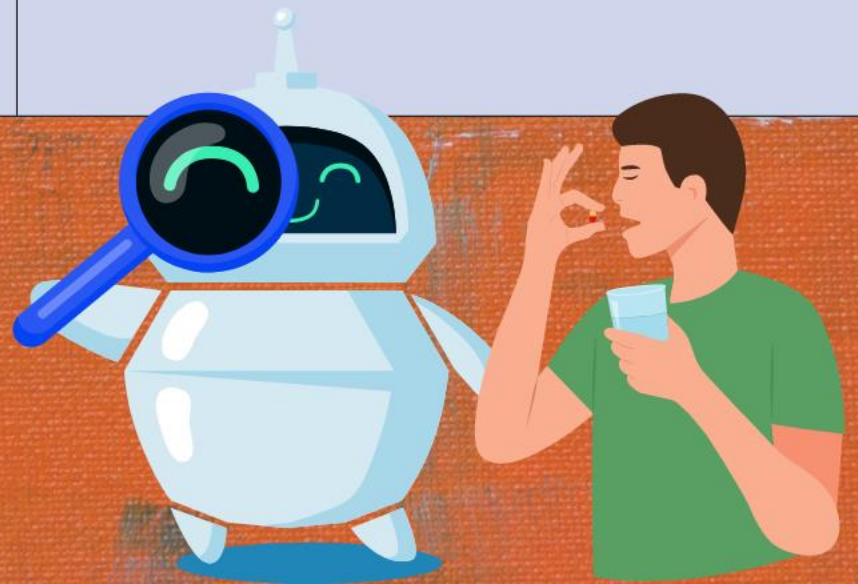
Why now?

- Internet of things (IOT)
- Artificial intelligence (AI)
- Smart mobile devices
- Big data
- Cloud
- Exponential increase in computing power

Watershed movement in digital transformation of healthcare

APPLICATION OF THIS DIGITAL HEALTH SOLUTION

	Technology-supported Self Administration of Medications (T-SAM)	Technology-monitored Treatment Order (TTO)
Concept	• Digital health solution is offered and recommended • No monitoring • No provision for feedback and alerts	• Digital health solution is prescribed



Technology-monitored Treatment Order (TTO)

- Involves active monitoring and feedback
- Provision of automatic alerts in case of non-adherence
- Treatment plan is co-produced in collaboration with the patient
- Has the ability to impose stepped restrictions
- In case of non-concordance first alert goes to person of choice, next to care-co and then if required to responsible clinician
- If failed, can trigger conventional CTO/Cancellation of leave/admission on MHA

Clinical Application Of This Digital Health Solution

	Technology-supported Self Administration of Medications (T-SAM)	Technology-monitored treatment order (TTO)
Indication	❖ Willing to self-administer medication ❖ May need support due to cognitive difficulties ❖ Low to medium risk of non-concordance with support	❖ Patients willing to self administer oral medications ❖ Treating team has concerns ❖ High risk of non-concordance ❖ High risk of harm to self or others secondary to non-concordance

Clinical Application Of This Digital Health Solution

	Technology-supported Self Administration of Medications (T-SAM)	Technology-monitored Treatment Order (TTO)
Purpose/Goal	❖ Support with medications ❖ Improve adherence ❖ Decreased dependence on healthcare services	❖ Monitoring ❖ Trial of less restrictive intervention before considering CTO/MHA
Advantages	❖ Improved adherence ❖ Less utilization of scarce human resources ❖ Early discharge ❖ Decreased rate of relapse and re-admissions	❖ Less restrictive ❖ More autonomy ❖ Power to choose ❖ Better physician-patient relationship

Challenges
More Questions Than Answers!

- Accuracy/sensitivity/specificity
- Digital exclusion
- Cost-effectiveness
- Learning curve
- Acceptance
- Evidence base
- Medico-legal implications

Myths And Misconceptions related to Digital Transformation

What it is not	What it is
Change of software	Change in culture
New cutting edge technology	New cutting edge attitude
Numbers and data	Data driven precision medicine
Increased funding and wastage of resources	Innovation and creativity

Take Home Message

Policy makers/ Government + Innovative Technology = Funding Budget

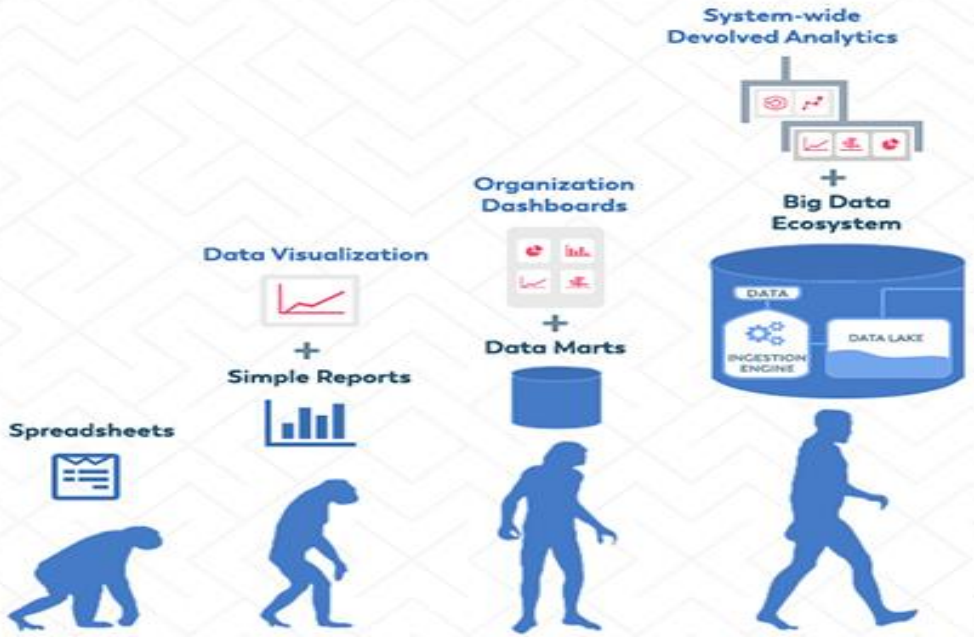
Corporates + Innovative Technology = Business and profit

Healthcare professionals Researchers + Innovative Technology = ?

- Choice
- Alternatives (Less restrictive)
- Autonomy
- Education

Disclaimers!

- No conflicts of interest
- Ideas and opinions my own



KEEP CALM AND Believe In Evolution

Bio-psycho-social model → Bio-psycho-socio-digital model

Thank you