New Technologies Using Patient Data for Healthcare
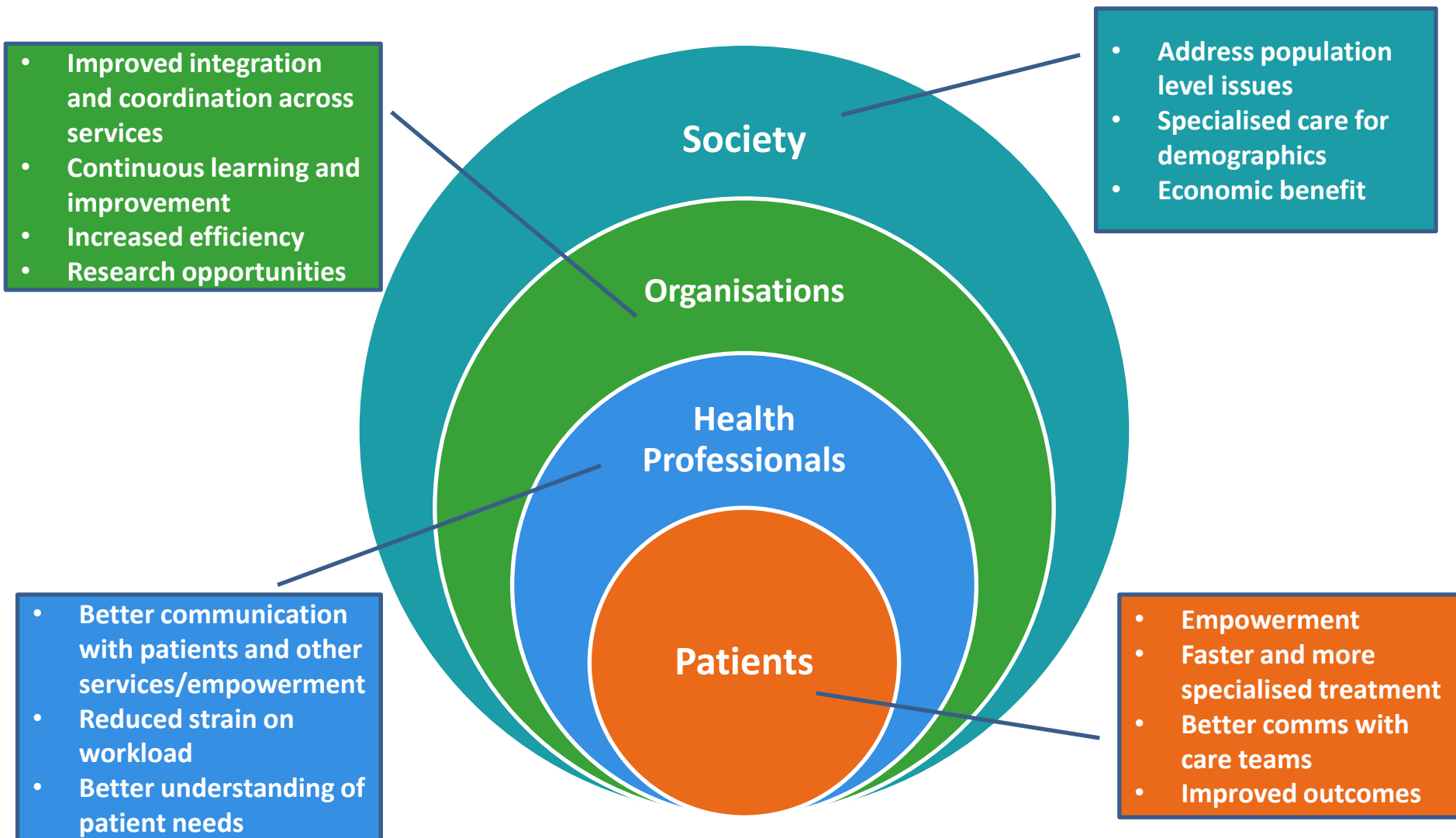
Mapping Opportunities: Impacts and Purposes

Framing the opportunities: Impacts

Society

Organisations

Health Professionals

Patients

- Improved integration and coordination across services
- Continuous learning and improvement
- Increased efficiency
- Research opportunities

- Address population level issues
- Specialised care for demographics
- Economic benefit

- Better communication with patients and other services/empowerment
- Reduced strain on workload
- Better understanding of patient needs

- Empowerment
- Faster and more specialised treatment
- Better comms with care teams
- Improved outcomes

New Digital Technologies

Diagnosis in Primary Care

Treatment

Service Planning & Delivery
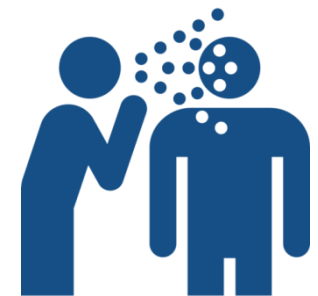
Understanding Disease

Specialist Diagnosis

Everyday Monitoring

Fitness & 'Wellness'

Infection Surveillance

Diagnosis in Primary Care

- Providing a preliminary diagnosis/triage, often automated (e.g. 111 service)

- Helping patients reach their first point of contact in the NHS

- Remote doctor appointments

Example
- British tech firm Babylon Health's intelligent health companion assesses symptoms reported by users to offer a diagnosis.
- It takes into account patient history, monitors health, follows up on past symptoms, gives medication reminders, and can set up a live video GP consultation if necessary.
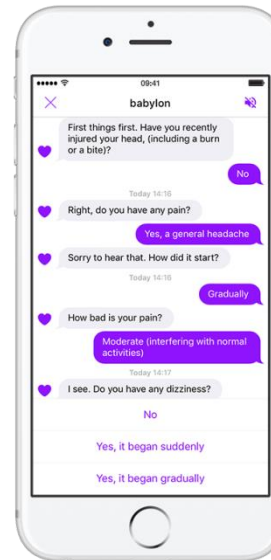
Credit: Babylon

Specialist Diagnosis

- Aiding clinicians in making more specialised diagnoses, e.g. through eye scan or MRI/CT scan analysis
- Providing automated recommendations that can inform treatment planning

Example
- Google DeepMind & UCLH are collaborating to use artificial intelligence (AI) to improve head and neck cancer treatment.
- The system will automatically differentiate between cancerous and healthy tissue on scans, to speed up planning and accurately target radiotherapy treatment.

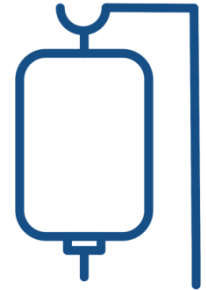**Example**
- Medical device company Peek Vision has developed a smartphone based ophthalmoscope that enables smartphone cameras to capture retinal images. It can be used by health and non-health professionals.
- Their app gathers data on communities lacking access to eye care to refer urgent cases to the right place quickly, and aid planning.

Credit: UCLH

Credit: Peek

Treatment

- Enabling automated, timely treatment as symptoms occur
- Assisting clinical decision-making about treatment options

Example
- IBM Watson for oncology analyses the datasets available to help inform cancer treatments.
- It locates insights for clinicians, specific to each patient's needs, to potentially improve treatment outcome.
- These include key information from medical records, relevant articles, reviews of treatment options and supporting evidence for each option.

Example
- Medical device company 11Health's Ostom-i Alert Sensor is an automated stoma bag.
- It detects and notifies patients of how full their stoma bag is and when it needs to be changed.

Example
- Cellnovo, a European medical technology company, is developing an automated diabetes management system.
- The pump attaches directly to a patient's skin and tracks activity (exercise, etc) through its sensor.
- It sends this data to the handset and web portal (accessible by care teams), and delivers doses of insulin to address glucose swings that it detects in blood levels.
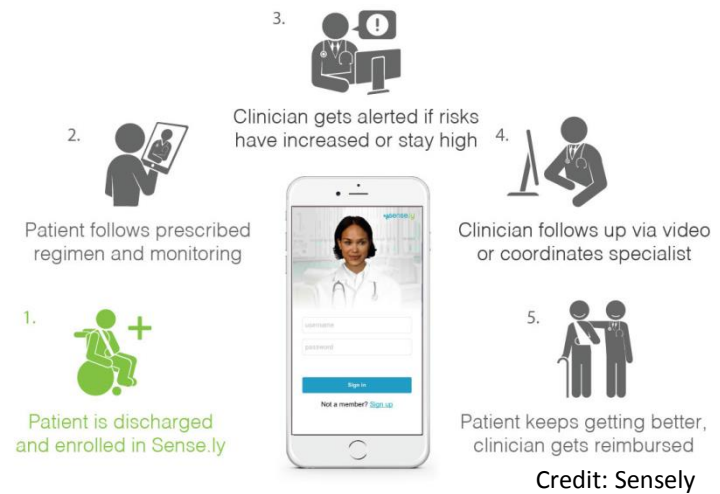
Credit: Cellnovo

Everyday Monitoring

- Empowering patients to self-manage their condition

- Allowing for remote monitoring by clinicians

Example

- AliveCor are a California health tech company who have developed an AI-based platform for patients and clinicians to detect early atrial fibrillation, and reduce risk of stroke.
- Their mobile app, 'Kardia Mobile' allows patients to take their own ECG and monitor their heart rhythm.

Credit: AliveCor

3. Clinician gets alerted if risks have increased or stay high

2. Patient follows prescribed regimen and monitoring

4. Clinician follows up via video or coordinates specialist

1. Patient is discharged and enrolled in Sense.ly

5. Patient keeps getting better, clinician gets reimbursed

Credit: Sensely

Example

- Sensely is a virtual nurse mobile app designed to support patients with chronic conditions in between visits to the doctor.
- It develops a personalised patient care plan, and gives clinicians insight into patient health, allowing them to monitor risk factors and adjust their care approach if necessary.

Service Planning & Delivery

- Increasing the efficiency of care pathways
- Improving communication between health professionals and teams
- Enabling data access, management and audit

Example
- Healthcare solutions organisation Vitalpac's mobile clinical system monitors and analyses patient vital signs to identify deteriorating conditions and provide risk scores.
- It flags patients to relevant teams, ensures faster responses and better outcomes, and reduces time spent on routine tasks.
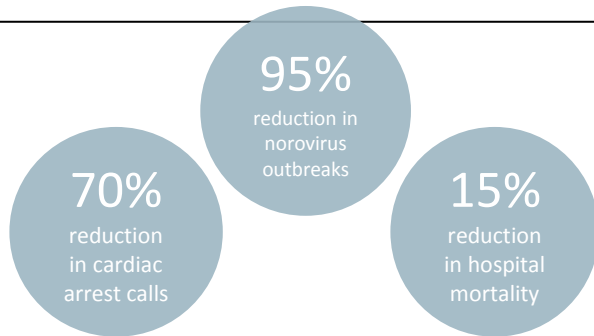
Example
- Google DeepMind's Streams app helps clinicians identify and treat acute kidney injury.
- It allows them to quickly view patient test results, and can send an urgent smartphone alert to relevant clinicians with information about previous conditions so they can make an immediate diagnosis.

Credit: DeepMind

95% reduction in norovirus outbreaks

70% reduction in cardiac arrest calls

15% reduction in hospital mortality

A day in the life of Streams at the Royal Free
February 2017

2,211 Blood tests analysed

66 Changes in kidney function

**23** AKI Alerts issued

11 Cases requiring action

11 Cases requiring action
- ⚠ Including potentially fatal sepsis and rise in potassium
- ⏱ >1 min 60% reviewed in less than a minute
- 📱 2 critical cases reviewed remotely

Infection Surveillance

- Tracking, predicting or modelling the spread of infections and disease
- Linking data sources to monitor and report on disease outbreaks in real time
- Identifying and predicting sources of outbreak/infection
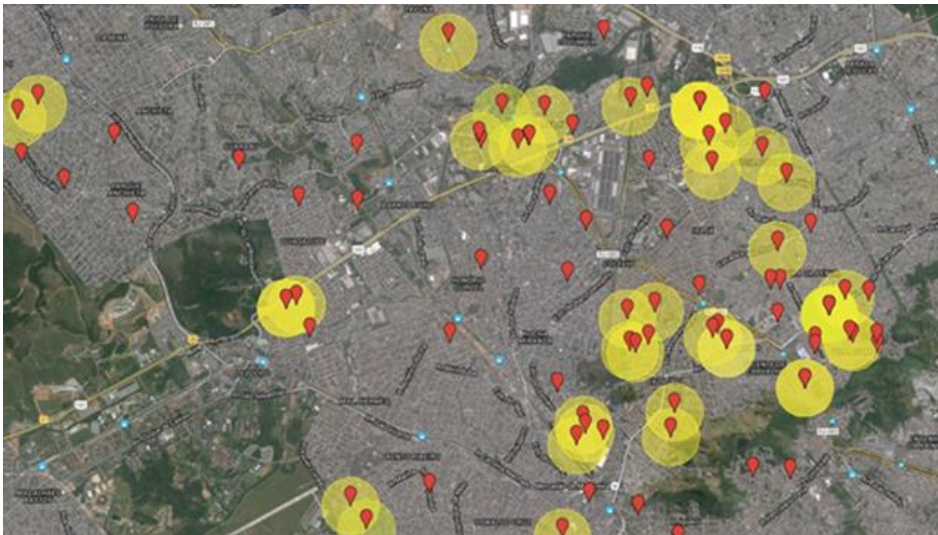
Example

- In 2016, the University of Rochester (New York) developed an app called nEmesis, which uses AI and natural language processing to pinpoint tweets related to food-poisoning and then uses geotagging to trace the source of the outbreak.

Example

- Epidemiological tech company Aime are working on a platform that can predict disease outbreaks in advance of their occurrence.
- Their Dengue Outbreak Prediction platform uses machine learning to provide users with the exact geolocation and date of a potential dengue outbreak up to three months in advance.

Credit: Webe Community

Understanding Disease

- Helping identify trends in complex datasets and literature
- Modelling disease cause and treatment mechanisms
- Speeding up drug discovery
- Symptom tracker studies, cancer-related genomics analyses

Example
- Tech company Benevolent AI use algorithms to improve the efficiency of drug development, produce better target selection, and optimise compounds.
- They also apply their algorithms to vast amounts of scientific data to find 'hidden knowledge', identify areas for further research and highlight unknown trends, mechanisms, etc.

Credit: Sea Hero Quest/Alzheimer's Research UK

Example
- Sea Hero Quest, a collaboration between Alzheimer's Research, UCL, gaming company Glitchers, and University of East Anglia, is a mobile game that collects anonymous data from its users on their navigational abilities.
- This data is then used by researchers to study navigational cognition, specifically what happens in the brain for people with dementia.
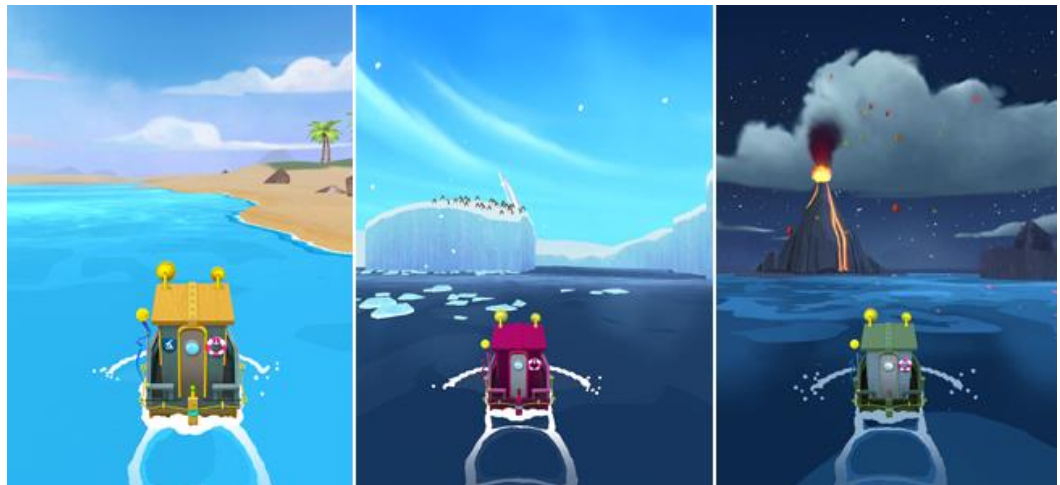
Fitness & "Wellness"

- Enabling people to informally monitor their health, fitness, nutrition, sleep and aspects of wellbeing through proxies for health information
- Linking across different data sources to potentially track other health-related factors

Example
Fitness trackers, step and calorie counters, sleep trackers, nutrition apps; e.g. Fitbit

Credit: Fitbit

Blockchain & Transparent Data Access

What is Blockchain?
An open, shared online ledger that can record transactions between parties in a verifiable, transparent and permanent way. Users choose their level of anonymity.

Where has it been used already?
Estonian eHealth Foundation and blockchain startup Guardtime partnered to protect medical records of 1m+ patients. Estonian citizens hold a unique identifier which links them to their personal medical record.

How could it be used in health?
In healthcare, any access of a patient record would be visible and logged permanently on the system for other users (including the patient) to see and verify.

What are the potential benefits?
Patients could manage their own data repositories (such as specifying levels of access to their data for different users), and security threats and breaches are easier to identify.