Healthcare data and orthopaedics: interoperability and standards

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What are the current challenges of healthcare data

I'm sure most of us have been frustrated when we are unable to view our local or neighbouring hospital's information on a patient that has turned up to our local hospital. We often wonder why patients' healthcare data is not viewable wherever we are in the healthcare setting. The request for notes despite them being in a digital format (EPR/EHR) takes a long time to obtain and often we are flying blind and as a result the patient journey is delayed and sub-optimal. The healthcare data landscape is fragmented and siloed within commercial electronic patient records (EPR) only easily viewable in full within a particular organisation that has procured it. Outside healthcare organisations, including other hospitals and primary care, cannot easily access or view or even update patient information due to the lack of interoperability of electronic health records (EHR).

What is interoperability

The Oxford dictionaries definition of interoperability is the ability of computer systems or software to exchange and make use of information. A more comprehensive definition for the healthcare setting is the ability of different information systems, devices and applications (systems) to access, exchange, integrate and cooperatively use data in a coordinated manner, within and across organisational, regional and national boundaries, to provide timely and seamless portability of information and optimise the health of individuals and populations globally.

What is the solution?

Data-driven healthcare platforms to support integrated multidisciplinary team approach to health and care has been proposed by the Harvard Business Review article *The Strategy That Will Fix Healthcare*[1]. There are six key areas in this strategy for modernising a data driven digital health platform:

1. ***A digital health platform, centred on patients: data should be aggregated around patients, not departments, units, or locations.***
   The creation of life-long, patient-centred electronic health records based on openEHR.

2. ***Common data definitions: terminology related to all diagnoses, lab values, treatments, and other aspects of care should be standardised so that the data can be understood, exchanged, and queried across the system.***
   Today, openEHR[2] specifications offer the most comprehensive semantic framework available in digital health, combining formal clinical modelling, terminology, and a service-based infrastructure. Furthermore, a worldwide network of openEHR clinicians are actively contributing to it, and building additional executable clinical content. A data-driven health ecosystems fuelled by openEHR, which enables everyone in the ecosystem to easily share and immediately use all of the clinical content created by the local or global community, such as decision support, guidelines, forms, patient pathways, assessments, and more.

3. ***Encompassing all patient data: data should be stored in a single place so that everyone participating in a patient's care has a comprehensive view.***
   Using openEHR provides a structured and vendor-neutral clinical data repository (CDR) which is compliant with openEHR specifications. Therefore, data-points are not fragmented or multiplied, and all health data is stored independently of applications. This also enables the creation of a best-of-breed ecosystem made up of connected applications which can be developed by various vendors. Whenever you change an application, you no longer have to migrate the data, and each new solution that you add to the ecosystem can immediately leverage and rely on all the other data stored in the common CDR.

4. ***Accessibility of medical records to all parties involved in care: sharing information among various care team members needs to become a routine.***
   A digital health platform allows data to be accessible and exchanged among all members of medical teams involved in the care processes. This is done under strict security and access rules, and through an ecosystem of various clinical applications connected to the central CDR.

5. ***Templates and expert systems for each medical condition: they make it easier and more efficient for care teams to enter and find data, execute procedures, use standard order sets, and measure outcomes and costs.***
   There is a growing global community around the openEHR approach, and on a daily basis it is building new best-practice and directly executable knowledge artefacts, such as guidelines, decision support, procedures, order-sets, pathways.

6. ***The system architecture makes it easy to extract information: the data needed for measuring outcomes, tracking costs, and controlling risk factors can be readily extracted.***
   An openEHR digital health platform provides the capability of integrating different data sources to a common CDR, as well as the tools to manage and export that data. The data is structured and clearly documented, which enables healthcare organisations to independently access and use the data for various secondary use cases, such as clinical dashboards, outcome tracking, research, registries and population health data.

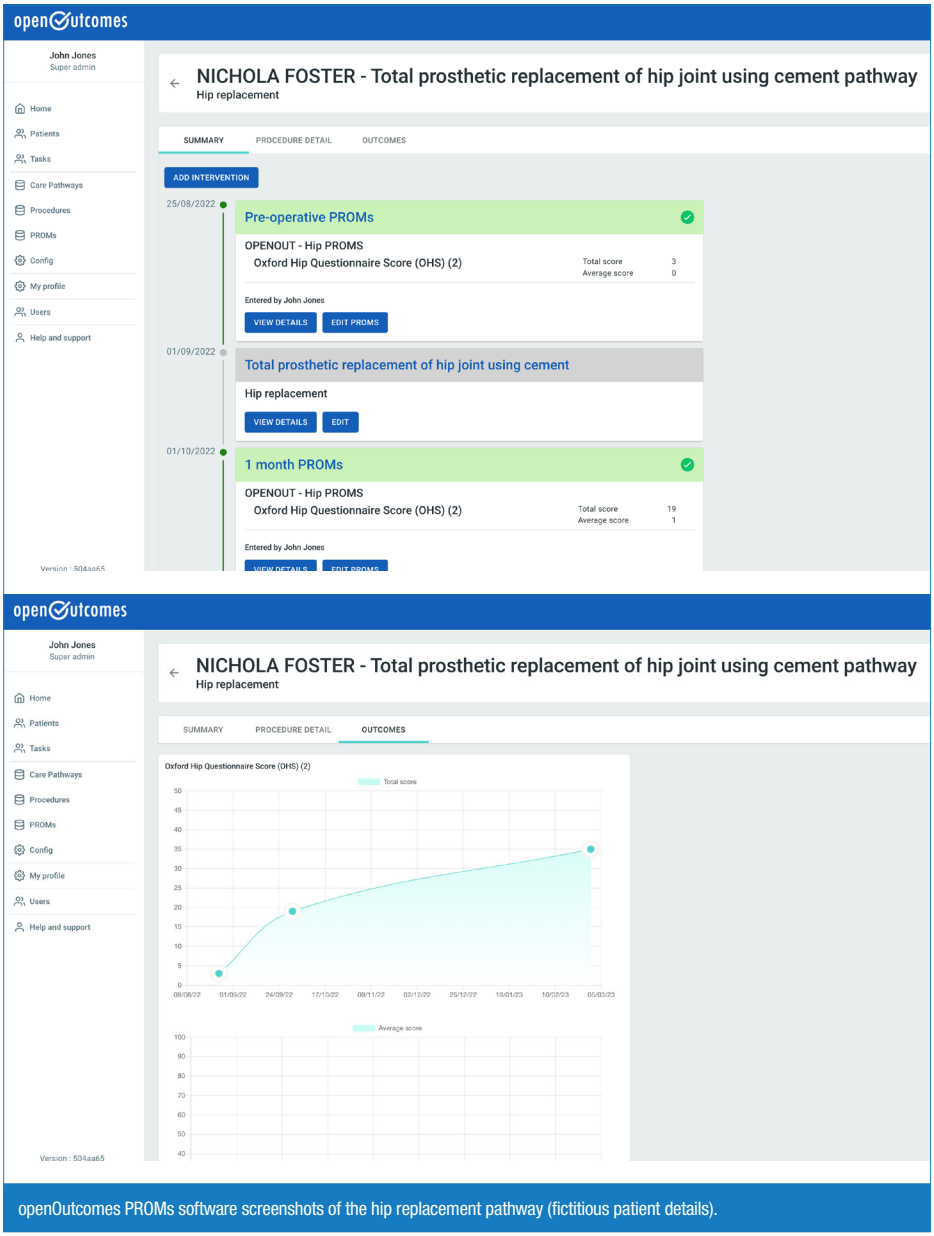
How can we help as an orthopaedic community?

As clinicians and orthopaedic surgeons we can be empowered and engaged in building these data models and take ownership to define these data points. If we get this right we could easily solve the problem of interoperability. Imagine if we could, as a national group (BOA), build these shared common data information models (openEHR) for trauma and orthopaedic care that could be used and re-used in any software application and defined accurately no matter what commercial software supplier is procured. Furthermore we could then choose any App that can simply 'plug n play' rather than migrating data from one vendors system to another system which can lose the integrity of the data or even lose data entirely as well being hugely costly. With good, accurate and faithful data inputs we can have confidence in our analysis of the data locally, regionally and nationally through federated data analysis. There has been many Artificial Intelligence (AI) and Machine Learning (ML) tools built to catch COVID. However none of them helped[3]. This was largely due to poor quality of the data input to develop the AI tools and the lack of semantic data standards. By using openEHR we could have a much stronger confidence and trustworthiness of AI and ML models.

Orthopaedic example of an open data standards based digital platform

The openOutcomes[4] team is a collaborative group of people from within the NHS, the private sector, not-for-profit organisations and academia all sharing the aim of maximising the benefit of digital Patient Reported Outcome Measures (PROMs) for the wellbeing of patients. The project was initiated by NHS staff and clinicians who are frustrated by significant limitations in current processes for collecting, recording and analysing PROMs and the lack of suitability of currently available commercial solutions which are perceived as being inflexible, siloed working, not interoperable and very costly. It is acknowledged that a national solution to the Cumberlege report[5] is required, and this project could be that solution (given its non-commercial nature, open standards (OpenEHR), and highly interoperable open source code), or the learning could inform its ultimate design.

The aim of openOutcomes is to allow patients to directly interact with the platform by recording their own PROMs. PROMs can also be collected and facilitated in a number of ways, by GPs, physiotherapists, clinicians and administrators, and patients together with a tablet, laptop or phone. >>



openOutcomes PROMs software screenshots of the hip replacement pathway (fictitious patient details).

openOutcomes provides multilingual support for patients with language barriers so that the text can be displayed in different languages to support self completion of the PROMs questionnaire. openOutcomes sits in fully compliant cloud-base server or within local IT infrastructure meeting all industry standards for security and GDPR. All data collected via the software is held in an open standards computable format (openEHR) which facilitates data analytics and is designed to interoperate with other hospital/ICS IT systems (Figure 1). NHS organisations have full real time access to their data for analysis, benchmarking and service improvement and population health data analysis and other uses (Figure 2).

openOutcomes has the ability to analyse PROMs data and view charts, graphs, and tables with a variety of queries possible. This allows real time data to be available to clinicians and teams within the NHS organisation using it. Furthermore, openOutcomes records data about the procedure itself which can be passed along with the PROMs data into analysis tools with a range of purposes including correlational analysis, creation of visualisations and machine learning.

Future aims include:

- Ability to push data into the various national registries to avoid duplication and save time.
- The ability for the software to generate bar coded questionnaires so they can be automatically posted out to patients and automatically read when returned and ascribed to the correct patient and operation/intervention therefore not excluding patients who are unable to use digital services.
- Voice generated PROMS scores from robotic generated phone calls.
- As recommended within the Cumberlege report and accepted by the Government in response to the *Report of the Independent Medicines and Medical Devices Safety Review*[6] to establish a UK wide Medical Device Information System (MDIS). openOutcomes can fulfil this by collecting PROMs and linking it to the mandated Unique Device Identification (UDI) number and to feed it into the MDIS.

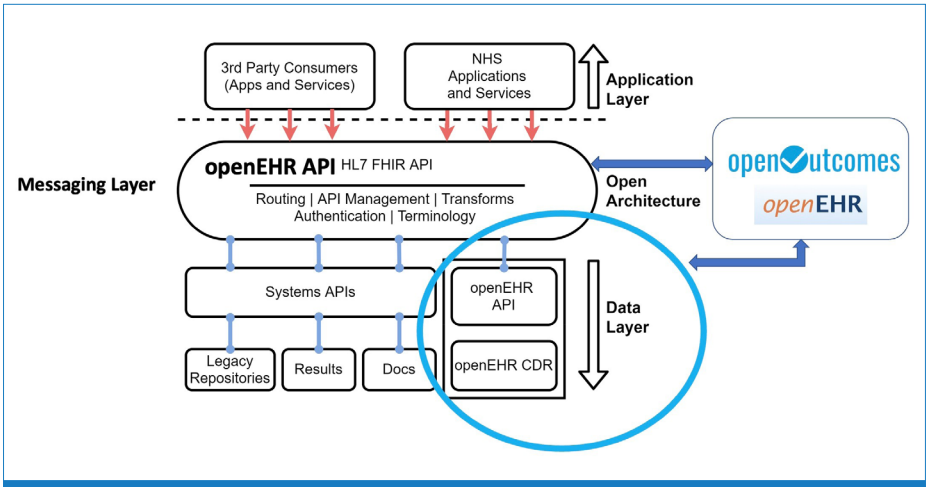


Figure 1: High level data architecture overview of openOutcomes and how it is interoperable with other IT system across the NHS (Diagram adapted from John Meredith, NHS Wales).

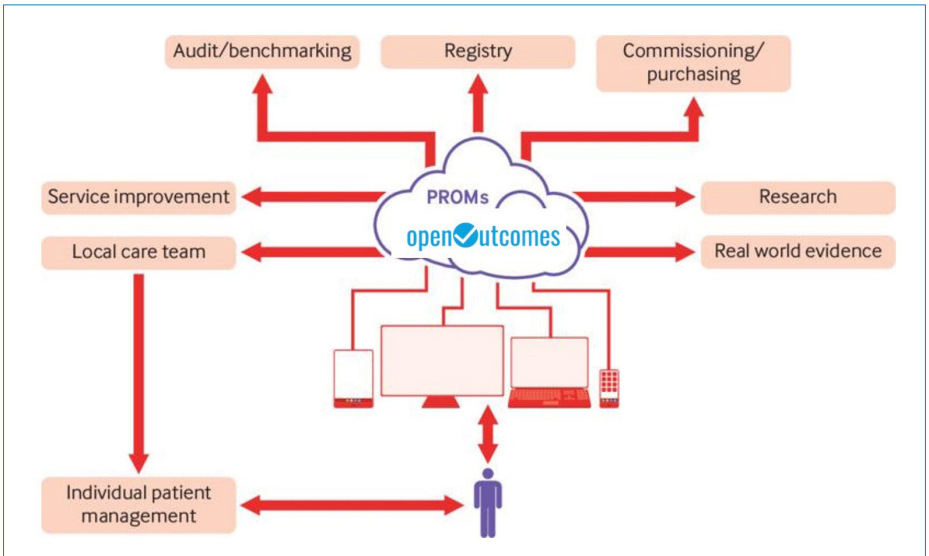


Figure 2: The many uses of PROMs using the openOutcomes digital platform.

Connecting communities for the future of healthcare

In order to create the right data environment for the future, we all have to work together: not only healthcare professionals and their organisations, technicians, vendors, standardisation bodies and interest groups but also public bodies who can create the conditions to embrace international standards (openEHR) and support the collaboration between communities behind them. ■

References

1. Porter M, Lee T. (2013). The Strategy That Will Fix Health Care. *Harvard Business Review*. 91. Available from: https://hbr.org/2013/10/the-strategy-that-will-fix-health-care

2. OpenEHR - A SEMANTICALLY-ENABLED, VENDOR-INDEPENDENT HEALTH COMPUTING PLATFORM Available from: www.openehr.org/resources/white_paper_docs/openEHR_vendor_independent_platform.pdf

3. Heaven WD, (2021). Hundreds of AI tools have been built to catch covid. None of them helped. MIT Technology Review. Available from: www.technologyreview.com/2021/07/30/1030329/machine-learning-ai-failed-covid-hospital-diagnosis-pandemic

4. Apperta Foundation. openOutcomes. Available from: https://apperta.org/openOutcomes

5. First Do No Harm – The report of the Independent Medicines and Medical Devices Safety Review. Available from: www.immdsreview.org.uk/downloads/IMMDSReview_Web.pdf

6. Government response to the Report of the Independent Medicines and Medical Devices Safety Review. Available from: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1005847/IMMDS_Review_-_Government_response_-_220721.pdf