

## Abstract number 5

**Author:** Mustafa Khanbhai

**Location:** London, England

**Title:** Healthcare Text Analytics: Unlocking the Evidence from Free Text

### Objective:

The majority of patient experience feedback remains un-used for quality improvement in Healthcare, mainly resulting from the resource intensity required to manually extract the necessary information, from the large volume of responses, in a timely manner. Furthermore, the information rich free-text responses contain feedback, which complement quantitative measures to help contextualise responses to close questions. Automated or semi-automated analysis using Natural Language Processing (NLP) allows previously unstructured human language input to be analysed using quantitative methods, thereby streamlining patient experience improvement efforts in near-real time. This study assesses the suitability of NLP and machine learning (ML) to successfully and reliably extract coded data from free-text patient experience data.

### Methods:

Retrospective free-text patient feedback data, from January to July 2017 across four healthcare services (Inpatients, Outpatients, Accident and Emergency [A&E] and Maternity) was used to build the ML algorithm. Free text comments were examined in response to the questions: "What did we do well" and "What could we do better". Ten percent of the comments were coded into themes according to the NHS Patient Experience Framework (PEXF) and the sentiment of each comment was rated as positive, negative, or neutral. The patient experience lead and a lay representative coded five percent of the same comments and inter-rater agreement was assessed using Cohen's Kappa.

### Results:

131,946 free-text comments were analysed. Inter-rater agreement in Inpatients was 0.852 and 0.952 for Patient Experience theme and sentiment respectively  $p < 0.001$ , with similar results in the other services. Of the six ML algorithms tested, Support Vector Machine (SVM) learner produced the highest accuracy. The time taken to analyse free-text comments was significantly less compared to reviewing comments manually; 15 minutes versus four days,  $p < 0.001$ . Using an iterative approach, theme and sentiment-driven interactive visualisation dashboards for frontline healthcare staff were created leveraging back-end analytics enabling patient-derived feedback on care quality to be analysed in near real-time, using ML techniques. Using this continually updated source data, the visualisation tool combined with PDSA cycles, has been used, to date, to 'test' for change in two healthcare settings; selected by virtue of their top three most negative patient feedback theme sentiment.

### Conclusions:

This translational work has demonstrated the feasibility of using ML techniques in everyday healthcare for quality improvement for direct patient benefit. Our preliminary work is a promising start to creating a method of analysing free-text comments in patient feedback surveys. By using the SVM learner for prospective near real-time feedback data, patient-reported quality and safety concerns can result in timely healthcare delivery improvements as part of a continuous, patient-directed, quality improvement initiative.

## Abstract number 7

**Author:** Angela Davies

**Location:** Manchester, England

**Title:** Digitally Transforming the United Workforce: Manchester's Journey - from the Masses to the Champions

### Objective:

Digital transformation of healthcare encompasses the movement to paperless patient records through to digital technologies such as wearable devices, robotics and use of artificial intelligence in clinical decision support. In clinical practice it has been accelerated by the ongoing pandemic with a shift in healthcare utilisation, including tele-consultations, usage of healthcare Apps combined with large-scale data sharing (1). Education and training of the workforce needs to keep pace and be equally transformational to maximise the potential from this progress and create a sustainable digital health ecosystem. A recent study that interviewed medical students from across Europe found that only 40% of 451 respondents felt suitably prepared to work in a digitised health system, and 84.9% respondents agreed or strongly agreed that digital health education should be included in the medical curriculum (2). Digital transformation requires strong partnerships between healthcare, academia and industry, enabled by digital champions, team science and strong communities of practice. Here we describe our journey to create such educational programmes underpinned by these capabilities.

1. Peek N, Sujan M, Scott P. Digital health and care in pandemic times: impact of COVID-19 BMJ Health & Care Informatics 2020;**27**:e100166. doi: 10.1136/bmjhci-2020-100166 (accessed 11 April 2021)
2. Machleid F, Kaczmarczyk R, Johann D, Balčiūnas J, Atienza-Carbonell B, von Maltzahn F, Mosch L. Perceptions of Digital Health Education Among European Medical Students: Mixed Methods Survey J Med Internet Res 2020;**22**(8):e19827 URL <https://www.jmir.org/2020/8/e19827> DOI: 10.2196/1982 (accessed 31 Mar 2021)

### Methods:

In collaboration with The Faculty of Clinical Informatics and Health Education England we have pioneered work to develop competency frameworks/curricula for: clinical informaticians; practitioners of digital medicine and artificial intelligence; and clinical data science. This work has been founded upon rigorous mixed method approaches including systematic review of literature and also semi-structured interviews with stakeholders and healthcare professionals (HCPs).

### Results:

This presentation will summarise key outputs from this work, including the frameworks and how they have been utilised at three different educational levels, developing knowledge, skills and behaviours in digital transformation including:

1. Massive Online Open Course (MOOC) **AI In Healthcare** (<https://www.futurelearn.com/courses/artificial-intelligence-in-healthcare>)
2. Training in machine learning for **Topol Fellows** (<https://topol.hee.nhs.uk/digital-fellowships/>)
3. **Clinical Data Science** Postgraduate Certificate, co-created with The Christie Hospital.

### Conclusions:

The provision of education and training to support digital transformation in healthcare needs to be comprehensive and inclusive, addressing the needs of digital novices, through to those wishing to lead and develop digital health innovations. While not everyone needs to understand the fine detail of how a machine learning algorithm works, an appreciation of the requirements, opportunities and limitations of such approaches by HCPs is critical. Furthermore, it is important to increase the cohort of digitally-literate clinicians, clinician informaticians and data scientists that are able to interrogate, regulate and also procure digital health solutions, software and devices to address real clinical problems, implemented in a safe and secure way that **benefits patients**.

## Abstract number 8

**Author:** Hannah Lonsdale

**Location:** Baltimore, Maryland US

**Title:** Machine Learning to Stratify the Perioperative Risk of Pediatric Patients: using the APRICOT Dataset

### Objective:

Anaesthesia risk is calculated on a population “one size fits all” basis, modified by the presence of certain known risk factors. A precision medicine approach to risk calculation for children considered “low risk” enables anaesthesia teams to stratify patients to receive care at satellite sites, or to make decisions in teaching and levels of supervision. We present a high-performance machine learning model for classification of patients as low perioperative risk, as a secondary use of the Anaesthesia Practice In Children Observational Trial (APRICOT) dataset.

### Methods:

APRICOT studied the primary endpoint of incidence of perioperative severe adverse events (AE) in 30 874 children undergoing anaesthetic procedures across 33 European countries. We identified 27 425 patients (88% of the registry) categorized as ASA I or II, presenting for their first procedure and whose AE was not caused by drug error. This subset experienced 1087 AEs, a rate of 4%.

We handled missing fields using multiple imputation for continuous variables and random draw for discrete variables. A 25:1 class imbalance existed in the original dataset. Several sampling techniques were tested, of which under-sampling of the majority class was most effective. Training and testing data was split in a stratified fashion 17:1. K-fold stratified cross validation was used for training (k=5). Models were built using multiple machine learning techniques. Model performance was evaluated using accuracy, AUROC, positive predictive value and negative predictive value. This study was classified as IRB exempt.

### Results:

The top performing model was extreme gradient boosting and achieved an accuracy between 0.7 and 0.8, an AUROC of 0.6-0.7, a maximum positive predictive value (PPV) of 0.13 and a negative predictive value (NPV) greater than 0.9. Our results show that type of airway interface, in-patient status and recent history of influenza are the most substantial predictive factors for AEs.

### Conclusions:

Our models show an AUROC that is considered acceptable when using a highly imbalanced dataset. However, even our best performing model demonstrates a low PPV- as do many other models trained on clinical data, where class imbalance is common. Most clinical utility may therefore lie in using the high NPV as a screening tool to identify patients at low risk for AEs. This may help stratify patients to receive care at satellite sites, or to make decisions in teaching and levels of supervision. We will produce a calculator and intuitive user interface for clinical use of the models in real-time.

## Abstract number 12

**Author:** Ben Glampson

**Location:** London, England

**Title:** North West London Covid-19 Vaccination Programme: Real-world evidence for vaccine uptake and effectiveness.

### Objective:

The study assessed the early vaccine administration coverage and effectiveness across North West London, with specific aims to describe vaccination coverage (including those declining a vaccine) across NWL and assess the early effectiveness of Covid-19 vaccination

### Methods:

The study used a Retrospective cohort design, analysing de-identified Whole Systems Integrated Care data (novel primary, secondary and social care linked dataset covering NW London population) for 2,183,939 individuals eligible for COVID 19 vaccination between 8/12/2020 and 15/2/2021 with follow up data to 24/2/21.

Multivariable Cox regression analysis was applied to investigate whether vaccination independently predicted having a COVID positive swab during follow-up, after adjusting for age, gender, ethnicity, index of multiple deprivation (IMD) and vaccination manufacturer. Cumulative COVID positive results were analysed accounting for censoring time.

### Results:

During the NWL vaccine programme study time period 5.88% of individuals declined and did not receive a vaccination. Black or black british individuals had the highest rate of declining a vaccine at 16.14% (4,337). There was a strong negative association between deprivation and rate of declining vaccination ( $r=-0.94$ ,  $p<0.01$ ) with 13.5% of individuals declining vaccination in the most deprived postcodes compared to 0.98% in the least deprived.

In the first six days after vaccination 344 of 389587 individuals tested positive for COVID-19 (0.09%). The rate increased to 0.13% (525/389,243) between days 7 and 13, before then gradually falling week on week.

At 28 days post vaccination there was a 74% (HR 0.26 (0.19-0.35)) and 78% (HR 0.22 (0.18-0.27)) reduction in risk of testing positive for COVID -19 for individuals that received the Oxford/Astrazeneca and Pfizer/BioNTech vaccines respectively, when compared with unvaccinated individuals.

After vaccination very low rates of hospital admission were seen in individuals testing positive for COVID-19 (0.01% of all patients vaccinated).

### Conclusions:

This study provides further evidence that a single dose of either the Pfizer/BioNTech vaccine or the Oxford/Astrazeneca vaccine is effective at reducing the risk of testing positive for COVID-19 up to 60 days across all adult age groups, ethnic groups, and risk categories in an urban UK population. There was no difference in effectiveness up to 28 days between the Oxford/Astrazeneca and Pfizer/BioNTech vaccines. The risk of contracting COVID-19 and/or becoming hospitalised after vaccination has been demonstrated to be very low in the vaccinated population.

In those declining vaccination higher rates were seen in those living in the most deprived areas and in Black and Black British groups.

## Abstract number 13

**Author:** Ben Glampson

**Location:** London, England

**Title:** Linking Patient Safety Incident Reporting System to Electronic Health Records at the Hospital level - the Opportunity for Digital Root Cause Analysis

### Objective:

Patient safety remains an integral component of the provision of high-quality care. In the UK, patient safety incidents are voluntarily reported in patient safety incident reporting systems, and not routinely linked to the patient electronic health record (EHR). The non-linkage of patient safety incidents with the EHR is a missed opportunity to generate better insights into safety incident prevalence, deeper analysis of the burden of harm and thereafter the effective prevention of adverse events.

This study aimed to determine if the linkage of a patient safety incidents database with a hospital EHR was feasible and provided additional information pertinent to understand the true prevalence of a patient safety incident and the burden of harm, using encounter-level clinical and diagnostic information of patients captured within the EHR.

### Methods:

Falls incidents were used in this study as they accounted for the highest reported safety incident category in a hospital care setting. A retrospective case study of patients from 01/01/2015-20/04/2018 was conducted. The patient safety incidents database was linked with the hospital EHR using deterministic and fuzzy matching techniques. To understand the mixed burden of harm between the two datasets, ICD-10 codes were used to extract inpatient falls from the EHR and to also develop a new standard of inferred injury severities.

### Results:

The cohort consisted of 5510 fall patients. Mean age of the patients who fell was 66.9 years; two-thirds were above the age of 65 and 59% were males. The combined prevalence showed that incident reporting system falls were under-reported by 10% and EHR coded as inpatient falls were under-reported by 82%. Those under-reported in incident reporting systems mostly had severe injuries post fall, and those under-reported in the EHR mostly had no injuries.

### Conclusions:

It was concluded that the linkage of Datix and the EHR has given us an in-depth view of the clinical and diagnostic details surrounding patients who fell and helped in the detailed analysis of the fall and post-fall injuries sustained.

## Abstract number 23

**Author:** Emma Ritchie

**Location:** London, England

**Title:** A Quality improvement project on heparin infusion safety at Guys and St Thomas' NHS Foundation Trust (GSTT)

### Objective:

To improve patient safety by implementing an Electronic Prescribing and Administration (ePMA) solution to replace the paper system for prescribing, monitoring and administration of unfractionated heparin (UFH) infusions for all non-critical care adult inpatients

### Methods:

- Established a multidisciplinary team (MDT) working group to scope, develop, test and deploy the ePMA system for UFH infusions.
- Go live date set to align with launch of updated UFH infusion guideline
- Using the established ePMA software at GSTT, the ePMA team developed a process to deliver safe prescribing, monitoring and administration relating to UFH infusions in accordance with the updated guidance
- E-learning training package developed enabling prescribers, nurses and pharmacists to safely carry out the new process pre go live
- Following an awareness campaign, the ePMA UFH infusion system was deployed in March 2019. A report was generated daily alerting the anticoagulation pharmacist of any new UFH infusion prescriptions across the Trust, enabling them support staff using the new process.
- Audit undertaken to measure whether patient safety improved when moving from a paper based to an ePMA system

### Results:

Paper-system audit 2016 (baseline) versus ePMA audit (2019). Chi-square statistical analysis applied Audit standards:

- 1-Baseline APTTr checked before starting infusion (93%v100%p=0.1)
- 2-Received correct loading dose of heparin based on APTTr (79%v96%p=0.07)
- 3-APTTr checked 6 hours after infusion started (72%v100%p<0.05)
- 4-APTTr checked 6 hours after infusion titrations (86%v96%p=0.2)
- 5-APTTr in target range within 24 hours (50%v70%p=0.2)
- 6-APTTr checked 24 hourly after 2 consecutive APTTr's in range (100%v100% no change)
- 7-Patient receives a medical review 24 hourly (65%v100%p<0.05)
- 8-Heparin syringe and giving set changed 24 hourly (65%v100%p<0.05)

UFH infusion related incidents reduced from one incident per 1.6 infusions, to one incident per 6.5 infusions following the implementation. UFH infusion incidents as a proportion of all anticoagulant incidents reduced from 43% (March-2016) to 20% (March-2019).

### Conclusions:

Implementing an electronic solution for prescribing, monitoring and administration of high-risk, complex infusions such as UFH infusions improves care quality and safety. The success of which requires an MDT approach alongside creative configuration of an ePMA system.

## Abstract number 24

**Author:** Fernando Santos Sanchez

**Location:** Southampton, England

**Title:** Employing crowdsourcing and quantitative readability metrics to identify, revise and validate sentences that are too hard to be universally understood in PIL from RCTs

### Objective:

The objective of this study was to assess the effect of employing readability metrics and crowdsourcing to identify, revise and validate Patient Information Leaflet (PILs) sentences that were deemed to be too hard to be universally understood.

### Methods:

The first phase of this study employed the ARI, Coleman-Liau, SMOG, Flesch-Kincaid and Gunning - Fog quantitative readability scores to identify sentences that were deemed too hard to be universally understood, In the second phase, a subset of 81 sentences was selected based on their topics and their readability scores, the Amazon Mechanical Turk (MTurk) platform was employed to crowdsource the rewording of these sentences by the public. A set of 243 proposed revisions for 27 original sentences was then ranked by 32 public participants, a one-way ANOVA test was used to determine the presence of statistically significant differences in the grades given by the participants for validation.

### Results:

An average of 34% (s.d. 2%) of the PILs sentences were too hard to be universally understood (3 or more indexes scored the sentence difficulty above 9<sup>th</sup> grade). 736 individual sentence revisions were gathered via MTurk by 117 participants for a subset of 81 original sentences. The readability scores of the proposed revisions increased by an average of 3.2 grades (s.d. 3.7). Significant associations were found between the readability improvement of the sentences and the number of complex words present in the original sentence ( $p < .001$ ), the time needed to revise the sentence ( $p < .001$ ), and the number of characters in the sentence ( $p < .008$ ). The public participants did not show a statistically significant preference for any of the revised options except in two cases, ( $.37 \pm 2.753$ ;  $p < .001$ ) and ( $.89 \pm 3.381$ ;  $p < .001$ ).

### Conclusions:

The use of readability metrics to identify PIL sections with readability issues and employing crowdsourcing to revise PIL sentences were found to be viable strategies, 90% the proposed revisions had a readability improvement. The improvement in readability was found to be associated to the original sentence difficulty (the number of complex words and characters and the time needed to revise the sentence), this was found to cause large variations in the observed improvements of the revisions. The use of crowdsourcing to revise the sentences produced similar proposals, the study showed that using crowdsourcing to rank the proposals was not viable if they were too similar.

## Abstract number 32

**Author:** Rachel Isba

**Location:** Lancaster, England

**Title:** You can't touch this: timely access to reliable vaccination data during a Paediatric Emergency Department attendance.

### Objective:

Vaccination remains one of the great global public health successes, yet uptake in the UK has fallen recently. Guidance recommends that the vaccination status of children/young people be checked routinely in all healthcare settings. The objective of this work was to map potential sources of vaccination data during a Paediatric Emergency Department (PED) attendance as part of a larger programme looking at vaccination delivery.

### Methods:

The work was carried out in a single PED in Greater Manchester (GM) with results derived from different strands within the vaccination project:

- a pilot study in the PED that included parent/carer recall of vaccination status;
- an exploration of the potential of summary primary care records to provide vaccination data;
- a mapping of Greater Manchester vaccination data systems – the vast majority of vaccines are given in primary care, with GP surgeries then submitting data to the network of “Child Health Information Systems” (CHIS), from where data are fed into a national system.

### Results:

Most children/young people (97%) were described by their accompanying parent/carer as “up-to-date” with their vaccinations, despite local vaccination rates being in the region of 80-90%.

Clinicians can access (via a separate portal) very limited content from patients' summary primary care records, including vaccination data for some (but not all). However, accessing the record also requires explicit consent to do so, is time-consuming, and no senior PED staff were aware of the portal's existence.

Once vaccination data leave primary care in GM they pass through one of ten CHIS, using an assortment of different data systems, after which they shed individual identifiers and progress up to the England-wide “Cover of vaccination rapidly evaluated” (COVER), arriving up to three months later. None of the existing GM CHIS are accessible to clinicians.

### Conclusions:

Children/young people attending settings such as the PED may benefit from interventions to improve vaccination coverage, however it is not currently possible to identify those who are not up-to-date.

Issues around parents/carers likely over-estimating vaccination status, and difficulties with accessing summary primary care records, are compounded by the complex structure of post-primary care data management, meaning there are no accessible and reliable sources of vaccination data during a PED attendance.

More work needs to be done to explore possible solutions that are either direct e.g. interoperability-focused, or indirect e.g. machine learning-derived risk stratification, to enable targeting of interventions.

## Abstract number 41

**Author:** Nehal Hassan

**Location:** Newcastle, England

**Title:** What are clinicians' and patients' perceptions towards the use of artificial intelligence decision aids to inform shared decision-making? A systematic review.

### **Objective:**

To conduct a systematic review to explore the perspectives of both clinicians and patients on the use of artificial intelligence decision aids to inform shared decision making in a variety of clinical settings.

### **Methods:**

We conducted a systematic literature review across four large databases: MEDLINE, CINAHL, SCOPUS, and Embase. Appropriate search terms were developed and grouped. Qualitative, quantitative, and mixed-method studies were included. Assessment of Quality and bias was carried out using the Critical Appraisal Skills Programme (CASP) Checklist, and a narrative synthesis was undertaken due to the subjective nature of the collected data. Titles, abstracts and full texts were reviewed by two independent reviewers. The review is registered in PROSPERO database: (CRD42020220320) and was performed based on the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines.

### **Results:**

Five hundred and nine articles were identified, with (n=492) removed at the title (n=384), abstract (n=106) and full-text (n=2) stages. Seventeen articles were eligible for inclusion. Artificial intelligence decision aids were used to support shared decision making at various stages of the patient journey, including prevention, screening, prognosis, diagnosis, and treatment. These decision aids were found to **promote** patients engagement and communication with their clinicians, **increase** patients confidence and compliance about their health decisions, **inform** the clinical decision making of patients for consenting, **present** risk estimated in an interactive and individualised manner, and **improve** satisfaction levels of patients towards their overall clinical care. The main barriers to using artificial intelligence decision aids were the patient's variability in health and technology literacy, and incomplete or missing information in the decision aids that could potentially mislead the shared decision-making process.

**Conclusions:** Artificial intelligence decision aids were perceived to be useful tools to inform the shared decision-making process for both patients and clinicians, although patients had more positive perceptions compared to clinicians. These perceptions should be considered in early development phases of future decision aids at different stages of the patient journey.

## Abstract number 44

**Author:** Debbie Phillips

**Location:** Milton Keynes, England

**Title:** Use of patient vital signs data for oxygen stewardship during the coronavirus pandemic

### **Objective:**

To use vital signs data from the Electronic Patient Record (EPR, Cerner Millennium) to identify patients for clinical review of their oxygen usage, with a view to reducing it where clinically appropriate. The overall aim being to protect the site oxygen supply which was running at 83% of maximum on 7<sup>th</sup> January 2021.

### **Methods:**

Data was queried from the EPR and reported in Power BI (Microsoft). We collected name, ward location, NHS number, oxygen delivery device, oxygen saturation, date and time of last observations for every adult inpatient outside of intensive care. Data was validated by checking sample cases from each ward. Visualisations including an oxygen use dashboard were built to give an overall impression of oxygen use across the site.

A subgroup of patients were identified who were receiving oxygen and had oxygen saturations of at least 94%. This list was saved as a subscription that would be emailed at 08:00 each morning to the project team including the physiotherapists who would then target review of these patients to ensure optimal oxygen treatment to enhance patient care and provide assurance that oxygen was being used appropriately and optimally across the site.

### **Results:**

On the 8<sup>th</sup> January 2021 56 patients were receiving oxygen with saturations of at least 94%. In total they were consuming 222 litres of oxygen. Estates reported a reduction in site usage of oxygen from 83% to 75% (1,483 l/min to 1344 l/min) by that afternoon which they attributed to the clinical reviews done through the morning. The process of daily publication and reviews continued and whilst some reduction in oxygen demand was inevitably the result of having less cases the estates team felt the telemetry always reflected significant changes 2 -3 hours after publication of the list.

### **Conclusions:**

This is a great example of the improved effectiveness of the multidisciplinary team when furnished with real-time data to inform clinical decision making and has been for our organisation a really positive example of driving improved performance and outcomes with data.

**Abstract number 45****Author:** Mariane Mello**Location:** London, England**Title:** Machine learning for Ophthalmology triage: an exploratory study

Area: - Artificial Intelligence and Clinical Decision support

**Objective:** To investigate whether it is possible to use retrospective patient data from hospital letters to build machine learning algorithms that could diagnose the most common ophthalmology diagnosis, to be utilised on the development of an Ophthalmology triage platform.**Methods:**

A total of 4,810,398 patient letters were saved between 1997 and 2019 on Moorfield's EMR system. The dataset comprised consultation letters, medical history report, discharge summaries, referral letters, GP letters, surgical operation notes and medical tests reports.

The letters were processed into a graphical framework by retaining keywords for symptoms, signs, investigations and diagnosis from the prescription text using natural language processing methods. Letters without those keywords were excluded.

A series of nine binary classifiers were trained using Logistic Regression (LR), gradient boosting (XGBoost), and Deep Neural Networks (DNN). All analyses were done in Python using the Scikit-learn, XGBoost, and Keras packages.

A randomly chosen test set of 20% samples was held out, then the remaining 80% samples split randomly five times to create five independent validation sets (5-fold cross-validation). Hyperparameters for each model were optimized by maximizing the average validation area under the curve (AUC) across the five validation sets.

The optimized set of hyperparameters was then used to train the model on all 504,486 (90%) samples excluding the test set. Finally, the test AUC was calculated on the held-out test set, with 95% confidence intervals constructed using the DeLong method implemented in the pROC package. Youden's index was used to find the optimal cutoff point on the ROC curve to calculate the sensitivity, specificity, positive predictive value, and negative predictive value for each model.

**Results:**

The best performance was achieved by the neural network and the random forest models both with F1 score of 77%, accuracy of 79%, precision (positive predictive value) of 77%, and recall (sensitivity) of 79%.

The performance of Logistic Regression and XG Boost algorithms were: F1 score both 75%, accuracy of 78% and 77%, precision of 75% and 76%, and recall of 78% and 77%.

**Conclusions:** The processing techniques and algorithms have been shown to give a strong initial performance with an F1 score 79% and emphasize the potential of machine learning models to help diagnose eye conditions. Future work will be performed prospectively and would involve different numerical representation of the data (an embedding matrix-like Glove or BERT) allowing more complex model architectures.

## Abstract number 50

**Author:** Syed Mustafa Ali

**Location:** Manchester, England

**Title:** Using smartwatches to track daily symptoms in individuals living with multimorbidity

### Objective:

The prevalence of multimorbidity (two or more long term conditions) is increasing in the UK. Smartphones and wearables have been proposed as a way of tracking changing symptoms across conditions for clinical care and research. However, it is unknown whether this population will engage with such technology. It is also unknown what day-to-day disease patterns might be revealed.

Our smartwatch feasibility study, Watch Your Steps, aimed to assess levels of engagement through time and to illustrate what symptom patterns became apparent through tracking daily data.

### Methods:

WYS was a prospective observational smartwatch study conducted over 90 days. Adults with multimorbidity were loaned a Fossil Sport smartwatch with a pre-loaded data collection app. The severity of seven core symptoms were scored at five different time points daily, including fatigue, function, mood, pain, stress, sleep quality and wellbeing, on an ordinal 0–10 scale. We calculated completion rates to assess levels of engagement through time. Daily completion rate of these symptoms was calculated by proportions of scheduled daily questions answered by each participant on each day. We calculated mean daily reported scores for pain, fatigue and mood over the course of the study and presented as smoothed patterns. These are illustrated through three representative example participants.

### Results:

Fifty three participants took part in the study: approximately half of them male ( $n=26$ ; 49%), and half aged between 50 and 69 years ( $n=28$ ; 52%). The majority provided data throughout the study, although sometimes at low rates and at sporadic intervals (Fig 1). Around one third of participants provided some symptom data nearly every day over 90 days. The median question completion rate was 45% (IQR 23–67%); but higher among 60–69-year-olds, with median 50% completion (42–68%) and 70–79-year-olds with 73% completion (55–82%). Figure 2 illustrate varying patterns in self-reported pain level, fatigue and mood for three representative example participants. While some participants experienced relative stability during the study period, others experienced a greater variability in their symptom scores, suggesting mean or median scores or linear trends may not always adequately describe patients' experiences over time.

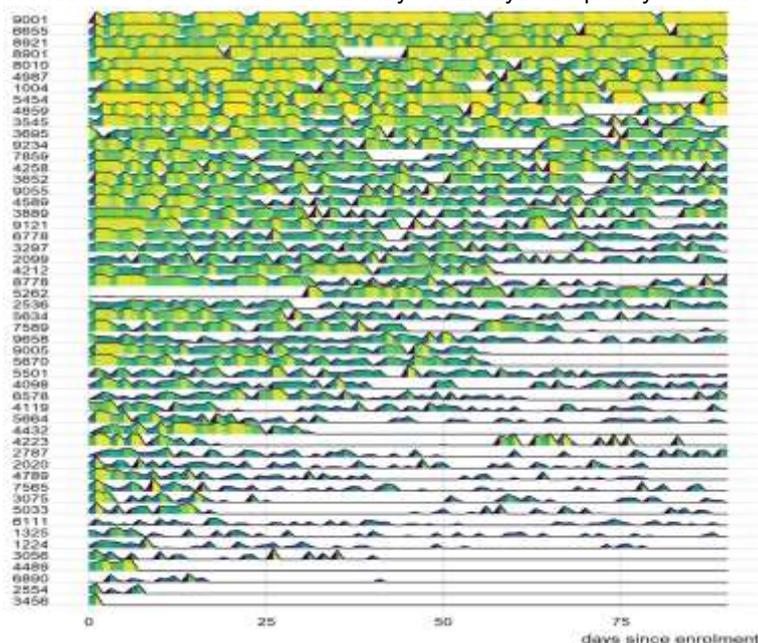


Figure 1: Daily completion rates for all study participants is encoded by the height and colour, i.e., tall and bright yellow segments represent days with nearly 100% of completion that day

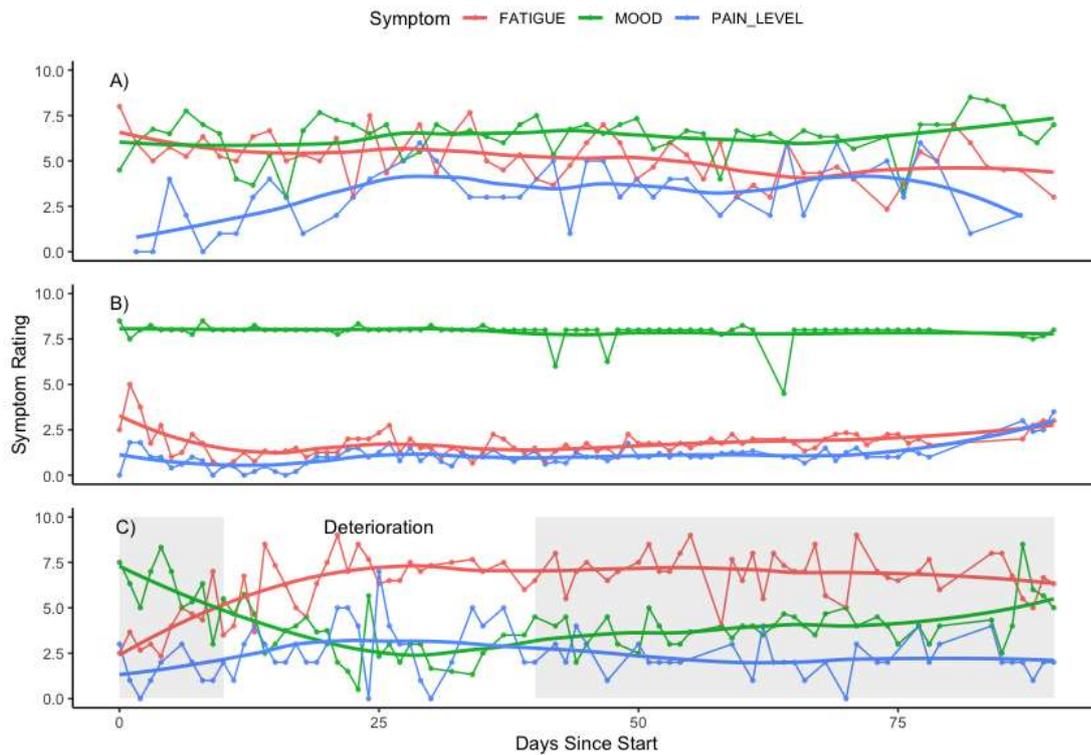


Figure 2: Illustration of symptom patterns of three selected cases

**Conclusions:**

This study demonstrates smartwatches are a feasible tool for collecting daily multiple symptoms from individuals living with multimorbidity. Also, smartwatch data collection captures symptoms' variability in real-time, which is otherwise dependent on recall at intermittent visits in clinical care and in research studies.

## Abstract number 4

**Author:** Alicia Ridout

**Location:** Leeds, England

**Title:** Occupational Therapy Digital Practice Development: Use of a webapp clinical onboarding guide (COG-OT) during the Covid 19 pandemic.

### **Objective:**

To develop, deploy and test a proof-of-concept digital tool to support Occupational Therapist as 'digital' practitioners during the COVID 19 pandemic.

### **Methods:**

A digital co-design process was used to create the Casson Trust funded webapp. This was underpinned by use of the Government Digital Service design manual enabling agile development and an iterative deployment.

Content was divided into topic areas and Model of Human Occupation themed questions generated, to stimulate a more comprehensive digital assessment. Clinical safety (DCB0160) risk management was also embedded. This content was subject to a mini-Delphi process, tested with a national group of Occupational Therapists and cross-checked using card sorting. Links to resources were added alongside personal development activities and a basic introduction to clinical safety standards. A basic safety review was completed using the DCB0129/0160 standards.

The webapp was deployed in 6 weeks during the pandemic and access stratified to prioritise students and preceptors, followed by open access to all Occupational Therapists.

Basic non-personal data was collected via an onboarding survey, usage stats and user feedback. Further discovery work was funded (RCOT Tunstall) to support a roadmap of co-designed developments and a business model for future deployment.

### **Results:**

The webapp data (to be shared) demonstrates that there are a range of COG-OT use cases which would support further development to enhance clinical practice and explore the opportunities to support transitioning students into novice practitioners. Feedback from users has been positive and the easy onboarding process and pdf download facility enabled users to access it in a highly pressured work context.

The most used topic area related to practice development and least was the e-safety/DCB0160 area.

### **Conclusions:**

The COG-OT project demonstrated an interest/need for a simple, easy to use, model/standards driven tool to support digital practice. It highlighted the lack of awareness of the DCB0160 standards. Further evaluation is required to demonstrate practice development in relation to personalised, safe and effective digital use with end users. There is an opportunity to map the growing number of competency frameworks into a more manageable set of core skills for novice practitioners that could support consistency in areas such as clinical safety, which would also benefit wider AHP practitioners.

## Abstract number 9

**Author:** Marcus Baw

**Location:** London, England

**Title:** Royal Colleges - meet your APIs! the RCPCH's Digital Growth Charts pattern for clinical digital success.

### Objective:

To enable the calculation of vitally important child health and growth parameters directly in the Electronic Patient Record (EPR) without having to fund the development of this functionality in each and every EPR system, at vastly higher cost and with much increased risk of inaccuracy or mis-implementation. The RCPCH developed the functionality in-house, using an alternative 'service-based' paradigm, which vastly reduced costs, enabled interoperability and integration, and increased uptake and integration speed.

### Methods:

- The RCPCH successfully built and deployed in under one year, and at a very low cost, a full Open Source Application Programming Interface and associated helper libraries which has brought the complex mathematics of calculating Growth Charts, Growth Centiles, SDS, and many other tools, to all EPRs that wish to include the feature.
- 'APIs do the hard work so that you don't have to' is a model followed by all of the wider tech industry but so far healthcare has been slow to adopt it.

### Results:

- APIs can successfully solve problems in health technology infrastructure which 'traditional application development paradigms' such as vertically integrated monolithic systems cannot solve.
- API development is straightforward and achievable for organisations not traditionally involved in software development
- APIs can extend functionality rapidly and it is easy to add new features even after the specification period is completed.
- Royal Colleges can successfully deliver software and infrastructure, using Agile Development practices, **under budget**, on time, and **exceeding** MVP specification.

### Conclusions:

- APIs represent a potential additional tool to development of advanced functionality in healthcare software.
- APIs are a feasible proposition for development by organisations which do not normally view themselves as software development organisations. 'Royal Colleges 3.0'
- Royal Colleges can successfully 'positively disrupt' areas of software development which have stagnated or in which innovation has stalled.

## Abstract number 10

**Author:** Garima Charan

**Location:** London, England

**Title:** Patient Satisfaction and Clinical Effectiveness of Prosthodontic New-Patient Telephone Clinics in a Specialist NHS Secondary Care Setting

### Objective:

In response to COVID-19, New-Patient Prosthodontic Clinics (NPPCC) at Eastman Dental Hospital have been undertaken via telephone (Tele-NPPCC) since March 2020. The 'MyCare UCLH' app, in which patients can take and upload their own clinical photographs has been implemented to support telephone consultations (TeleMyCare-NPPCC). Video consultations (Video-NPPCC), using NHS England's Attend Anywhere platform has also commenced.

The project objective was to evaluate the efficacy of these remote NPPCC to improve service delivery, patient outcomes and satisfaction.

### Methods:

100 patient records were retrospectively assessed from Tele-NPPCC, undertaken over March-September 2020. Information collected analysed referral quality, clinical activity, remote consultation guidance compliance, patient pathways and outcomes. Comparisons were made from an equivalent dataset of pre-COVID-19 Face-to-Face NPPCC (baseline/'gold-standard'), as well as results from 6 TeleMyCare-NPPCC and 1 Video-NPPCC within this period. Patient satisfaction evaluation was also collected via an online survey.

Based on these results, an action plan was implemented to improve patient pathways and delivery of remote platforms. A second evaluation cycle was undertaken between January-March 2021, which also assessed barriers to teledentistry uptake.

### Results:

Both cycles showed an improvement in referral quality and over 50% decrease in failure-to-attend and booking errors with remote NPPCC, in comparison to pre-COVID-19 Face-to-Face NPPCC.

More patients were seen on average per Tele-NPPCC than Face-to-Face NPPCC, with an increase in clinical activity via remote NPPCC. However, 86% of patients required a Face-to-Face follow-up after their Tele-NPPCC, with an average wait of 3.8 weeks between appointments. No patients exceeded the NHS 52 weeks Referral-To-Treatment target.

For TeleMyCare-NPPCC and Video-NPPCC, patients requiring Face-to-Face follow-up decreased by 31% and 59%, respectively. Definitive outcomes were provided for 46% of patients assessed on TeleMyCare-NPPCC and 75% on Video-NPPCC.

Good patient satisfaction for the process, usability, experience and perceived benefit was noted across the remote platforms, with highest satisfaction from Video-NPPCC, followed by TeleMyCare-NPPCC and Tele-NPPCC. Main barriers to teledentistry uptake identified, included lack of awareness and inaccessibility to digital devices.

### Conclusions:

Remote NPPCC enabled continued service provision and recovery during the COVID-19 pandemic. Clinical effectiveness and patient satisfaction increased with MyCareUCLH and Video platforms, which allowed for enhanced assessment and engagement, as well as earlier decision-making. The project is currently working towards improving the pathways, increasing teledentistry uptake and confirming patient cohorts that would most benefit from the various platforms available. Future adoption and establishment of teledentistry may complement existing services in terms of eliminating inappropriate referrals, accelerating patient-care pathways and improving cost-effectiveness.

## Abstract number 15

**Author:** Mark Bailey

**Location:** Gloucestershire, England

**Title:** Robotic process automation (RPA) speeds up daily clinical tasks by 30.2%

### Objective:

Previous studies have shown that a hospital doctor can spend around 16 minutes on electronic patient records and around 15 minutes with the patient. Considering a doctor can see over 20 patients a day, over half the day is centred on a computer rather than a patient. Our objective was to reduce the time taken on these non-patient facing tasks through the use of robotic process automation (RPA).

### Methods:

We built a RPA digital solution to control several different clinical IT systems used in daily clinical tasks. We used the open source RPA program AutoHotKey and the code can be viewed at <https://github.com/Cotswoldsmaker/QuickSpiritum>. The programs controlled by this RPA solution included the trust's EPR, PAS, letter database, PACS, labs results system, requests system and lung function tests. It can also automate otherwise paper based requests and referrals and it can send SMS messages, email and letters to patients containing links to patient information videos. The latter functionalities however were not included in this timed study. 7 clinicians were recruited to this study to help measure the time saved and the smallest number of clicks or key strokes (SNCKS) to undertake either manually or automation tasks.

### Results:

The average time saved for opening a clinical program, typing in credentials and searching for a patient's results was 39.2%. The SNCKS dropped from 14 (excluding entering username and password) to 2. The average time saved for searching for results in an already open program showed a 19.8% reduction. The SNCKS dropped from 8 to 2 for these tasks. The average time saved for starting up a program and using an already open program was 30.2%.

### Conclusions:

On average the time saved using our RPA solution was 30.2% versus manual methods. It also reduced the SNCKs down to 2. Hence, this RPA solution can lead to a substantial time savings during the day, giving almost an extra 5 minutes back per patient. This RPA solution has been made open source and hence others can benefit from its use to help speed up their daily clinical tasks. We plan to expand this study to recruit more clinicians to obtain further representative data.

## Abstract number 18

**Author:** Cecilia Okusi

**Location:** Oxford, England

**Title:** Building data visualisation infrastructure in the Oxford-Royal College of General Practitioners Clinical Informatics Digital Hub to address social prescribing

### **Objective:**

Social prescribing became a formal part of NHS England's Personalised Care Plan in 2019. During the course of the COVID-19 pandemic in England, the Oxford-Royal College of General Practitioners Clinical Informatics Digital Hub (ORCHID), a sentinel network of general practices, was commissioned by NHS England & NHS Improvement to provide regularly updated dashboard-level insight for social prescribing, social needs, and non-medical interventions, in the form of national observatories and dashboards for general practices and ICSs. The aim of this program was to use data visualisation to analyse the uptake of social prescribing activity in England, across geographic and demographic domains.

### **Methods:**

Our ability to respond to NHS England's request relied on several factors including: development of ontological case finding methodology, SQL database infrastructure, data manipulation and extraction techniques, and the willingness of general practices and patients to voluntarily participate in surveillance, quality improvement, and research with ORCHID. While, clinical information presented by digital dashboard technology is exciting for the end-user to interact with and digest, it is important to emphasize the level of expertise and creativity that is required to develop a digital health tool using Tableau as the software platform.

### **Results:**

Developing re-usable data visualisation infrastructure within the ORCHID platform was a major achievement alongside the development of a suite of national observatories and practice-level dashboards for social prescribing, social needs, and non-medical interventions. These digital health tools are refreshed on a weekly basis using pseudonymised patient-level general practice data that is processed weekly within the ORCHID secure data environment.

### **Conclusions:**

The program has proven public health benefit, where it has supported a personalized care learning health system approach, highlighted trends such as the increase in social prescribing referrals and declines, and disparities by age, gender and socio-economic status. The program has improved the epidemiological evidence-base for social prescribing and, thereby, addressed social determinants of health for the improvement of population health. The program has also provided evidence for the usefulness of link workers in supporting patients on the NHS Shielded Patient List during the COVID-19 pandemic.

## Abstract number 19

**Author:** Christina Sothinathan

**Location:** London, England

**Title:** Patient and staff satisfaction of physiotherapy delivered remotely during the COVID-19 pandemic: A service evaluation

### **Objective:**

To gain feedback from patients and staff on their experience of telemedicine (TM), to guide future modes of physiotherapy delivery.

### **Methods:**

Patient and staff satisfaction questionnaires included multiple choice questions with free text for comments and were administered using SurveyMonkey. The patient satisfaction survey was offered to all patients who received a video consultation (VC) for physiotherapy (all specialities) via Attend Anywhere. The survey link was added to post consultation emails to capture feedback of telephone consultation (TC). The staff satisfaction survey was sent to all physiotherapy staff via email.

### **Results:**

Patient satisfaction data was collected between 03/07/2020 and 12/08/2020 with 328 responses, which represents a response rate of 27%. 96% of responders selected that their TM consultation experience was either 'very good' or 'good'. 88% felt 'completely' involved in their care. 43% selected that TM was 'much better for me' or 'better for me' compared to face-to-face, with 18% selecting 'worse for me' or 'much worse for me'. 80% of VC versus 38% of TC responders were 'extremely likely' or 'likely' to want to have VC or TC, respectively, in the future. Free text patient quotes include "received same quality of care as an in-person appointment" and cited benefits of TM included saving time and money on commuting, convenience and feeling safer during COVID-19. Patient cited disadvantages of TM included being left in the virtual waiting area, and preferring face-to-face due to "hands on".

Staff satisfaction data was collected over 2 weeks with a response rate of 78% (25 clinicians and 4 administrators). Staff reported TM benefits, such as improved clinic utilisation, increased flexibility during clinical sessions with complex patients and opportunities to work remotely. 90% of staff want to offer a blend of face-to-face and TM post-COVID-19. Staff reported higher quality of assessment using VC compared to TC.

### **Conclusions:**

High levels of patient satisfaction with TM were reported. These data included responses from patients who received TM and may not be representative of the population, including those less likely to access TM due to lower digital literacy or disabilities.

We recommend administrative support and training for patients and staff. Further study post-COVID-19 may be beneficial to assess patient and staff satisfaction of a 'virtual first' approach.

## Abstract number 20

**Author:** Claire Chew

**Location:** London, England

**Title:** Exploring behavioural influences for successful adoption of remote patient monitoring services

### **Objective:**

We draw on recent experience from a covid-19 safety netting service to explore behavioural influences on adoption of a remote patient monitoring (RPM) by patient and staff. We sought out generalisable insights to inform RPM roll out across a wide range of specialties at UCLH.

### **Methods:**

A temporary covid-19 safety netting service was implemented for patients discharged home after robotic assisted laparoscopic prostatectomy (RALP). Patients used a pulse oximeter to measure their own oxygen saturation (O2 sats) and took part in telephone clinics. We surveyed staff (doctors, nurses and admin and clerical) and patients using a framework aligned to the COM-B behavioural science model where target behaviours were adoption of the service. Surveys were carried out using video semi-structured interviews, online questionnaires and email. Findings were generated from a combination of quantitative and qualitative analysis of structured and free text responses.

### **Results:**

Patients enjoyed direct engagement with their clinical team and monitoring their own health. Staff thought that this would empower patients, helping them feel reassured and safe. The purpose and benefits were clearly understood by staff and patients. However, a minority of patients were uncertain about how this helped them with their recovery as it was not strictly related to their surgery. Most patients found the service and device very easy to use. Recommendations to improve the service mainly related to automation and device integration to reduce resource burden and increase efficiency. Patients also indicated that they were willing to be part of more integrated and automated RPM service, but a few were concerned that this would replace direct communication with the clinical team. Further benefits of this service beyond direct clinical care were identified such as extracting data for clinical model development.

### **Conclusions:**

In terms of COM-B framework, the service implemented clearly met the criteria of patients and staff possessing enough capability, opportunity and motivation to carry out their respective parts of the workflow. The service studied was implemented during the covid-19 pandemic which heavily influenced factors such as patient motivation and available staff time. Therefore, when we move to spread this innovation at UCLH we would still need to actively consider behavioural factors for successful local adoption. Patients valued direct communication with the clinical team which is at-risk of being lost through automation. This emphasises the importance of the patient voice when designing advances to this innovation.

## Abstract number 21

**Author:** Donia El-Nemr

**Location:** Manchester, England

**Title:** Methodical assessment of medical record keeping and the new MREH proforma

### **Objective:**

To develop a methodical audit tool to assess compliance with medical records keeping standards (as set by the Royal College of Physicians) at individual, departmental and organisational level by calculating a numerical score.

### **Methods:**

The Methodical Record Examination in Healthcare (MREH) proforma was designed based on the Manchester University NHS Foundation Trust (MFT) minimum core standards for medical record keeping (adapted from the guidelines by the Royal College of Physicians (RCP). All the stakeholders involved in medical records keeping, audit and clinical governance were consulted during the development and deployment. MREH was proven to be fit for purpose by using it in a local audit with a total of 74 case records being reviewed for 4 junior ophthalmology trainees over 30 weeks (each doctor audited over 5 days?). The primary validation criteria included: 1) purpose of the measurement, 2) scope and 3) regulatory requirements.

### **Results:**

Compliance of individual doctors and group (e.g. service/divisional level) was calculated for each specific standard, as well as an overall score for all the standards. The whole group (4 doctors, 74 medical records reviewed) overall scores of standard 6 "designation" and standard 7 "GMC/professional registration number" were 88% and 73%, respectively. Below the required 95% target. The overall score (for all standards, 19 medical records reviewed) of one particular doctor (Dr2) was (88%) (below the required 95% target). On day 3 (of 5 audited), Dr 2 had the majority of their deductions (37%).

### **Conclusions:**

The MREH tool use demonstrated it can identify accurately inadequacies in medical record keeping resulting in poor compliance. Based on this data, the user/Trust can decide how to efficiently and accurately target compliance issues and actions to improve it.

We believe that the MREH is the first audit tool to calculate compliance at individual and organisational level for each standard and overall score for all standards. With the future integration of MREH with electronic patient record system, it will be possible to calculate compliance in real time with a concise dashboard highlighting the areas of inadequacies needing to be addressed without delay.

## Abstract number 22

**Author:** Edmond Li

**Location:** London, England

**Title:** The perceptions of chief clinical information officers on the state of electronic health records systems interoperability in England

### **Background:**

The lack of electronic health records (EHR) interoperability is often cited as one of the many shortcomings of clinical informatics systems currently in use. In the fragmented EHR landscape of the United Kingdom, understanding this issue and accurately measuring its cost both to patient safety and the health system, remains challenging.

### **Aims & Objectives:**

The main aim of this study is to gain a better understanding of how EHR interoperability impacts patient safety from the perspective of those responsible for procuring and implementing them in clinical settings (i.e., chief clinical information officers, CCIOs). Specifically, this study intends on addressing following objectives:

1. To investigate the perceptions and expectations of CCIOs regarding the current state of EHR interoperability and its effects on patient safety in NHS hospitals.
2. To investigate past administrative facilitators and barriers to achieving interoperability in the past decade during their initial introduction in the NHS.
3. To explore how CCIOs perceive the evolution and development of EHR interoperability and how it could improve patient safety in the NHS for the coming decade.

### **Methods:**

Semi-structured, in-depth online interviews are being conducted to investigate the experiences and expectations of CCIOs regarding EHR interoperability issues. Data collection is being completed from December 2020 - June 2021, with approximately 20-25 CCIOs associated with the NHS Digital Academy working in secondary/tertiary care centres being recruited. The interviews are audio-recorded, transcribed, and thematically analysed afterwards.

### **Results:**

While data collection is still ongoing and further analysis will be necessary to fully address all three study objectives, preliminary reviews of the transcripts have already revealed some nuanced views concerning what barriers are limiting EHR interoperability across NHS hospitals.

Resistance to change by clinical staff, institutional inertia, reluctance to relinquish control of patient data, and fear of judgement by others on data quality practices, were notable factors described by some participants. While there is recognition for the need for greater EHR integration, solutions often remained piecemeal and fragmented. Identifying these less well-documented views would likely be constructive to improving EHR interoperability in the future.

### **Conclusions:**

As EHRs continue to play an increasingly pivotal role in health systems of high-income countries, understanding past successes and failures to achieving interoperability, is imperative to informing more efficacious clinical informatics policies. Ascertaining the administrative perspective to this problem, is especially important to ensuring that future EHR modernisation initiatives become more relevant, safe, and better suited to the evolving clinical needs of healthcare providers and patients alike.

## Abstract number 25

**Author:** Fergus Taylor

**Location:** Dundee, Scotland

**Title:** Visualising BNF Drug Interactions

### Objective:

To visualise frequency and class relationships of drug interactions; including 'severe' drug interactions as defined by the BNF using the existing online database of BNF interactions.

This will be achieved by creating a tool for exploring the interactions between selected drugs; for example, a new proposed drugs and the pre-existing prescription of a hypothetical patient, or a list of commonly prescribed drugs in a department.

### Methods:

Using existing packages in the R language for 'webscraping', i.e the systematic collection of data from a web page, we have compiled a database of the BNF (British National Formulary) drug interactions listed [online](#) and exported this in a format for interactive visualisation.

The R workflow has been designed to be rerun and update this database accordingly.

Using tools designed for interactive data visualisation, (D3.js), we have created a tool for the selection of multiple drugs, and visualisation and exploration of the recorded drug interactions.

The main graphic is based on the work of Mike Bostock, creator of D3.js and the original graph is shown [here](#). It was subsequently modified with the author's permission to annotate the interaction data and highlight severe interactions.

### Results:

The resulting tool can be explored [here](#). The code used to create it can be found in its GitHub repository [here](#).

The resulting tool has been a thoughtful exercise in exploring existing drug interaction relationships and highlighting both the frequency and severity of interactions between commonly prescribed drugs.

An example selection of [100 commonly prescribed drugs](#) which included a grouping by drug classes was used in multiple teaching exercises to highlight the same point, as well as on a number of specific departmental drug lists as teaching exercises in clinical practice.

### Conclusions:

The advent of large, clinically relevant online databases and new tools designed explicitly for interactive data visualisation have a developing role in clinical informatics. D3.js is a tool familiar to many people, but not necessarily realised. D3.js is now a primary tool for data visualisation in online newspapers, for example, [visualising ONS data on COVID cases](#).

As clinicians continue to work with large data sets and seek to use data visualisation that people can engage with and will update with the data, the use of such tools may become increasingly relevant.

## Abstract number 26

**Author:** Fiona Wu

**Location:** Kent, England

**Title:** The feasibility and effectiveness of a home-based prehabilitation programme during the COVID-19 pandemic

### Objective:

At the peak of the COVID-19 pandemic, patients awaiting cancer treatment were classified as “vulnerable” and advised to shield to protect themselves from exposure to coronavirus. These measures can have a negative impact on patients, including feelings of social isolation, anxiety, depression, physical deconditioning, and immobilisation. Prior to COVID-19, we were able to offer our patients a centre-based face-to-face prehabilitation service. Prehabilitation is a healthcare intervention to improve the patient’s functional capacity to mitigate the unwanted consequences of cancer treatment by promoting health-optimising behaviours. Following the government’s announcement of the national lockdown in late March 2020, we were able to adapt our existing programme to a “virtual” format. In this project, we sought to establish the feasibility and effects of a telehealth delivered home-based prehabilitation programme to meet our patients’ needs during the pandemic.

### Methods:

Eligible patients were referred from multiple centres to a regional prehabilitation unit providing home-based “virtual” prehabilitation. Enrolled patients performed prehabilitation prior to surgery and/or during non-surgical cancer treatment. Our telehealth delivered programme consisted of 1) training exercises, 2) nutritional advice, 3) medical-optimising measures (including referrals to stop smoking and alcohol reduction services) and 4) counselling. The primary outcome was to investigate the feasibility of our programme. The secondary outcome was to investigate the relationship of our programme on patient-reported outcomes (PROs). Patients completed 2 questionnaires (the EQ-5D-3L and the FACIT Fatigue Scale) pre- and post-intervention.

### Results:

182 patients were referred during the study period. Of the 182 patients that were referred, 139 (76%) patients agreed to partake, and 43 (24%) patients declined or were unable to participate. The most common reasons for non-participation included self-perceived lack of benefit, cancer treatment beginning within weeks and did not want to enrol unless it was face-to-face. Among the 139 (76%) patients that were enrolled, 100 patients completed the programme, 24 have still to complete and 15 have discontinued. 66 patients were able to return questionnaires. Patients were recruited from colorectal, urology, breast, and cardiothoracic. 34 male and 32 females. The mean age was 67 years old (60-73). The mean duration of the programme was 4 weeks (3-9). Paretian classification of health change found 38% of the patients “improved” their health status after prehabilitation. Patients significantly improved self-perceived health ( $p=0.001$ ), and fatigue ( $p=0.000$ ).

### Conclusions:

Home-based “virtual” prehabilitation is a feasible intervention. PROs improved post-intervention. Our programme should be continued to mitigate the consequences of the pandemic.

**Abstract number 28****Author:** Luca Mercuri**Location:** London, England**Title:** Improving the identification and reporting of patient's smoking status in electronic health records. A clinical analytics approach to leveraging information captured in both structured and unstructured data.**Objective:**

Accurately recording the smoking status of patients in the electronic patient record provides a critical opportunity for identifying and providing timely smoking cessation advice as well as positively influencing risk-reduction in developing associated illness such as lung cancer and cardiovascular disease. In this study, two rule-based algorithms were used to extract smoking status information of lung cancer patients combining the information held within structured and unstructured data elements.

**Methods:**

Patients diagnosed with lung cancer were identified from the cohort included in the Trust's COSD returns between 1st January 2016 and 31st March 2018, N=955. A rule-based algorithm was developed to examine and extract structured parameters that classified smoking status from structured data. A Natural Language Processing rule-based algorithm was developed to extract the smoking status information from clinical notes. This algorithm filtered clinical documents with a set of smoking-related keywords and classified information into tobacco-use categories using information annotated in a training set. Both algorithms were used across different Electronic health records (EHR) systems in a single secondary care Trust. Additionally, manually annotated data was used to evaluate the Natural Language Processing rule-based algorithm.

**Results:**

The algorithm using only structured data across multiple systems increased smoking status data completeness from 18% to 68%. The NLP rule-based algorithm increased smoking status data completeness to 88% with an accuracy of 96%. Overall, the use of both algorithms resulted in smoking status data completion of 91%.

**Conclusions:**

This study has demonstrated the value of using a translational data analytics approach to combining information held within both structured and unstructured data elements within EHR systems. Without needing to ask staff to change data entry behaviours, the ability to determine patients' smoking status accurately increased significantly, thereby providing the opportunity for targeted smoking cessation intervention. Secondly it provides the opportunity to improve data quality completion rates for smoking status for internal and external reporting, including to national cancer outcomes datasets.

## Abstract number 29

**Author:** Mark Ragoo

**Location:** UAE

**Title:** Development of a dashboard to automatically calculate overcrowding in an emergency department

**Objective:**

One of the major challenges affecting an emergency department (ED) is overcrowding. An objective way of measuring overcrowding is the measurement of the national emergency department overcrowding score (NEDOCS). We used the information in our electronic medical system (CERNER) to automatically calculate the NEDOCS every hour and display it in a dashboard

**Methods:**

The NEDOCS is a standardised score which is calculated using the number of patients in the ED, the number of beds in the ED, the number of patients waiting for admission, the number of inpatient beds in the hospital, the number of patients on ventilators in the ED, the waiting time of the longest admitted patient, and the waiting time of the longest patient in the waiting room. The dashboard automatically calculates the NEDOCS every hour and displays it as a bar chart. Six levels of overcrowding (not busy, busy, extremely busy, overcrowded, severely overcrowded and dangerously overcrowded) are calculated using the NEDOCS and shown on the dashboard.

**Results:**

Using a standardised scoring system has been helpful as it allows us to express the pressures in the emergency department in an objective way. The dashboard also automatically keeps a record of the NEDOCS every hour since we have activated it which has several advantages. Firstly, we can look at a specific day and time and tell how busy the emergency department was at the time. We have started using this data when we analyse safety incidents and patient complaints. Secondly, we are analysing the trends in the NEDOCS so that we can understand which times of the day the department becomes more crowded. We will use this data to plan interventions like improving resources such as staffing and diagnostic services to try to prevent the department becoming overcrowded. Finally, we will use the dashboard to measure the success of the various interventions that we have taken to reduce the crowding in the department.

**Conclusions:**

The NEDOCS has been used as an objective way to measure overcrowding in emergency departments. Other departments have used the strategy of manually measuring the NEDOCS every two hours or every hour when it is busy. Having the NEDOCS automatically calculated and recorded every hour using routinely collected data improves data quality and consistency. We will use this data to help plan interventions and measure their effectiveness in reducing the level of overcrowding in our ED in the future.

## Abstract number 30

**Author:** Paul Nav

**Location:** London, England

**Title:** How skin typing systems in Dermatology could be contributing to data bias

### Objective:

To determine if current skin typing systems in Dermatology could contribute to data bias for the development of digital technology

The UK population is expected to grow to 84.5 million by 2061 with the percentage of Black, Asian and other Minority ethnic groups to expand from 8% to 30% during this time (1). This development is likely to have a significant impact on disease prevalence as well as medical education. Our background research uncovered a lack of diversity in the images of skin conditions in educational literature, websites and other resources. Dark skin comprised just 4.5% of images in medical textbooks (2).

**Methods:** A literature review was conducted to determine current skin colour typing systems used by clinicians in healthcare.

### Results:

Our research determined two main skin colour typing systems used in clinical practice. The principal one used is the Fitzpatrick photo skin type, which categorises skin on a scale from I-VI (3). Skin type I typically relates to pale white skin and is described as 'always burns and does not tan'. Skin type VI on the other end of the spectrum and refers to dark brown or black skin, which 'never burns and always tans darkly'. Skin types II, III, IV and V refer to fair skin, darker white skin, light brown skin and brown skin respectively (4). In addition to this, the Taylor Hyperpigmentation scale has been developed as a reference point for skin darkening during specific disease processes (5). The Taylor hyperpigmentation scale refers to 15 different skin colours but is rarely used in clinical practice or research studies. A systematic review of machine learning in Dermatology has revealed that the images used to develop the computer-aided diagnostic are usually from a population of light skinned patients, with concerns being raised that some of these systems may be biased (6). Multiple reports, including another systematic review, demonstrate that research cohorts in Dermatology lack full racial and ethnic representation (7). In addition to this, it appears there is no universal standardised language used when making in reference to skin colour or ethnicity (8, 9).

### Conclusions:

As digital health technologies and artificial intelligence systems are essentially 'trained' on historical datasets it is important to establish inclusive categorization terminology moving forwards (10). Our research highlights potential biases in the development of digital technology in dermatology and other medical specialties. To ensure these remains relevant and beneficial to all, it is important to develop datasets that are representative of the UK and global population.

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**Abstract number 31****Author:** Onkar Mudhar**Location:** London, England**Title:** Implementation of Virtual Oral Surgery Clinics in a London Teaching Hospital in Response to the COVID-19 Pandemic**Objective:**

In order to mitigate the spread of COVID-19, consideration has been required in maintaining communication with patients and methods of provision of care which are compatible with lockdown measures implemented in the UK, such as shielding, social distancing and legal restrictions on movement. Dental services in particular have undergone drastic changes, with disruption to delivery of elective care, wide use of triaging systems and restricted access for those requiring operative interventions through local Urgent Dental Centres.

The use of online platforms to conduct video consultations has provided continuity between clinicians and patients, without physical interaction and the associated risks from COVID-19. Patient convenience, improved access to clinical services and more efficient triaging are further benefits proposed by virtual clinics (VC) which may provide continued benefits for the National Health Service beyond the pandemic.

At the Eastman Dental Hospitals, this has provided a framework for establishment of oral surgery VC, with the objective of introducing a standard operating procedure for the implementation of this new service in a centrally based teaching hospital.

**Methods:**

We present Standard Operating Procedures (SOPs) for the introduction of oral surgery VC. These are designed to provide clinicians, administration and management staff with guidance for new patients and follow up consultations being conducted on VC. Patient and clinician feedback questionnaires are also being collected from the clinics.

**Results:**

Patients requiring simple extractions who are deemed high risk of COVID-19 transmission or vulnerable groups with complex medical histories or mobility problems can be considered suitable for a VC. Clinical photographs or videos of the area of interest will support this initial triage process. Pre-consultation work up such as special investigations and liaising with other specialists, may be completed in advance of the face-to-face assessment, thus reducing the number of appointments, patient travel and footfall into the premises. The patient and staff feedback overall has been positive from the VC.

**Conclusions:**

VC can increase patient access to healthcare services and preserve resources during the COVID-19 pandemic. The field of dentistry does not initially seem an obvious area for VCs, however innovation led us to investigate. The benefits in triaging of patients, reducing inappropriate referrals, waiting lists and improving financial costs became apparent and will remain as we emerge from the emergency public health response. Virtual care has rapidly become a future of health service delivery. Clinical services should consider developing systems to incorporate digital-consulting and improve patient resources to enhance teledentistry services.

## Abstract number 34

**Author:** Shree Patel

**Location:** London, England

**Title:** eWHO Surgical Safety Checklist Implementation At The Eastman Dental Hospital

**Objective:**

The World Health Organisation's (WHO) surgical safety checklist was introduced in 2008. It's application within dentistry, in particular Oral Surgery (OS) is to prevent wrong tooth extraction.

The digital modified WHO (eWHO) surgical checklist was introduced within the Eastman Dental Hospital following conversion from paper notes to digital notes (EPIC) in 2019 to reduce carbon footprint.

This audit aims to ensure the dental hospital is attaining 'Local Safety Standards for Invasive Procedures' (LocSSIPS) standard of care (RCS, 2020) by achieving 100% compliance of the checklist.

**Methods:**

A retrospective audit from September to December 2020 was carried out. 114 patients were chosen via randomized selection. The eWHO checklists were analysed against the standards set out by the LocSSIPS toolkit to achieve 100% compliance.

**Results:**

Of the total sample 50.8% had a checklist completed with no errors this is a reduction from cycle 4 (96%). 92% of the records assessed had an eWHO checklist present as part of the OS procedure. Of the checklists that contained errors, these included: comments for procedural sign-in and sign-out not documented in 13 checklists; 42 checklists had the same clinician completing the sign-in and sign-out; and 8 checklists demonstrated a lack of contemporaneous record keeping including checklists being completed the day following the procedure and others with a recorded treatment time of 1 minute.

**Conclusions:**

The introduction of the eWHO checklist is an essential application in dentistry and vital in clinical patient safety. The checklist forms an integral part of EPIC notes and is included as part of their treatment. The prompts and aids within the checklist enable empowerment of all staff members as team members are encouraged to be part of the LocSSIPs process as well as raise concerns, reducing the risk of patient harm. The results have shown that compliance (50.8%) in the most recent cycle. Further staff training will be provided to ensure all team members are accustomed to the digital form of this checklist. We shall also consider the use of compulsory "hard stops" in completing patient notes, to avoid missing sections, and particularly using the real-time data function as a useful audit and monitoring tool.

## Abstract number 35

**Author:** Lei Hua

**Location:** Lothian, Scotland

**Title:** Electronic Sign Off of Results in the General Surgery Department, Royal Infirmary of Edinburgh

### **Objective:**

The primary objective was to audit current practice in 'reading' results in the General Surgery department, Royal Infirmary of Edinburgh. A secondary aim was to review current Foundation doctors' attitudes and compliance towards practice. NHS Lothian uses an administration system which records inpatient results onto an electronic patient record. Results can be signed as 'read' when reviewed and any 'unread' result will be highlighted on the patient's record until all results have been 'read', notionally emphasizing new results.

### **Methods:**

All results on the electronic record of patients admitted under the emergency take over two weeks in early 2021 were audited, excluding results reported post-discharge. Data collected included number and type of results, number of unread results, patient location and day of result. Additionally, a survey consisting of nine multiple choice and free text questions exploring self-perceived practice and utility of signing off results was distributed to departmental Foundation doctors.

### **Results:**

Results (n=1013) from 136 patients were audited. 461/1013 (45.5%) were 'unread' at time of discharge. The type of investigation influenced findings, with 70% of microbiology results left 'unread' compared to 29% of blood results. Fewer results were signed off for patients admitted to the ward compared with those discharged from the assessment unit, irrespective of total number of results. 'Take' days were used as a proxy for workload and more results were left 'unread' on these busier days.

Survey uptake was 84% (n=16). 31% (n=5) reported signing off results "all or most of the time" and 37.5% (n=6) agreed that they found signing off results beneficial to their clinical practice. 25% (n=4) had personal experience of important unread results being missed. Free-text questions identified perceived benefits to signing off results such as highlighting new results and encouraging results review. Practical barriers identified related to time and lack of departmental culture of signing off results, making the process more time-consuming due to multiple results left unread by colleagues. Furthermore, some respondents were unaware of the sign-off process altogether.

### **Conclusions:**

Our audit highlighted that almost 50% of patient results were not 'signed off' on TRAK during this period on General Surgery. Given the risk of delayed acknowledgement of new results and potential detrimental impacts on patient safety, this has now been highlighted as an area for improvement across all grades of medical staff working in the department, with the aim to change the workplace culture and improve current practice.

## Abstract number 36

**Author:** Yogini Gani

**Location:** London, England

**Title:** A machine learning approach to analysing voluntary incident reports

**Objective:**

To explore the feasibility of using machine learning (ML) approaches for thematic analysis of incident reports involving patients with penicillin allergies.

**Methods:**

Incident reports involving reactions to anti-infective medicines were requested from the National Reporting and Learning System. Mixed methods were used to quantify the characteristics of reported incidents and to conduct a thematic review of a sample of incidents that led to harm.

The themes were used to train a ML model to detect these themes in reports in the remaining dataset. Each report in the training subset for the ML model had been pre-labelled with one of more of the aforementioned themes. For each identified theme the annotator highlighted the corresponding phrase(s), e.g., for the theme 'temporary staff' the report might contain 'locum doctor'. These extracted phrases or terms (sometimes sentences) were then used to identify reports containing similar terms based on a predefined similarity measure. For themes in which the extracted features were mostly keywords/phrases we used a similarity measure based on custom (word2vec) word embeddings. For themes in which the extracted features were entire sentences we used a sentence embedding approach based on sentence transformers (SBert). We used a 80:20 training split and assessed the macro-f1 score for the subthemes.

**Results:**

20,788 incidents were extracted between 01/01/2012 and 31/12/2016. 6 key themes were identified manually and further refined to train the models: time (night, out of hours); documentation (source, completeness, conflicts), knowledge (patient, medicine, cross-sensitivity), external or system factors (guidelines, microbiology advice/results, visual prompts), internal or individual factors (clinical condition, policy or procedure non-compliance, considered decision making) and medical/prescribing system (electronic or paper-based).

170 allergy reports were annotated and used to train the model. The macro-f1 was 0.62 across all subthemes. The model reported higher f1s for simpler themes, such as temporary staff (1.0) and microbiology advice (0.93) whereas for more complex themes, such as non-compliance to policy (0.45), the reported f1s were lower. This was because unlike the simpler themes, the complex themes could not be identified through keywords/phrases, and the number of training examples were too few for the model to be able to learn general semantic patterns for these themes.

**Conclusions:**

ML approaches have the potential to be used in conjunction with traditional qualitative thematic analysis for large volume data. Further work is planned to extend the number of annotated documents in order to improve the ML performance.

## Abstract number 37

**Author:** Yogini Gani

**Location:** London, England

**Title:** Data driven approach to understand and improve bar-coded medication administration compliance

**Objective:**

To improve bar-coded medication administration (BCMA) scanning rates by examining data to understand factors that influence scanning compliance

**Methods:**

Observational study of electronic data on approximately 1.3 million medication administrations between April 2019 and July 2020 from elective and acute wards from one NHS hospital trust. Descriptive statistics were used to identify differences between the settings. Time series analysis was used to examine changes in compliance with patient scanning, medication scanning, reported reasons for non-compliance and the effect of data driven quality improvement initiatives to sustain and improve scanning rates.

The statistical package R studio was used to build a variety of regression models to assess differences in BCMA compliance. Data on items that were reported as unscannable were collected to identify strategies to promote BCMA use, and changes in user action were used as an indicator of safety catches due to BCMA use.

**Results:**

Overall BCMA compliance (patient and medication scanning) ranged from 4% to 89% depending on the ward. Acute, high volume settings demonstrated a sharp the drop in compliance (25% to 5% in 3 months post implementation), whilst elective settings generally presented a more gradual downtrend. The exception was a single ward that undertook data driven quality improvement initiatives and managed to increase and maintain BCMA compliance from below 20% in July 2019 to above 55% by July 2020.

Regression models identified medication routes as an influencing factor for successful BCMA scanning, with tablets more likely to be scanned than infusions in the acute setting. Acute wards most commonly selected "scanner not available" as the reasoning for non-compliance suggesting a shortage of available hardware or possible selection of the default option to override scan requests; elective wards most frequently selected "bar-code unreadable" as the reason for non-compliance. Examination of unscannable items identified over 1000 medications that could not be scanned. Analysis of safety catch data found that BCMA compliance successfully altered the actions of the user between 33% and 40% of the time dependent of setting.

**Conclusions:**

Large variation in scanning compliance were seen across wards in one organisation, highlighting the importance of contextual factors. Data driven quality improvement was an important factor to maintain compliance. Logistical issues such as unscannable items, infusion components being difficult to scan and the possibility of a lack of hardware were identified as areas for further improvement. Limited safety data suggests that BCMA can improve safety when used correctly.

## Abstract number 38

**Author:** Lan Wang

**Location:** London, England

**Title:** A Novel Patient Pathway Analysis Framework for the Prediction of Lung Cancer

### **Objective:**

Research into early diagnosis of cancer remains a national priority as treatment intensity and cancer outcomes and survival are strongly linked to cancer stage at diagnosis. Although there are a number of red flag symptoms, robust evidence on predictive symptoms and signs is limited. In many cases, a combination of poorly predictive features is required for cancer likelihood to exceed referral thresholds (3% in NICE 2015 guidance). This study proposes a novel framework for deriving, modelling and analysing the pathways patients follow to the point of diagnosis using EHR data across primary and secondary care, resulting in a predictive model for early diagnosis of lung cancer and a set of cancer-specific clinical indicators and standards that encompass the transition of patients from primary to secondary care.

### **Methods:**

Through unique patient-level data linkage from GP systems through NWL Whole Systems Integrated Care with secondary care data from Imperial College Healthcare NHS Trust (ICHNT), via iCARE (Imperial Clinical Analytics, Research & Evaluation), we have created a novel interoperable cancer specific dataset for Real-world evidence AI research. From this, we derived patient pathways, consisting of a sequence of medical events for each patient over one to three years before the date of lung cancer diagnosis. We developed a pathway analysis tool based on a deep contextualized pathway representation model that extracts a semantic representation of the medical concepts/codes present in a pathway as well as the sequential and temporal relationships between the codes. This allows us to discover associations with the underlying health state of the patient and the corresponding diagnosis. After pre-training the pathway representation model, it then fine-tuned with a classifier to create a predictive model that can help inform diagnosis for lung cancer.

### **Results:**

The deep pathway representation model has been pre-trained on 3-year pathways of 9337 patients with a wide range of conditions. The performance of our predictive model trained on the most recent one-year pathways before diagnosis is: achieves Precision (94.41%), Recall (96.2%), F1-score (95.3%) and ROC-AUC (98.68%) for lung cancer prediction, and Precision (95.68%), Recall (93.66%) and F1-score (94.66%) for the prediction of other conditions. Using the first two years of the 3-year pathway data, the predictive model achieves Precision (86.38%), Recall (88.64%) and ROC-AUC (94.93%) for lung cancer prediction, outperforming existing models.

### **Conclusions:**

The linked primary care and secondary care EHR data possesses a wealth of information related to cancer diagnosis. Our pathway analysis framework is highly effective in identifying lung cancer progression patterns and clinical investigation patterns in the data and the resulting predictive model achieves state-of-the-art performance on the prediction of lung cancer.

## Abstract number 39

**Author:** Alison Kelly

**Location:** Edinburgh, Scotland

**Title:** The role of mHealth applications to support prehabilitation in cancer care. A scoping review

### **Objective:**

With the rising use and ownership of smartphones, the use of mobile applications in healthcare (commonly referred to as mHealth) may be a viable option for increasing access to prehabilitation care prior to treatment for patients with a cancer diagnosis. The ability to provide remote support to patients to access prehabilitation services without the need for them to come into hospital is of huge importance considering the impact of the current COVID-19 pandemic and how many of these patients can be immunocompromised. However despite great interest in the use of mHealth applications, limited studies have applied such platforms in the context of prehabilitation to patients pre surgical and or pre cancer treatment. This review was conducted as part of a PhD research project examining the feasibility of mHealth applications in patients with oesophageal cancer. Preliminary searches did not identify any existing systematic or scoping reviews on the topic.

**Aim:** To determine the role of mHealth applications to support prehabilitation in cancer care.

The objectives of the review were to:

- Examine the extent of published scientific literature on the role of mHealth applications in prehabilitation and how such programmes are conducted
- Identify the key characteristics related to remote prehabilitation interventions
- To identify research gaps in the existing literature concerning prehabilitation in cancer care using mHealth technologies.

### **Methods:**

A comprehensive scoping review was conducted using the databases Scopus, PubMed, CINAHL, CENTRAL, MEDLINE and PsychInfo. In the initial search spanning across six databases 1,297 results were yielded and after a through double blinded screening process 32 articles met the criteria for full review. Two reviewers independently screen articles to determine eligibility and extracted terminology used to describe the mHealth application used and the intervention details for its delivery.

### **Results:**

Of the 32 records identified, 6 articles were included in the review. Prehabilitation interventions ranged from mHealth apps, smartphone messaging, to remote monitoring using a Fitbit. The key outcome measures collected were feasibility, functional exercise capacity and quality of life. Studies showed improvement in these outcomes using mHealth applications, behaviour change, and self-monitoring approaches utilised in the prehabilitation phase.

### **Conclusions:**

This scoping review highlights the role mHealth applications can play in preparing and enhancing patients ability to tolerate the treatments associated with cancer. However there is little evidence for impact and or feasibility of such applications on patients with a diagnosis of oesophageal cancer. This requires further research.

<b>Abstract number 40</b>	
<b>Author:</b> Nehal Hassan	<b>Location:</b> Newcastle, England
Title: Preventing sepsis; how can artificial intelligence inform the clinical decision-making process? A systematic review	
<b>Objective:</b> To identify the optimal set of predictors used to develop artificial intelligence models to predict the likelihood of an infection and subsequent sepsis in different clinical settings.	
<b>Methods:</b> This systematic review was registered in PROSPERO database (CRD42020158685). We searched 3 large databases: Medline, Cumulative Index of Nursing and Allied Health Literature, and Embase, using appropriate search terms. We included quantitative primary research studies that focused on sepsis prediction associated with bacterial infection in adult population (>18 years) in all care settings, which included data on predictors to develop artificial intelligence algorithms. Any articles published between 1st January 2000 and 5th of October 2020 were screened to determine whether they met the inclusion criteria. Data extraction was performed using a data extraction sheet, and a narrative synthesis of eligible studies was undertaken. Quality assessment was performed using Newcastle-Ottawa Quality Assessment scale, which was used to evaluate the quality of non-randomized studies. Bias was not assessed due to the non-randomised nature of the included studies.	
<b>Results:</b> Seventeen articles met our inclusion criteria. We identified 194 predictors that were used to train artificial intelligence algorithms, with 13 predictors used on average across all included studies. The most significant predictors for the likelihood of infection, and subsequent sepsis, included age, gender, smoking, alcohol intake, heart rate, blood pressure, lactate level, cardiovascular disease, endocrine disease, cancer, chronic kidney disease (eGFR<60ml/min), white blood cell count, liver dysfunction, surgical approach (open or minimally invasive), and pre-operative haematocrit < 30%. All included studies used artificial intelligence techniques to predict the likelihood of sepsis, with average sensitivity 75.7±17.88, and average specificity 63.08±22.01.	
<b>Conclusions:</b> The type of predictors used were found to influence the predictive power and predictive timeframe of the developed artificial intelligence algorithm. Predicting the likelihood of sepsis through artificial intelligence can help concentrate finite resources to those patients who are most at risk. The currently available tools are limited by either their reduced specificity or sensitivity or both. Additionally, the short duration between time of sepsis onset and the time at prediction can reduce the clinical benefit of these tools. The set of predictors identified in this review can guide future studies in developing more sensitive and specific algorithms as clinical decision support tools with increased predictive time window to allow for preventive clinical measures.	

## Abstract number 42

**Author:** Debbie Phillips

**Location:** Milton Keynes, England

**Title:** A Solution for Staff Lateral Flow Test Reporting utilising Office365

### Objective:

To design and deploy an electronic solution for

1. Staff to log Lateral Flow Test Results (LFT) simply and quickly
2. Collate data for upload into national portal
3. Local reporting including breakdown by Division / CSU / Ward / Role

### Methods:

Office 365 and Multifactor Authentication (MFA) were already fully deployed. Forms (Microsoft) were designed for staff to log results. Type 1 for staff with an MKUH email address, Type 2 for those without an MKUH email address and Type 3 to be completed by the Covid Staff helpline in the event an individual was unable to complete form for themselves for any reason.

We used PowerAutomate (Microsoft) to trigger a flow each time a form was submitted. The flow included

1. Adding a row to master spreadsheet for that form type
2. Using email of the individual to pull in Employee ID from Azure Active Directory (Microsoft)
3. For any positive tests, a message to the Covid Staff TEAM and creating a task (Microsoft Planner) within the team to contact the individual to arrange a confirmatory PCR – target time <12 hours
4. Excel spreadsheets combined in Power BI (Microsoft) and linked via Employee ID to extract from Electronic Staff Record (ESR) to add in required demographics for National Reporting and role / department for local reporting.
5. Daily report generated to HR team.
6. Weekly report for Information Team to upload data to National POCT portal

### Results:

The solution has been well received and to date almost 40,000 results have been reported. 93.8% of submissions were on type 1 forms, 5.8% on type 2 and 0.4% on type 3 – the majority of the latter in the first 2 months of reporting.

Subsequently a further data source has been connected to the report to facilitate linking with PCR swab results for the confirmatory tests.

### Conclusions:

Having deployed Office 365 across our organisation we can now use it to generate “no code” solutions at no further cost and reassuringly the vast majority of staff have been able to transition well to these new ways of working. Staff can enter LFT results and need only enter 3 pieces of information – the date, the result and the LOT number of kit. If positive they are additionally prompted to add a contact number.

## Abstract number 43

**Author:** Debbie Phillips

**Location:** Milton Keynes, England

**Title:** Unlocking the power of the Electronic Patient Record – Driving the organisation with data through a global pandemic

**Objective:**

To use data from our Electronic Patient Record (EPR, Cerner Millennium) to build a live report reflecting the current situation in the organisation with regards to coronavirus cases. This would not only inform local decision making but was expected to help with mandatory National Reporting requirements.

**Methods:**

Having previously successfully linked our EPR to Power BI (Microsoft) and impressed by the intuitive visualisations that could be built in reports and dashboards, we initially queried the EPR for details of all patients in whom testing for coronavirus had been requested including NHS number, date of birth, gender, ethnicity, home postcode, date of PCR request, result of PCR, admission date, inpatient location, discharge date and discharge outcome and destination. Version 1 of our Covid Report was launched during March 2020. Two upgraded iterations followed quite quickly with Version 3 being our stalwart through the first wave. Through August 2020 a major redevelopment was undertaken including validation of all the first wave data and additional functionality added. This took account of newly available onsite PCR testing, more detailed order entry format for PCR requesting and the need to assess nosocomial infection rates, assess location history of inpatients and monitor swab compliance rates. In addition, separate reports were created to look at oxygen usage in the organisation and for covid patients to look at the use of oxygen, VTE prophylaxis, corticosteroids and Remdesivir to assure best practice. Our Covid report version 5 has now been live for several months.

**Results:**

The Covid Report has consistently been our most viewed report in the organisation throughout 2020 and continuing into 2021. It now supports 6 bespoke Covid Updates which are shared as appropriate with clinicians, local public health teams, our communications team, laboratory staff, executive teams and clinical site teams. It has become an invaluable tool in managing coronavirus in our organisation but more importantly, and perhaps for the first time it has truly opened the eyes of clinicians and managers alike to the power of the data in the EPR.

**Conclusions:**

Data routinely collected in an EPR can be utilised in near real-time using modern BI software to produce engaging and useful reports to both inform decision making and provide assurance of best practice. Both are powerful incentives to promote even better use of EPRs.

## Abstract number 47

**Author:** Anoop Shah

**Location:** London, England

**Title:** Transition to SNOMED CT as the interface terminology in a large EHR system

### Objective:

In March 2019, the Epic electronic health record (EHR) was installed at UCLH, a large teaching hospital in London. Like the majority of Epic implementations, UCLH purchased a 3rd-party interface terminology to provide the diagnosis term list in Epic, which maps to SNOMED CT in the background. We sought to switch to using SNOMED CT natively as the interface terminology, in order to reduce the overhead of maintaining an additional mapping.

### Methods:

We created a utility to convert SNOMED CT NHS Digital (TRUD) release files into an Epic compatible format. Existing diagnoses in problem lists could either be left as is, with clinicians being prompted to select a SNOMED CT term when the entry is edited, or batch converted to SNOMED CT. We sought to pre-convert the majority of diagnoses in order to save clinicians' time.

The vendor of the proprietary terminology supplied a mapping to SNOMED CT, but around 10% of the maps were less than optimal. We created a review process whereby mapped terms with similar wording were automatically approved by an algorithm, and the remainder were reviewed by at least two clinicians or terminologists. Testing and validation processes were implemented to correct any mapping errors, ensure that EHR functionality such as decision support was not affected, and minimise any risk to patient safety.

### Results:

UCLH patient records contained 45,993 distinct diagnoses recorded using the proprietary terminology, of which 33,013 required manual review as they did not map to a SNOMED CT term with similar wording. We were able to map 68.5% of distinct diagnosis terms, comprising 95.6% of all diagnosis entries in the EHR, and successfully transitioned to SNOMED CT on 7th April 2021.

### Conclusions:

We have demonstrated that SNOMED CT can be used as the Interface terminology in a UK hospital. Expected benefits include simplification of terminology version control and maintenance, improved interoperability with other organisations, and improved precision of diagnosis records when data are used for audit, service evaluation or research.

As an organisation, we aim to use this project as a springboard to encourage clinicians to engage with the UK SNOMED CT community. Furthermore, we are proud to have worked with Epic to enable future UK and international sites to adopt an open internationally recognised standard as their interface terminology.

We recommend that organisations should carefully consider the trade-offs in using proprietary terminology systems for recording clinical information.

## Abstract number 51

**Author:** Hannah Lonsdale

**Location:** Baltimore, Maryland, US

**Title:** Finding hidden treasure: development of a hybrid manual and programmatic approach to uncover the valuable data from patient records contained in our hospital systems.

### **Objective:**

Patient records should be suitable for demonstrating performance of care and for use in research. However appropriate curation of this complex data is difficult to achieve at scale. Development and testing of AI systems requires large and reliable datasets which are often not available outside a few prospectively collected areas such as national breast screening. We have used moderate risk family history breast cancer screening at the Royal Marsden Hospital as an exemplar to investigate feasibility of generating research datasets derived from routinely collected clinical records using hybrid manual and programmatic curation.

### **Methods:**

We defined multiple data points required for analysis then studied the clinical patient journey to discover how EPR and PACS information can populate these. Selected information from the electronic patient record (EPR) was extracted into SQL tables. This included imaging and pathology reports to determine screening performance and patient information including ethnicity to assess for potential bias in AI systems. Using SQL to link records we identified our cohort and generated a derived patient journey dataset. We used an iterative approach, coding to collect data, examining and analysing, then revising our code. We find exceptions and errors by searching for suspected difficult / complex cases by targeted sampling. Limited numbers of cases resistant to accurate automated analysis are flagged and manually reviewed.

### **Results:**

Out of an initial identified cohort of 7781 we identified 5390 genuine MRFH screening patients within the 10-year study period with over 26,000 screening attendances. This has been audited for accuracy of inclusion against 600 imaging attendance samples with no omissions discovered. We have performed numerous ad hoc reviews and 10 formal targeted audits resulting alteration of the patient journey code during development. Manual classification of cases resistant to automated classification has been required in 82 cases.

### **Conclusions:**

Close teamworking between data analysis and clinical staff using this hybrid approach can deliver reliable datasets from routinely collected clinical records at a scale not feasible with manual collection. We will complete this work with robust audit of the data to demonstrate accuracy and use this data to determine screening performance at RMH over the 10 year study period. This will form the basis of an anonymised dataset suitable for testing AI systems and further projects in associated areas.

Funding provided by RMH / ICR BRC pump priming grant.

## Abstract number 52

**Author:** Brendan Delaney

**Location:** London, England

**Title:** RECAP (remote COVID-19 Assessment in Primary Care): A risk score to predict hospital admission using a learning system approach.

**Objective:**

Primary care settings require a validated acute COVID 'risk of admission' score to safely decide which patients can be managed at home. We aimed to develop and validate the RECAP score using a 'learning system' approach.

**Methods:**

Given the requirements to collect data routinely in GP Electronic Health Record (EHR) systems and to predict the outcome 'hospital admission in 28 days', we needed to: 1. Reduce the number of items that were collected to a practicable amount. 2. Express these items as available SNOMED clinical concepts. 3. Distribute templates with these concepts in an easy format for use. 4. Consent and track data across several hundred participating practices and the NHS111 Covid Clinical Assessment Service (CCAS). 5. Extract data from EHR systems and link with outcome data (hospital admission in 28 days) in a secure environment for analysis. A sample size of 1317 is required for 24 predictors at an admission rate of 10%. 1400 subjects are required to validate the model (85% specificity, precision 0.05). Allowing for incomplete data the sample size was 2880. Two cut-points will be defined to enable patients to be divided into green, amber, red groups using interval likelihood ratios. Separate scores will be developed for GPs and for CCAS.

**Results:**

A Delphi panel of 50 clinicians suggested a minimum set of clinical data items, including potential severity levels as outcome sets. Templates were prepared for use in systems, SystmOne, EMIS and Adastral (CCAS). Verbal consent supported by a web-based information sheet was recorded by using the SNOMED term for 'consent for research study obtained and the study Central Portfolio Management System number. We used two existing networks (WSIC and ORCHID) where data from records are extracted from EHR systems and linked with outcomes. The study was supported by NIHR CRN as an Urgent Public Health Study. Data collection commenced in October 2020. The study closed to recruitment on Feb 28th, 2021. In NW London 2505 subjects were recruited by 103 practices and for the RCGP Research and Surveillance Centre (Oxford), 1297 subjects from 90 practices, (total 3,802). CCAS have so far recruited 1,300. Data are currently being extracted and linked for analysis.

**Conclusions:**

Existing EHR and data linkage systems can be used to recruit cohorts at scale for large simple studies. However, a lack of SNOMED post-co-ordination or a full set of post-coordinated SNOMED terms means that some compromises are required in data collected.