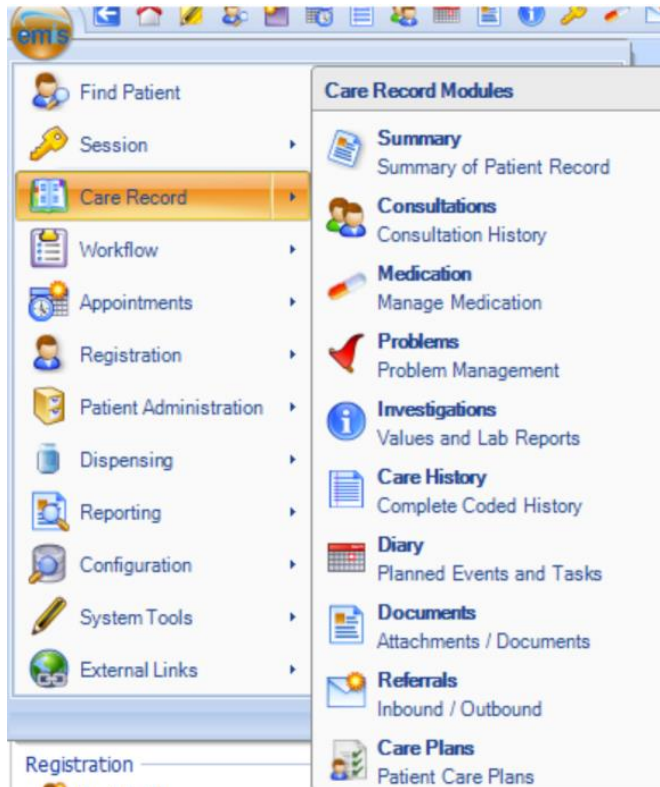


# Processing free-text health data to support prescription decision-making for mental health patients

Turing Institute AI-Assisted Real-Time Decision Making  
Sandpit Funding

Harriet Cant

# Background



- A patient's complete\* medical profile is contained in **electronic healthcare records (EHRs)**
- GPs use EHRs **during consultations** to guide **decisions** around **prescribing**
- However, **EHRs are difficult to navigate**, especially in a 10 minute appointment, meaning important clinical information is often **available but not accessible**

# Background

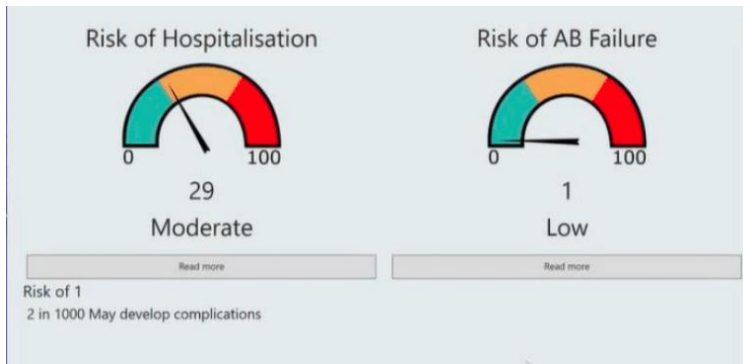
## ☰ Patient characteristics

<b>Allergies</b>		<b>Other Comorbidities</b>
<b>IUP</b>		<b>Diabetes</b>
<b>Renal</b>	No problem recorded	<b>Height(cm)</b>
<b>Hepatic</b>	No problem recorded	<b>Weight(kg)</b>
		<b>BMI</b>

## ⊕ Antibiotic history

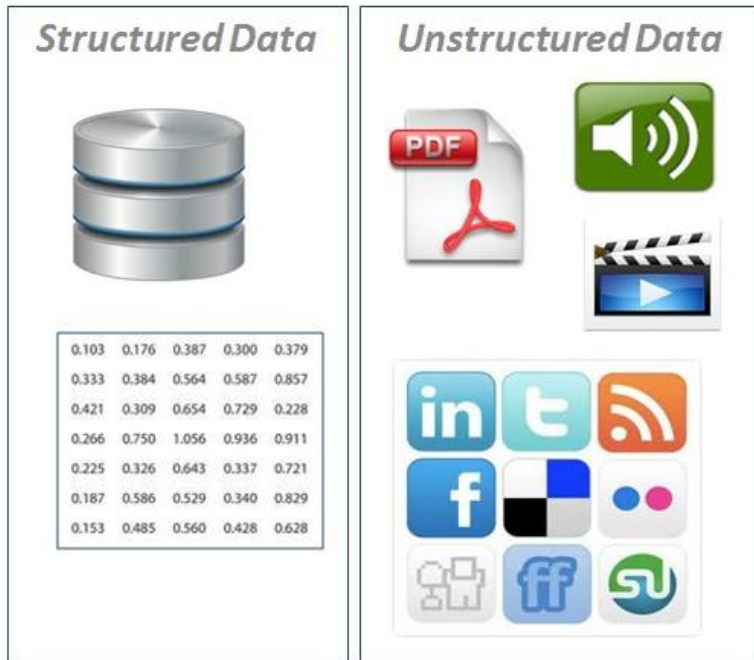
Prescribing over the last 12 months

Antibiotic	Antibiotic family	Prescription type	Issue date	Dose	Amount
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- A patient's complete\* medical profile is contained in **electronic healthcare records (EHRs)**
- GPs use EHRs **during consultations** to guide **decisions** around **prescribing**
- However, **EHRs are difficult to navigate**, especially in a 10 minute appointment, meaning important clinical information is often **available but not accessible**
- **Knowledge Support Systems (KSS)** can be activated during consultations to **extract relevant data** from EHRs and summarise these in a clinically helpful, **user-friendly** manner. They can also **run analytics** on the patient's data, such as risk of hospitalisation

# What's the problem?



- KSSs have previously been developed to extract **structured data**, e.g. medication codes, date of prescription. However, **data relevant to prescribing are often coded as free-text**, such as reasons for stopping a previous medication
- The processing of free-text data is **significantly more complicated** than structured data →
  - Subjective, context dependent
  - Subject to more human error (typos)
  - Medical terminology and acronyms
  - Different underlying architecture to data storage
  - Restricted access

# Study aim

Free-text data presents a different set of benefits and risks from both technical and clinical standpoints. These need to be explored before such data could be integrated into a KSS.

To assess the **technical feasibility** and **clinical benefit and risks** of integrating **free-text** electronic healthcare records (EHR) data into an existing **Knowledge Support System (KSS)** to support **prescription decision-making** for **mental health patients** in primary care

# Application: why mental health patients?

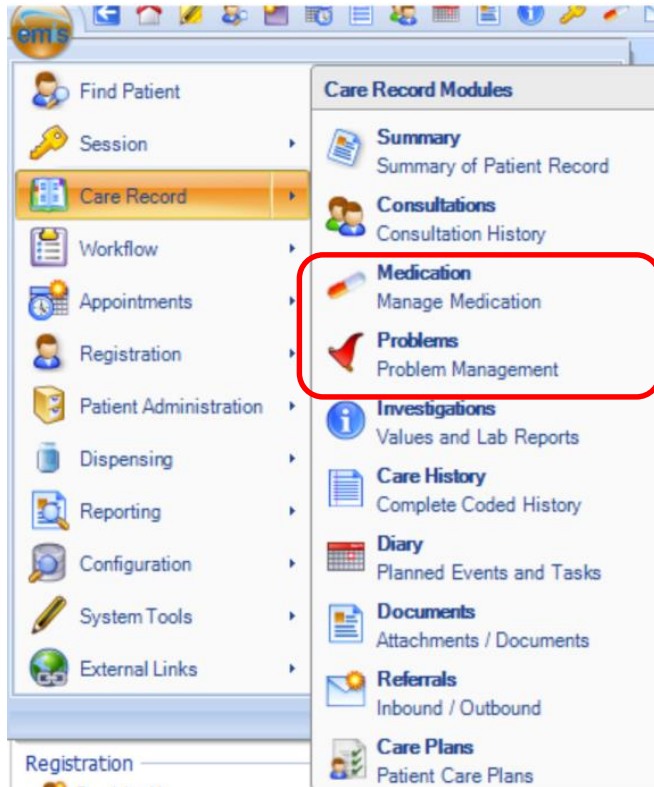
- Mental health patients often have **complex** clinical histories and treatment profiles
  - **EHRs** are more **difficult to navigate**
  - More **at-risk** of important information being overlooked and the resulting **prescribing errors**
- Several contributing factors
  - High number of physical conditions/medications
  - On/off treatment (relapse), and switching due to side effects
  - Contact with secondary care units (e.g. psychiatrists)
  - Problems with adherence
- Additionally, more **records may be narrative** for mental health patients (e.g. patient experience as opposed to more objective metrics, like blood pressure for hypertension)



Image from:

<https://pharmaceutical-journal.com/article/opinion/how-polypharmacy-has-become-a-medical-burden-worldwide>

# Looking inside an EHR



Complementary information  
spread across **multiple tabs**

# Looking inside an EHR

EMIS Web Health Care System - Keele University Enterprise Search && Reports - 27205

Summary Consultations Medication Problems Investigations Care History Diary Documents Referrals

Tasks - 3 (2)

Active TEST PATIENT, Winston (Mr) Born 12-Nov-1960 (59y) Gender Male NHS No. Unkn

Date Navigator	Date	Consultation Text	
2020 (1)	28-Sep-2020 15:12	GP Surgery (Keele University Enterprise Search & Reports)	WATHALL
Sep (1)	Additional	Research study observation activity 45200 CPMS ID PROMPPT - 1st Assessment CRF	
28th: [SW] GP S		Research study observation activity 45200 CPMS ID PROMPPT - Pain review plan & self-care information	
2018 (1)	11-May-2018 12:11	GP Surgery (Keele University Enterprise Search & Reports)	WATHALL
May (1)	Problem	<b>C/O - low back pain (First)</b>	
11th: [SW] GP S	Additional	Possibly eligible for participation in clinical trial 32182 Keele TAPS main Trial - Control	
2016 (2)		Keele TAPS trial - patient declined invitation (Main Trial) Patient declined consent to share contact details to receive invitation	
Nov (1)	15-Nov-2016 11:32	GP Surgery (Keele University Enterprise Search & Reports)	EVANS, Mark (Mr)
15th: [ME] GP S	Problem	<b>Dupuytren's disease - finger(s), nodules with no contracture (First)</b> Laterality: Right	
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2nd: [ME] GP S	02-Apr-2015 12:52	GP Surgery (Keele University Enterprise Search & Reports)	EVANS, Mark (Mr)
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Data is mostly presented chronologically and not based on relevance to the appointment



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Data is mostly presented chronologically and not based on relevance to the appointment

Dense information in small-text, meaning GPs can only scan for top-level information

# Case study: KSS for antibiotic prescribing

Only information relevant to antibiotic prescribing is shown, such as previous antibiotics instead of all previous treatments

The screenshot displays a medical knowledge support system interface. On the left is a blue sidebar with a patient profile for Mr Edward Pugh (13/09/1948, 73 y/o) and a list of navigation options: Diagnosis Selection, Symptom Survey, Patient Summary (highlighted), Patient Risk, Treatment Guidelines, Treatment Decision, Patient Leaflet, and Update Medical Record. The main content area shows the 'Patient Summary' for 'BRIT2 Knowledge Support System: Lower respiratory tract infection (disorder)'. It includes a section for 'Patient characteristics' with a table of 'Allergies' (IUP, Renal, Hepatic) and 'Other Comorbidities' (Diabetes, Height, Weight, BMI). A red box highlights the 'Antibiotic history' section, which is titled 'Antibiotic history' and 'Prescribing over the last 12 months'. The bottom of the interface has a purple bar with 'About' and a blue bar with navigation buttons for 'Up to Symptom Survey' and 'Down to Patient Risk'.

BRIT2 Knowledge Support System: Lower respiratory tract infection (disorder)

*Patient Summary*

① Patient characteristics that may be relevant to immune function and antimicrobial prescribing.

### 👤 Patient characteristics

Allergies	Other Comorbidities
<b>IUP</b>	<b>Diabetes</b>
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**🔗 Antibiotic history**  
Prescribing over the last 12 months

Antibiotic Antibiotic family Prescription type Issue date Dose Amount

*i About* Up to Symptom Survey Down to Patient Risk

# Case study: KSS for antibiotic prescribing

The screenshot displays the BRIT2 Knowledge Support System interface for a patient with a lower respiratory tract infection. The patient's name is Mr Edward Pugh, born 13/09/1948, aged 73. The interface includes a navigation menu on the left with options like Diagnosis Selection, Symptom Survey, Patient Summary, Patient Risk, Treatment Guidelines, Treatment Decision, Patient Leaflet, and Update Medical Record. The main content area shows a Patient Summary section with a sub-section for Patient characteristics, which is highlighted with a red box. This section lists Allergies (IUP, Renal, Hepatic) and Other Comorbidities (Diabetes, Height, Weight, BMI). Below this is the Antibiotic history section, showing prescribing over the last 12 months.

BRIT2 Knowledge Support System: Lower respiratory tract infection (disorder)

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**Person icon** Patient characteristics

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**User-friendly** presentation: large-text, clear subheadings, all patient info in one place

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Navigation: Up to Symptom Survey | Down to Patient Risk

Left sidebar menu: Mr Edward Pugh, 13/09/1948, 73 y/o. Diagnosis Selection, Symptom Survey, Patient Summary, **Patient Risk**, Treatment Guidelines, Treatment Decision, Patient Leaflet, Update Medical Record.

Only information **relevant** to antibiotic prescribing is shown, such as previous antibiotics instead of all previous treatments

**User-friendly** presentation: large-text, clear subheadings, all patient info in one place

Can combine with other **useful information**, such as NICE guidelines and personalised risk scores

# Project questions: two streams

## CLINICAL BENEFITS/RISKS

- Which free-text data would be of **greatest benefit** to extract from EHRs, and how should this be **presented**? E.g. adherence, reasons for stopping
- How serious could the **consequences** be to patients if extraction did not work as expected? What is an **acceptable risk**?

## TECHNICAL FEASIBILITY

- Which clinical data **can existing natural language processing (NLP)** algorithms interpret? What are the **limitations**?
- Does the **EHR architecture** allow for these algorithms to process free-text data?
- What are the potential **technical risks and solutions**? E.g. error handling

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Software engineers

**Iterative  
process**

The diagram illustrates an iterative process between two streams of project questions. On the left, a purple rounded rectangle contains 'CLINICAL BENEFITS/RISKS' questions. On the right, an orange rounded rectangle contains 'TECHNICAL FEASIBILITY' questions. Three red arrows point from the clinical questions to the technical questions, and three red arrows point from the technical questions back to the clinical questions, forming a cycle. Below each stream is a rounded rectangle identifying the participants: 'Clinical workshop(s)' for the clinical side and 'Software engineers' for the technical side. The text 'Iterative process' is centered between the two streams.

# Possible use cases

Referral letters →  
indicate other prescribers



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Referral letters →  
indicate other prescribers

Detailed symptom  
profiles

Patient experience and  
quality of life

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Treatment plans (e.g.  
dosing and administration,  
especially if off license)

# Possible use cases

Referral letters →  
indicate other prescribers

Detailed symptom  
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Patient experience and  
quality of life

Reasons why a medication  
was stopped → why not to  
re-prescribe

Reasons why a dose  
was altered

Treatment plans (e.g.  
dosing and administration,  
especially if off license)

Any questions?