Text Analytics & Business Application

Text Analytics in Healthcare

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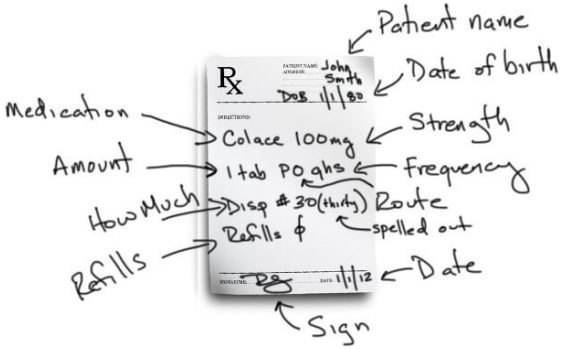
Outline of Today's Class

- Health and medical records
- Applications
- Electronic health records
- Two examples
  - Medical information extraction and analysis
  - Mental healthcare monitoring

Health and Medical Records

- A large proportion of health and medical data is often collected and stored in unstructured text formats.
- Health and medical records make the data hard to search, organize, study, and understand in its raw form.
- **Unstructured text**
  - Nursing notes
  - Clinical agreements
  - Medical publications



Use Cases by Chilmark Research

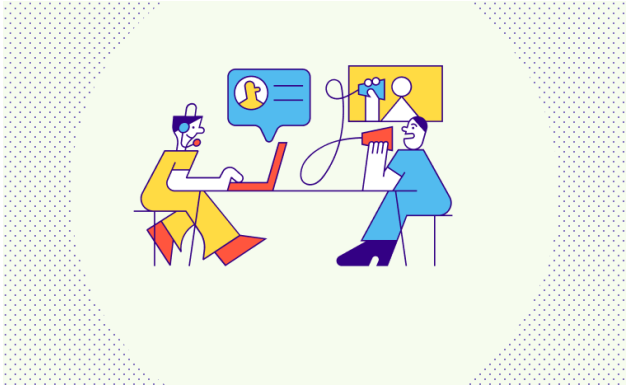
Research	Treat	Capture	Population Health	Revenue Cycle Management	Analytics/ Reporting
Data Mining					
Cohost Discovery	Clinical Decision Support	Speech Recognition	Pharmacosurveillance	Computer Assisted Coding	Registry Reporting
Clinical Trial Matching	Computations Phenotyping	Clinical Documentation Improvement (CDI)	Population Surveillance	Prior Authorization	Descriptive Analytics
Drug Discovery	Biomarker Discovery	Patient Reported Outcomes	Adverse Event Detection	Risk Adjustment	Predictive Analytics
Precision Medicine	Virtual Therapy	Ambient Virtual Scribe	Social Determinants of Health	Payer Provider Convergence	Prescriptive Analytics
	Triage		Readmissions		

Next-Generation Emerging Proven

Applications of Text Mining in Healthcare

Patient Prioritization and Billing

- NLP techniques can be used on physician notes to understand their state and urgency to prioritize various health procedures and checkups.
- This can minimize delays and administrative errors and automate processes.
- Similarly, parsing and extracting information from unstructured notes to identify medical codes can facilitate billing.

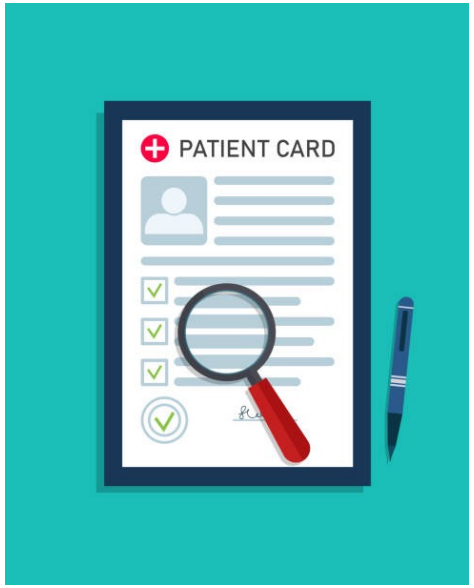


Pharmacovigilance

- Pharmacovigilance entails all activities that are needed to ensure that a drug is safe.
- This involves collection and detection and monitoring of adverse drug or medication reactions.
- With increasing use of **social media**, more of such side effects are being mentioned in social media messages; monitoring and identifying these is part of the solution.

Patient Profile Analytics

- Patient profile analytics is used to identify individuals who would benefit from proactive care or lifestyle changes.
- Using text analytics, we can extract patient's data from various sources and store the information in a patient profile graph.

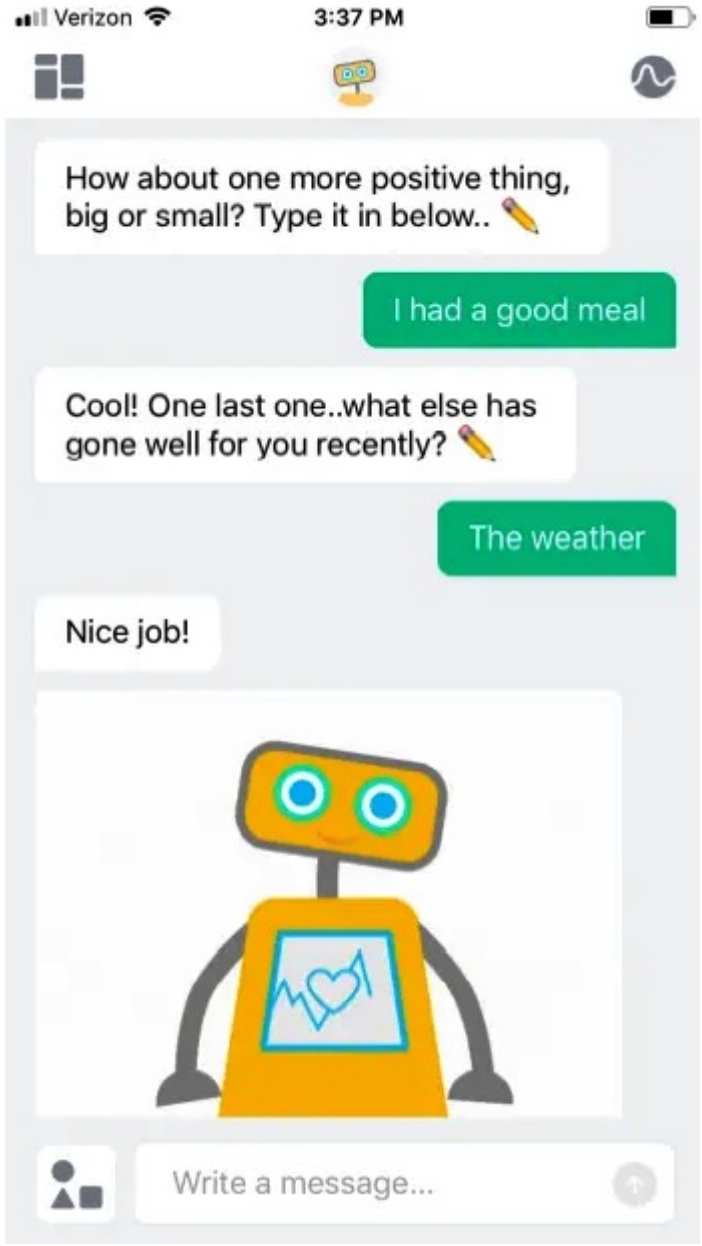


Clinical Decision Support Systems

- Decision support systems assist medical workers in making healthcare-related decisions.
  - These include screening, diagnosis, treatments, and monitoring.
- Various text data can be used as an input to these systems, including electronic health records, column-tabulated laboratory results, and operative notes.
- NLP is utilized on all of these to improve the decision support systems.

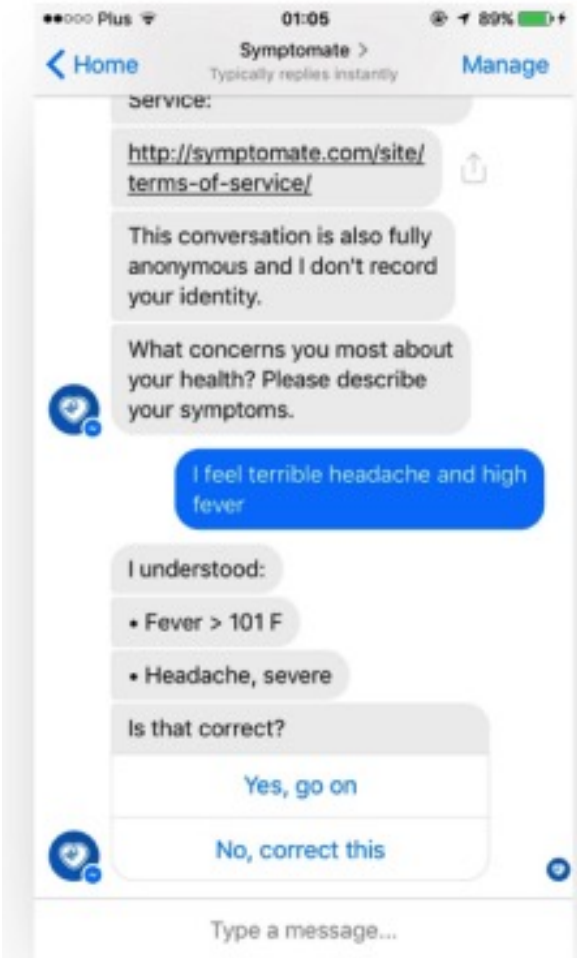
Health Assistants

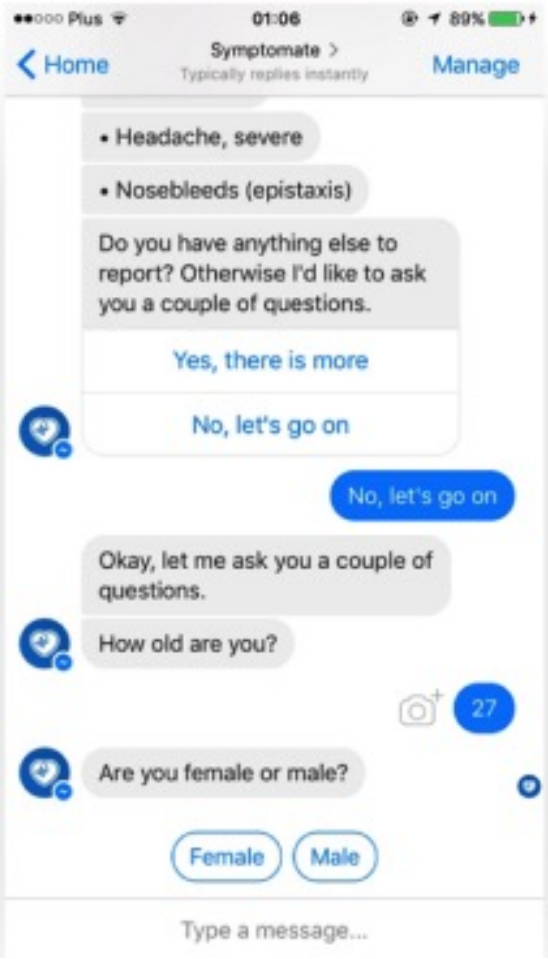
- Health assistants and chatbots can improve the patient and caregiver experiences by using various aspects of expert systems and NLP
- For instance, services like Woebot can keep the spirits of patients suffering from mental illness and depression.
- Health assistants can also assess patients' symptoms to **diagnose** potential medical issues.

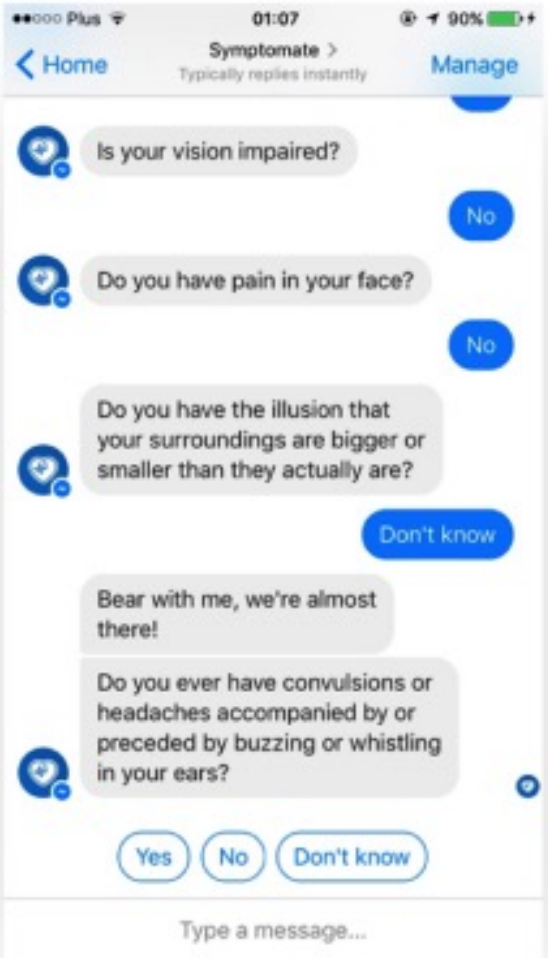


Health Assistants: Examples

- Diagnosis chatbot made by Infermedica API:







Electronic Health Records

Electronic Health Records

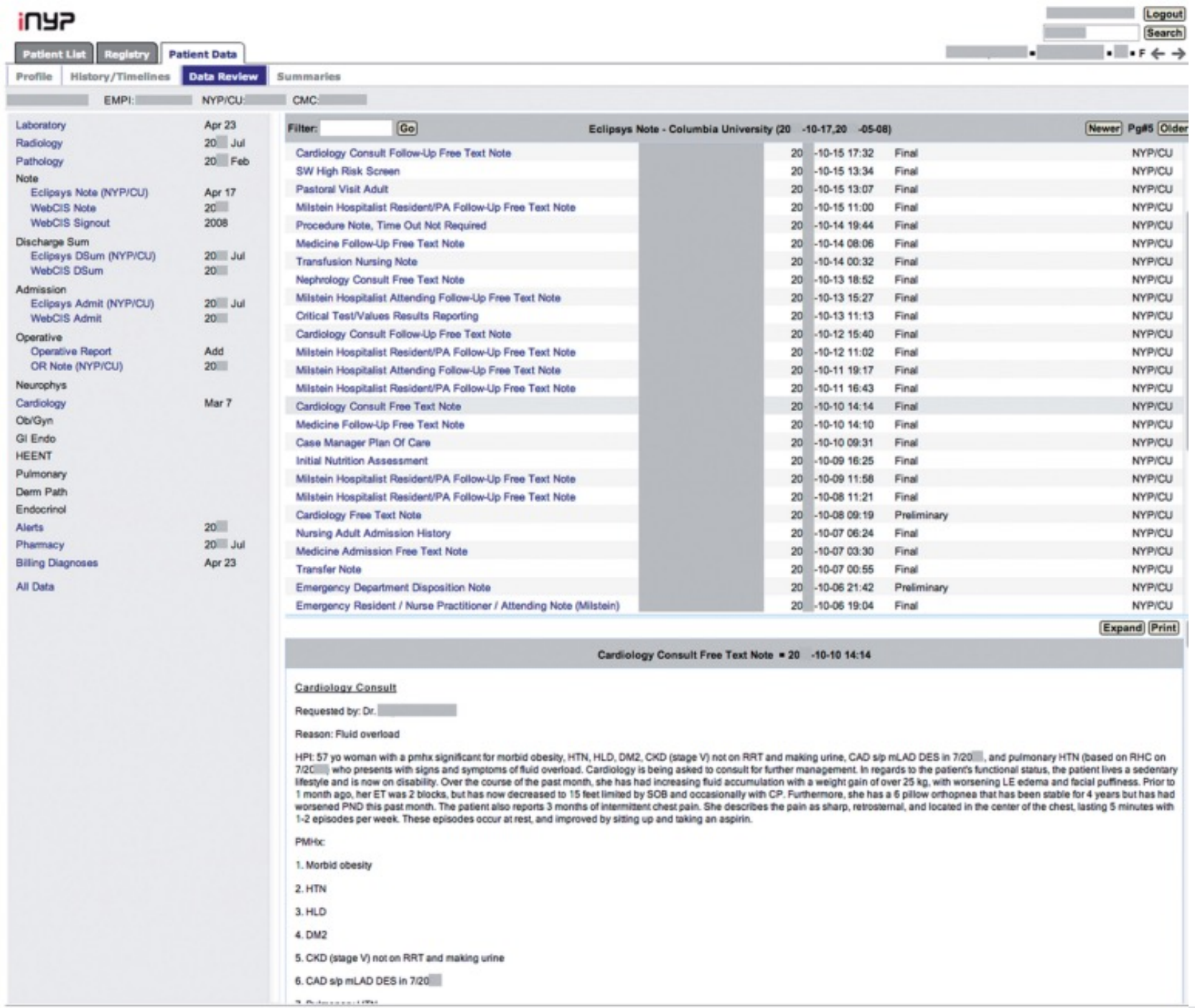
- Increased adoption of storing clinical and healthcare data electronically has led to an explosion of medical data and overwhelmingly large personal records.
- With this increasing adoption and larger document size and history, it's getting harder for doctors and clinical staff to access this data, leading to an information overload.
  - This, in turn, leads to more errors, omissions, and delays and affects patient safety.

HARVEST: Longitudinal Report Understanding

- HARVEST has been built to overcome the informational overload we mentioned earlier from Columbia University.
- The tool has been used extensively across hospitals in New York City.
- To start with, however, we need to cover how a standard clinical information system works.

Example

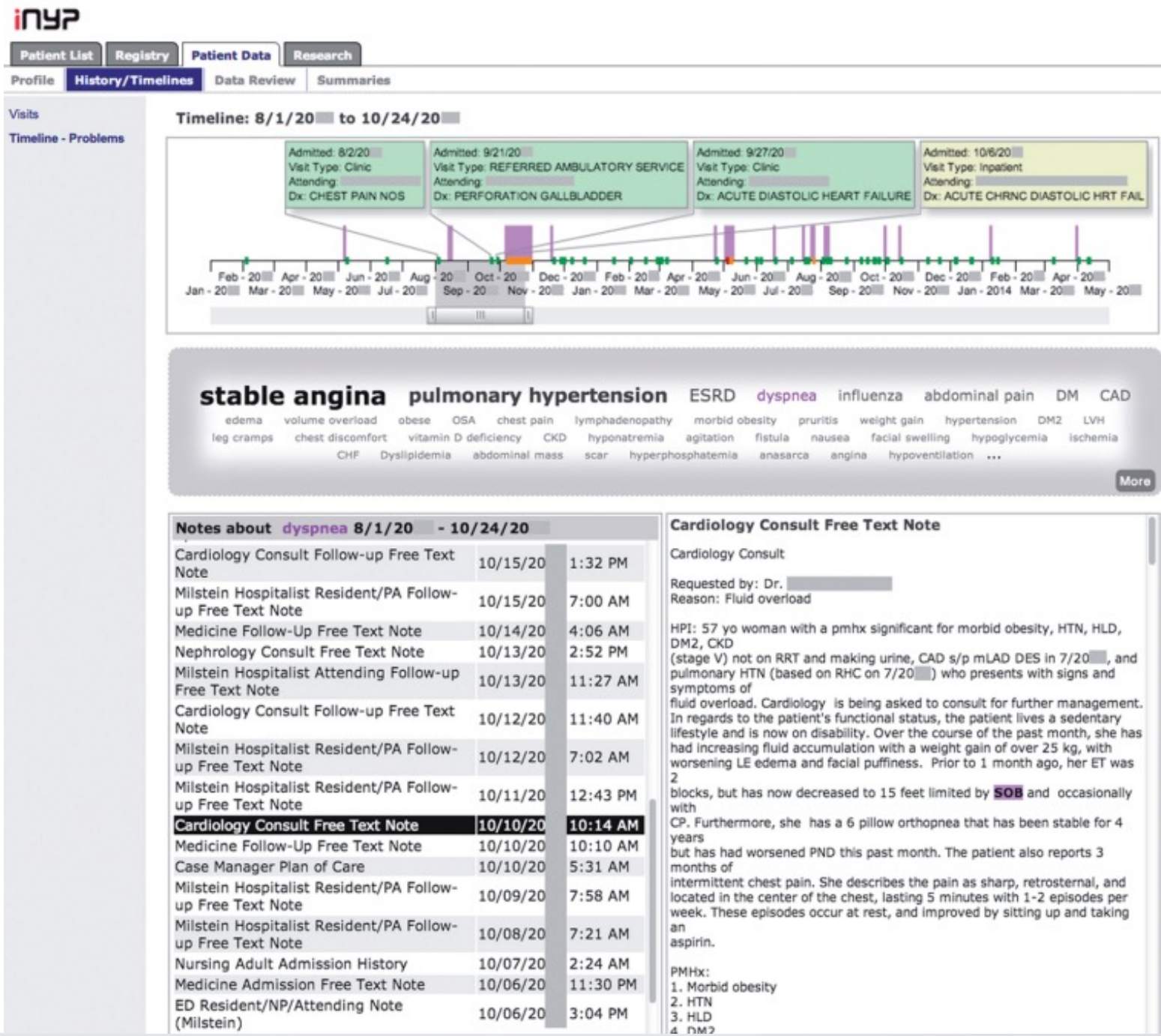
The standard clinical information review system at iNYP:



HARVEST

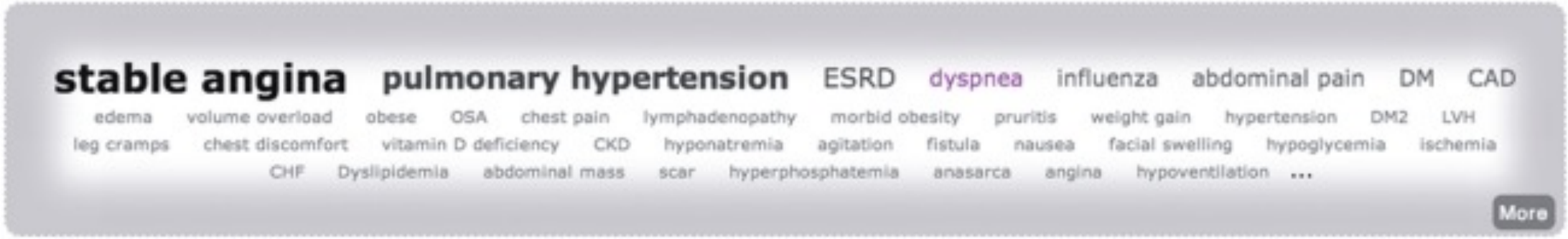
In contrast, HARVEST parses all of the medical data to make it easy to analyze and can sit on top of any medical system.

HARVEST system for the same patient from:



HARVEST

- All historical observations (from doctors, nurses, nutritionists, etc.) related to that patient are run through a **named entity recognizer** called HealthTermFinder.
- This finds all healthcare-related terms, which are then mapped to the Unified Medical Language System (UMLS) semantic group.
- The larger to smaller font sizes indicate the degree and frequency of the various issues a patient has been carrying.



Two Examples of Text Analytics Applications in Healthcare

1. Medical Information Extraction and Analysis

- **Medical information extraction (IE)** helps to identify clinical syndromes, medical conditions, medication, dosage, strength, and common biomedical concepts from health records, radiology reports, and discharge summaries, as well as nursing documentation and medical education documents.
- We can use both **cloud APIs** and **pre-built models** for it

Named Entity Recognition

Text analytics for health detects medical concepts in the following categories:

- Anatomy
- Demographics
- Examinations
- External Influence
- General attributes
- Genomics
- Healthcare
- Medical condition
- Medication
- Social
- Treatment

Examples

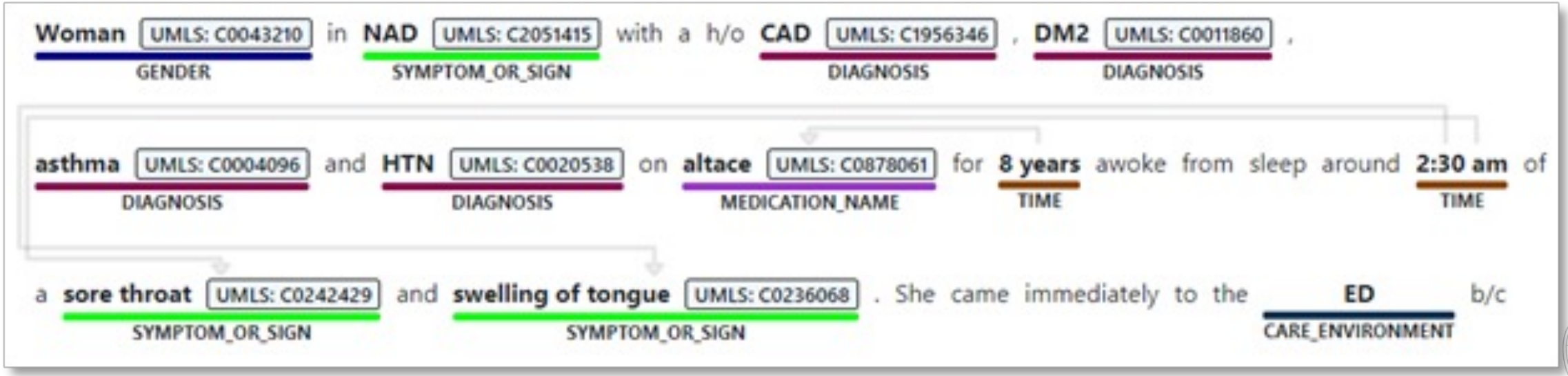
Anatomy entities:

- BODY_STRUCTURE: Body systems, anatomic locations or regions, and body sites. For example, arm, knee, abdomen, nose, liver, head, respiratory system, lymphocytes

Examples

Medical condition entities:

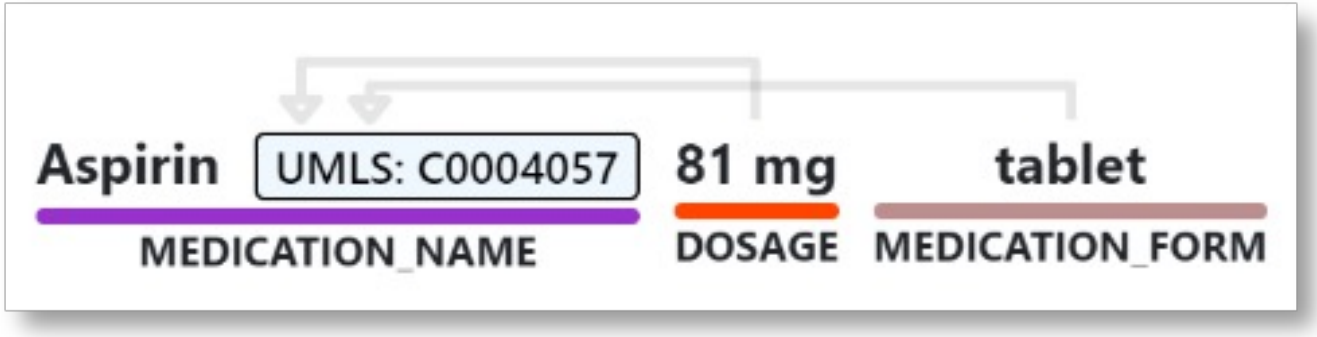
- DIAGNOSIS – Disease, syndrome, poisoning. For example, breast cancer, Alzheimer's, HTN, CHF, spinal cord injury.
- SYMPTOM_OR_SIGN – Subjective or objective evidence of disease or other diagnoses. For example, chest pain, headache, dizziness, rash, SOB, abdomen was soft, good bowel sounds, well nourished.



Examples

Medication entities:

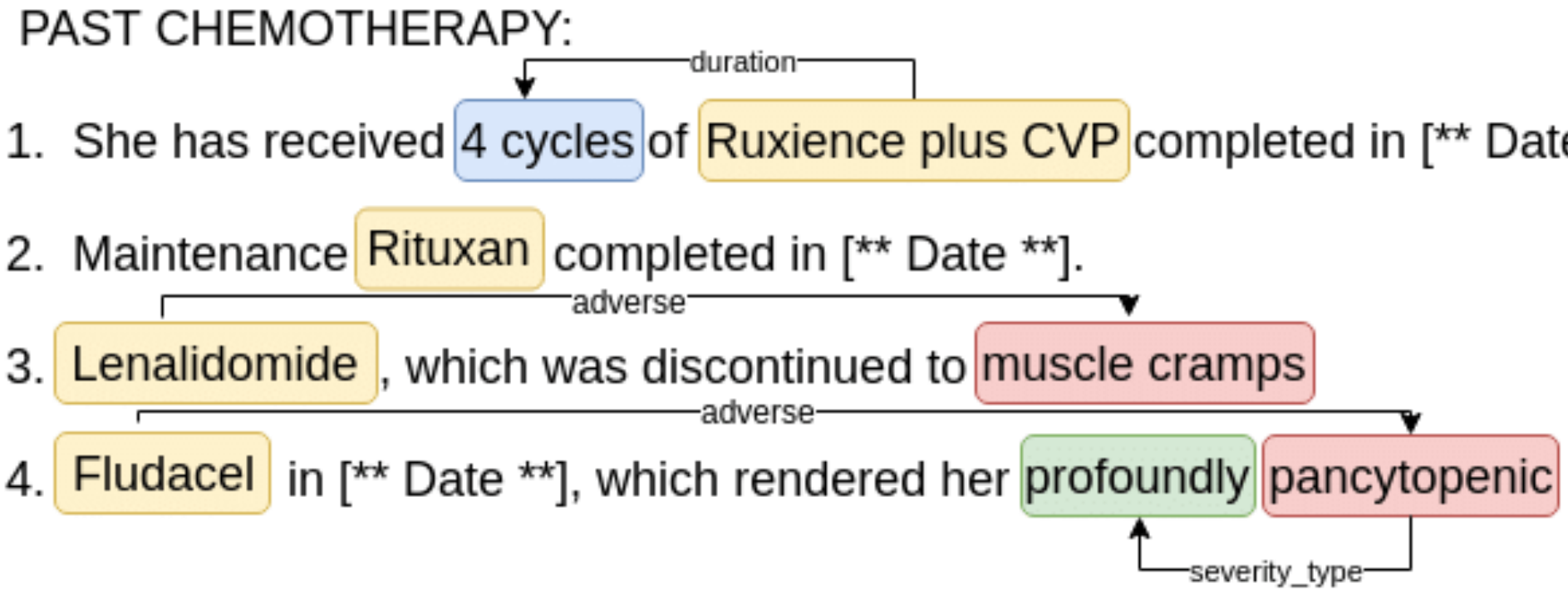
- MEDICATION_NAME – Medication mentions, including copyrighted brand names, and non-brand names. For example, Ibuprofen.
- DOSAGE - Amount of medication ordered. For example, Infuse Sodium Chloride solution 1000 mL.
- MEDICATION_FORM - The form of the medication. For example, solution, pill, capsule, tablet, patch, gel, paste, foam, spray, drops, cream, syrup.



Relation Extraction

- Extracted relationships usually occur between two or more entities of a certain type (e.g., Person, Organization, Location) and fall into a number of semantic categories (e.g., married to, employed by, lives in).
- Text analytics for health recognizes relations between different concepts, including relations between attribute and entity (for example, direction of body structure, dosage of medication) and between entities (for example, abbreviation detection).

Example


PAST CHEMOTHERAPY:
duration
1. She has received 4 cycles of Ruxience plus CVP completed in [** Date **].
2. Maintenance Rituxan completed in [** Date **].
adverse
3. Lenalidomide , which was discontinued to muscle cramps
adverse
4. Fludacel in [** Date **], which rendered her profoundly pancytopenic
severity_type

2. Mental Healthcare Monitoring

- It is the process of tracking, recording, and analyzing data related to a person's mental health over a period of time.
- It involves collecting information about a person‘s behavior, symptoms, and mood through various tools such as surveys, wearables, and mobile apps, allowing for early intervention and treatment.

Examples & Exercises using Google Colab