EMERSE: an easy-to-use, self-service search engine and chart review tool for EHR notes

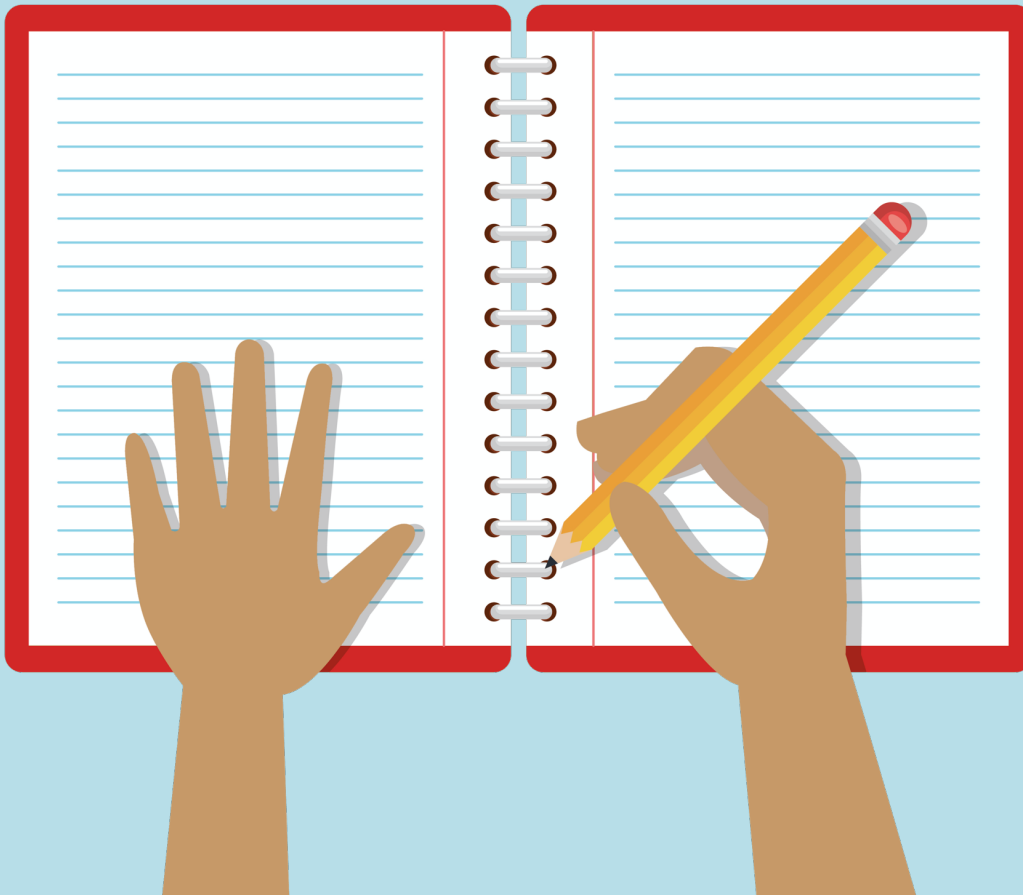January 11, 2023

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Web: project-emerse.org

http://project-emerse.org/presentations.html

If you're thinking of taking notes or want to visit links

these slides can be found at:

this link will be on most slides

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Disclosures

Funding: NIH (NCI, NCATS); PCORI

Licenses/Royalties: EMERSE "Synonyms" (used for query expansion) which is licensed by the U of Michigan

Free for academic use within EMERSE

I am here to tell you about EMERSE

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2021 study out of UC Irvine: *Design, Implementation, and Usability of the Electronic Medical Record Search Engine (EMERSE) Tool*
https://escholarship.org/uc/item/44p23878

"Users unanimously responded that they would recommend the system to others, and…for a tool they found so useful, they believed that <u>far too few people both within and outside of their network knew about the tool's existence</u>."

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Unstructured vs Structured Data

EMERSE is for this…	…not this
Unstructured Data (free text)	*Structured Data*
Mrs. Jones is a 56 year old female with a history of HTN, hypercholesterolemia, and T2DM who comes to the clinic today with a 3 day h/o dizziness and severe headache on the left side.	WBC: 5.6 Total cholesterol: 182 Weight: 67.4 AST: 30 ALT: 52

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80% of EHR data are in unstructured free text

structured data

unstructured data/free text

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The EMERSE solution

- A system "for the people"

- Users search the notes on their own
  - No need to wait in a queue for an analyst or a data scientist

- Easy-to-use for non-technical researchers

- It just works

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The EMERSE solution

- A system "for the admins"

- Enterprise grade, easy to support

- Configurable with roles/privileges to control access

- Data are kept secure within a centralized, audited system
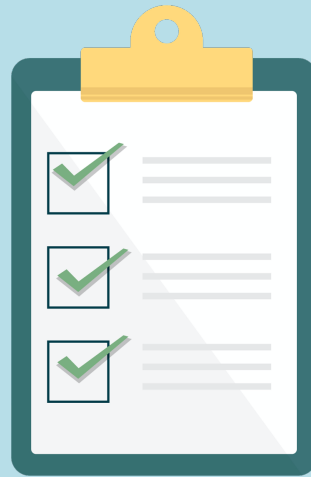
    – No need to download/store the data elsewhere

Find cohorts

EMERSE allows you to find cohorts based on things mentioned in the notes

- diseases

- drugs

- symptoms

- anything*

*if it is mentioned
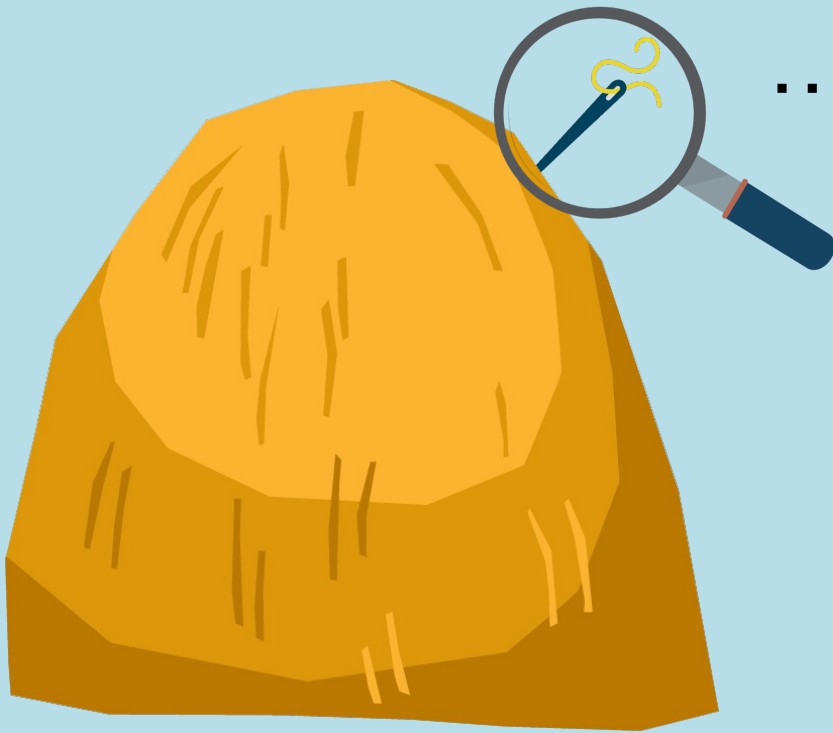
Find cohorts

It's perfect for finding rare things…

…like rare cancers

See this talk for more details:
https://vimeo.com/677482835
"Using EMERSE to Improve Research Involving Rare Cancers"

Highlight documents for chart review

Thoracocentesis confirmed the recurrence of mantle cell lymphoma. Disease restaging work-up revealed multicompartment lymphadenopathy in the neck, mediastinal, retrocrural, retroperitoneal and pelvic regions. Bone marrow was also involved. The patient was treated with a total of six cycles of rituximab, cyclophosphamide, vincristine, doxorubicin and dexamethasone (R-HyperCVAD) completed in January 2007. That treatment led to complete remission that lasted until October 2008, when the disease was found to have recurred in the left pleural space and retroperitoneum without bone marrow involvement.

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Our philosophy

It's important to see the terms/concepts in the context of the original text to truly understand the clinical meaning.

Phrase: A 31-year old Caucasian British woman with a history of long-term zopiclone use
>>>>> Phrase
a 31 year old caucasian british woman with a history of long term zopiclone use
<<<<< Phrase
>>>>> Mappings
Meta Mapping (696):
  567   31 [Quantitative Concept]
  567   YEAR (year) [Temporal Concept]
  567   Old [Temporal Concept]
  579   Caucasian British (White British) [Population Group]
  733   WOMAN (Woman) [Population Group]
  567   History [Occupation or Discipline]
  579   Long Term (Long-term) [Temporal Concept]
  567   ZOPICLONE (zopiclone) [Organic Chemical,Pharmacologic Substance]
  578   Use of [Functional Concept]
  567   history (Historical aspects qualifier) [Functional Concept]
  567   history (History of present illness (finding)) [Finding]
  567   History (Medical History) [Finding]
  567   History (Concept History) [Conceptual Entity]
  567   History (History of previous events) [Finding]
  567   History, NOS (History of (present illness) (contextual qualifier) (situation)) [Intellectual Product]
  733   Woman (Human, Female adult) [Human]
  567   /Year (per year) [Temporal Concept]
<<<<< Mappings

Phrase: and
Phrase: anorexia nervosa
anorexia nervosa
Meta Mapping (1000):
  1000   ANOREXIA NERVOSA (Anorexia Nervosa) [Mental or Behavioral Dysfunction]
Phrase: was
Phrase: admitted as an inpatient
admitted as an inpatient
  1000   Admitted as an inpatient (Admitted as an inpatient:Find:Pt:^Patient:Ord) [Clinical Attribute]
  1000   Admitted as an inpatient [Finding]
Phrase: for a ten-day alcohol detoxification.
ten day alcohol detoxification
Meta Mapping (888):
  694   TEN-DAY (Ten-Day Report) [Intellectual Product]
  861   Alcohol detoxification (Detoxication psychiatric therapy for alcoholism) [Therapeutic or Preventive Procedure]
  861   Alcohol detoxification [Therapeutic or Preventive Procedure]

Processing inter_12192022_20:07:23_27484_hanauer@umich.edu_6099 65139.tmp.tx.2: Her weekly (four days out of seven) intake of alcohol was 180 units and her daily intake of zopiclone, 30 mg.
Phrase: Her weekly
weekly
  1000   Weekly [Temporal Concept]
  1000   Weekly (Chief Complaint is Present Weekly) [Finding]
Phrase: (four days out of seven
four days out of seven
Meta Mapping (752):
  593   Four [Quantitative Concept]
  593   Out (Out (direction)) [Spatial Concept]
  781   SEVEN-DAY (Seven-Day Report) [Intellectual Product]
  593   Out (Removed) [Qualitative Concept]
Phrase:)
Phrase: intake of alcohol
intake of alcohol
Meta Mapping (858):
  858   intake alcohol (Alcohol consumption) [Individual Behavior]
Phrase: 180 units
180 units
Meta Mapping (861):
  861   Units (Unit) [Quantitative Concept]
  861   Units (Unit of Measure) [Quantitative Concept]
  861   UNITS (Enzyme Unit) [Quantitative Concept]
  861   Units (Unit - NCI Thesaurus Property) [Quantitative Concept]
Phrase: her daily intake of zopiclone,
her daily intake of zopiclone
Meta Mapping (733):
  593   HER (Herero language) [Language]
  760   Daily [Temporal Concept]
  760   Intake [Functional Concept]
  593   ZOPICLONE (zopiclone) [Organic Chemical,Pharmacologic Substance]
  760   Daily (Chief Complaint is Present Daily) [Finding]
Phrase: 30 mg.
30 mg
  694   30% [Quantitative Concept]
  861   MG (Mammography) [Diagnostic Procedure]
  861   mg% (mg/dL) [Quantitative Concept]
  861   Mg (Mg antigen) [Amino Acid, Peptide, or Protein,Immunologic Factor]
  861   mg % (Milligram percent) [Quantitative Concept]
  861   Mg++ (magnesium cation) [Element, Ion, or Isotope,Pharmacologic Substance]
  861   MG (US Military Commissioned Officer O8) [Classification]

  861   MG (Mongol Chinese) [Population Group]
Processing inter_12192022_20:07:23_27484_hanauer@umich.edu_6099 65139.tmp.tx.3: Apart from a short period five years ago, she had been taking zopiclone for 13 years at daily doses of up to 90 mg.
Phrase: Apart from a short period five years ago,
short period five years ago
Meta Mapping (798):
  673   short period (Short menstrual periods) [Finding]
  637   Five [Quantitative Concept]
  804   YEARS (year) [Temporal Concept]
Phrase: she
Phrase: had
Phrase: been
Phrase: taking
taking
Meta Mapping (966):
  966   Take [Health Care Activity]
Phrase: zopiclone for 13 years
zopiclone for 13 years
Meta Mapping (708):
  770   ZOPICLONE (zopiclone) [Organic Chemical,Pharmacologic Substance]
  604   YEARS (year) [Temporal Concept]
Phrase: at daily doses of
at daily doses of
Meta Mapping (794):
  604   At [Spatial Concept]
  799   Daily Dose [Quantitative Concept]
  604   AT (GATM wt Allele) [Gene or Genome]
  604   AT (AT genotype) [Finding]
  604   AT (Apnea Time) [Quantitative Concept]
Phrase: up to 90 mg.
90 mg
  694   >90 [Quantitative Concept]
  694   <90 [Quantitative Concept]
  694   90% [Quantitative Concept]
Processing inter_12192022_20:07:23_27484_hanauer@umich.edu_6099 65139.tmp.tx.4: She admitted to using 'on top' of her prescribed medication, purchasing extra tablets from friends or receiving them gratis from her partner.
Phrase: admitted to using '
admitted to using
Meta Mapping (746):
  790   admitted (Hospital admission) [Health Care Activity]
  790   Using (Use of) [Functional Concept]
  790   Admitted (Admission activity) [Health Care Activity]
Phrase: on top' of her prescribed medication,

prescribed medication
  694   Prescribed [Health Care Activity]
  861   Medication (Pharmaceutical Preparations) [Pharmacologic Substance]
  861   MEDICATION (Concomitant Agent) [Idea or Concept]
  861   medication (medication - HL7 publishing domain) [Intellectual Product]
  861   Medication (Medications) [Intellectual Product]
Phrase: purchasing
purchasing
  1000   Purchasing (Purchase) [Activity]
Phrase: extra tablets from friends
extra tablets from friends
  604   Extra (Supernumerary) [Quantitative Concept]
  770   Tablets (Tablet Dosage Form) [Biomedical or Dental Material]
  604   Friends (friend) [Population Group]
  604   Friends (Friends - (Religious Affiliation)) [Population Group]
Phrase: or
Phrase: receiving
receiving
  1000   RECEIVING (Receive) [Qualitative Concept]
Phrase: them gratis from her partner.
them gratis from her partner
Meta Mapping (528):
  593   Partner (Partner in relationship) [Family Group]
  593   Partner [Population Group]
Processing inter_12192022_20:07:23_27484_hanauer@umich.edu_6099 65139.tmp.tx.5: After detoxification from alcohol and zopiclone, she was prescribed diazepam which she found ineffectual and voiced her intention of returning to zopiclone on leaving the hospital.
Phrase: After detoxification from alcohol
after detoxification from alcohol
Meta Mapping (783):
  604   After (Status post) [Temporal Concept]
  819   Alcohol detoxification (Detoxication psychiatric therapy for alcoholism) [Therapeutic or Preventive Procedure]
  819   detoxification alcohol (Alcohol detoxification) [Therapeutic or Preventive Procedure]
  604   AFTER (Post) [Temporal Concept]
Phrase: zopiclone,
zopiclone
  1000   ZOPICLONE (zopiclone) [Organic Chemical,Pharmacologic Substance]
Phrase: prescribed
prescribed
  1000   Prescribed [Health Care Activity]
Phrase: diazepam

diazepam
  1000   DIAZEPAM (diazepam) [Organic Chemical,Pharmacologic Substance]
  1000   Diazepam (Diazepam measurement) [Laboratory Procedure]
Phrase: which she
Phrase: found
found
  1000   Found (Present) [Finding]
Phrase: ineffectual
ineffectual
Phrase: voiced
voiced
  966   VOICE (Voice) [Organism Function]
  966   voice (TelecommunicationCapabilities <voice>) [Qualitative Concept]
  966   Voice (Voice G-code) [Intellectual Product]
Phrase: her intention of
her intention of
Meta Mapping (771):
  623   HER (Herero language) [Language]
  790   Intention (Intention - mental process) [Mental Process]
  790   Intention (intent) [Qualitative Concept]
Phrase: returning to zopiclone
returning to zopiclone
Meta Mapping (730):
  756   Return (Return to (contextual qualifier) (qualifier value)) [Qualitative Concept]
  790   ZOPICLONE (zopiclone) [Organic Chemical,Pharmacologic Substance]
Phrase: on leaving
leaving
  1000   Leaving (Departure - action) [Activity]
Phrase: the hospital.
hospital
  1000   HOSPITAL (Hospitals) [Health Care Related Organization,Manufactured Object]
  1000   Hospital (Hospital environment) [Qualitative Concept]

MetaMap output

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Location_Start	Location_End	Semantic	Entity
56	79	problem	long-term zopiclone use
84	100	problem	anorexia nervosa
244	249	frequency	daily
260	269	drug	zopiclone
271	276	strength	30 mg
340	349	drug	zopiclone
350	362	duration	for 13 years
354	362	temporal	13 years
366	371	frequency	daily
387	392	strength	90 mg
428	453	treatment	her prescribed medication
574	583	drug	zopiclone
604	612	drug	diazepam

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Case presentation

A 31-year old Caucasian British woman with a history of long-term zopiclone use and anorexia nervosa was admitted as an inpatient for a ten-day alcohol detoxification. Her weekly (four days out of seven) intake of alcohol was 180 units and her daily intake of zopiclone, 30 mg. Apart from a short period five years ago, she had been taking zopiclone for 13 years at daily doses of up to 90 mg. She admitted to using 'on top' of her prescribed medication, purchasing extra tablets from friends or receiving them *gratis* from her partner. After detoxification from alcohol and zopiclone, she was prescribed diazepam which she found ineffectual and voiced her intention of returning to zopiclone on leaving the hospital.

EMERSE is *fast*

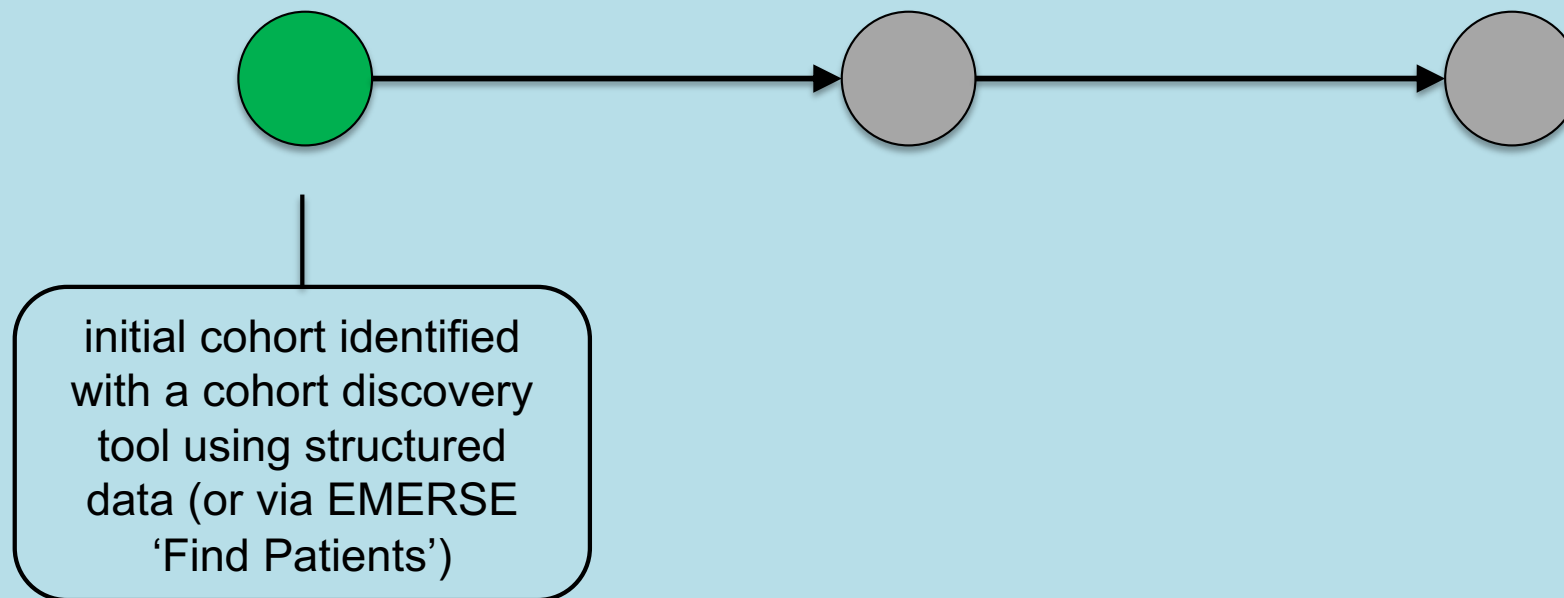| Query to identify all patients with the following	Reporting DB time (s)	EMERSE time (s)	EMERSE advantage
cavernous hemangioma	14,652	2	7,320x
gray platelet syndrome	14,940	2	7,470x
inferior lingular segment of the left upper lobe	17,784	9	1,980x

...enabling real-time querying

Synonyms

- Used for query expansions
- User-controlled
- Multiple datasets can be included
- EMERSE Synonyms
  - acronyms, abbreviations, professional/consumer terms, misspellings, trade/generic drug names, species, chemo regimens, phrase variations, malapropisms, idioms, neologisms, organizations, companies, & more
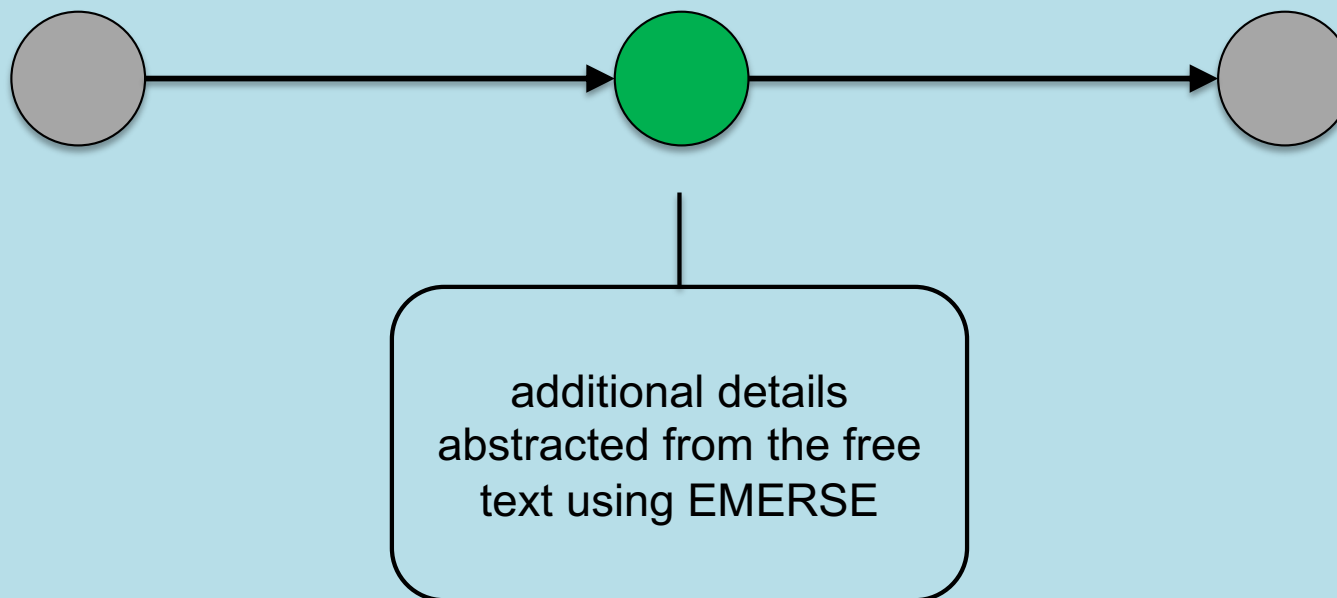 - 1.6 million unique entries (85% not within UMLS)

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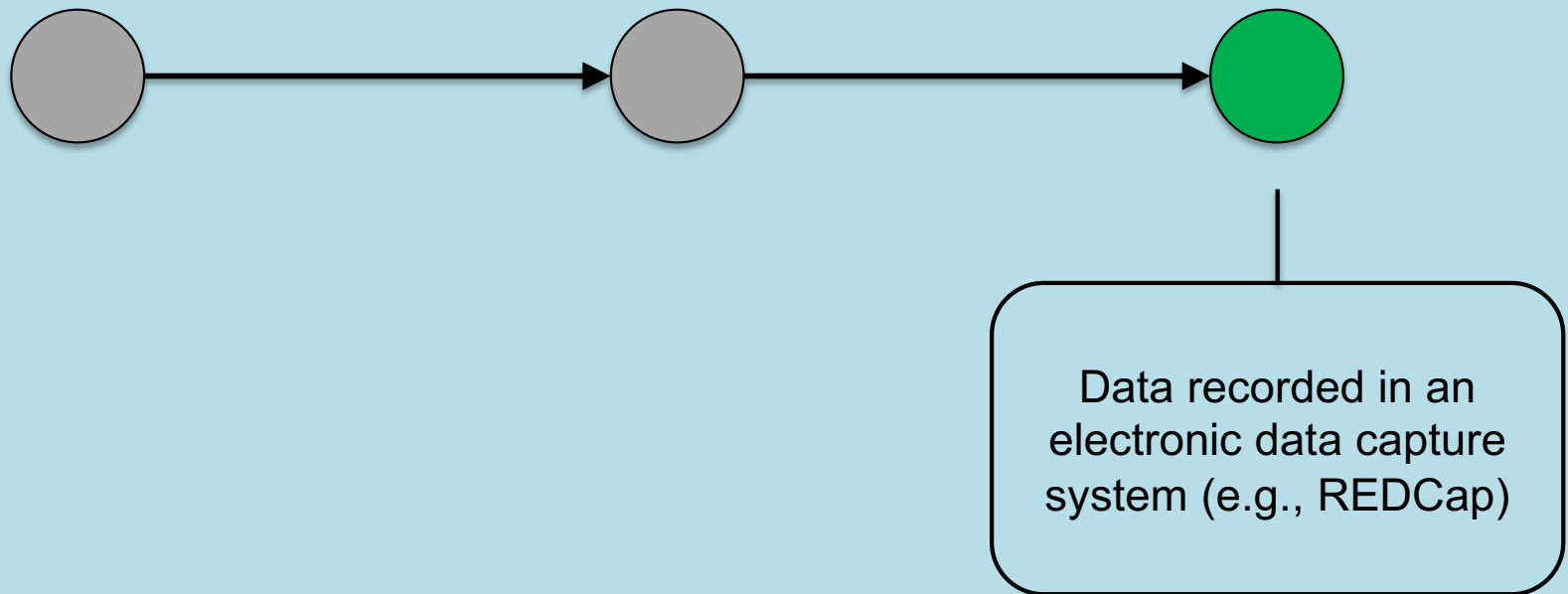ELECTRONIC MEDICAL RECORD SEARCH ENGINE

Typical workflow

initial cohort identified with a cohort discovery tool using structured data (or via EMERSE 'Find Patients')

Cohort discovery tools: i2b2/ENACT, Leaf, etc.

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Typical workflow

additional details abstracted from the free text using EMERSE

Typical workflow

Data recorded in an electronic data capture system (e.g., REDCap)

Publications using EMERSE

590

papers and abstracts

Full list at:
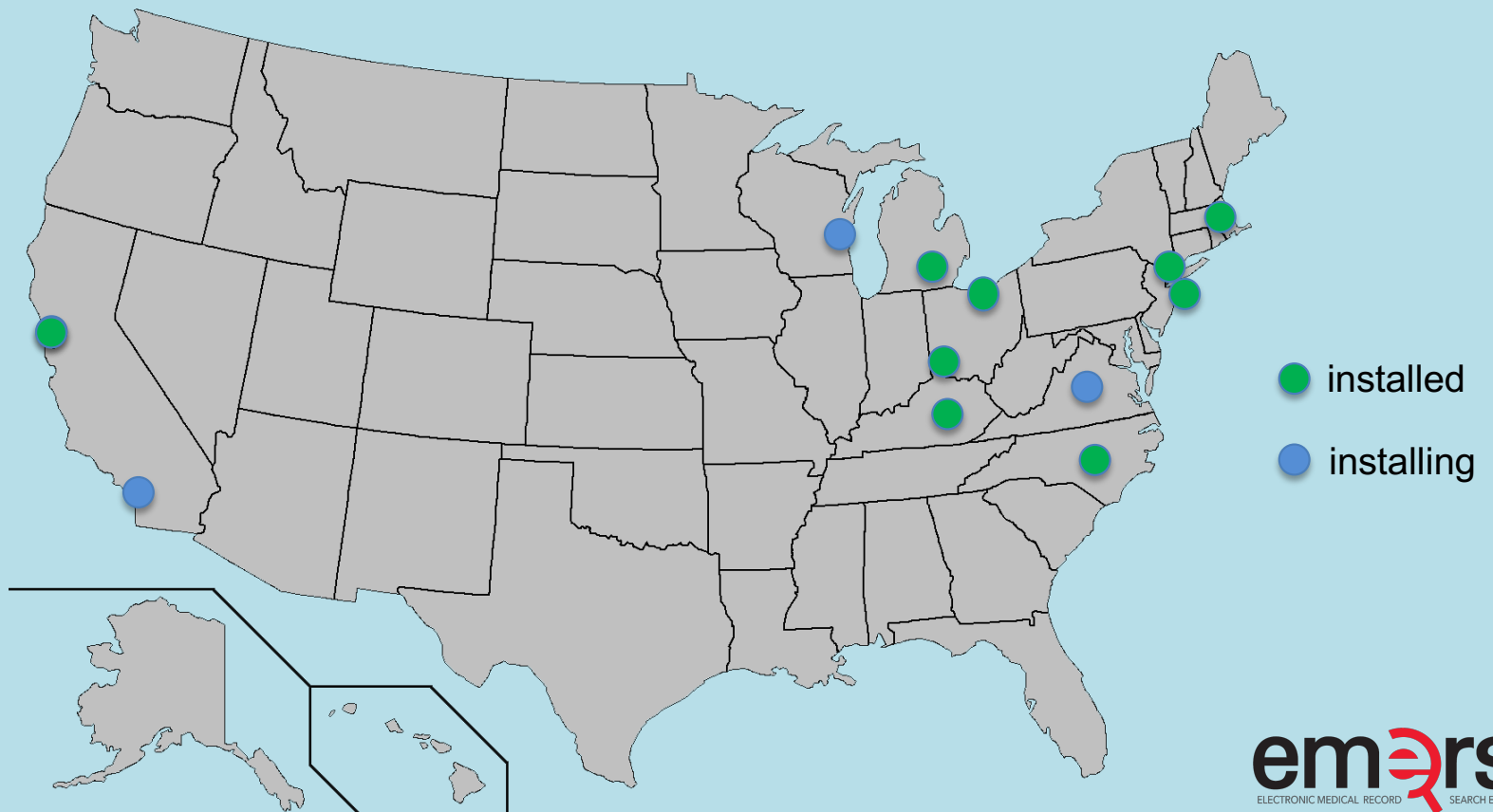
http://project-emerse.org/publications.html

Where is EMERSE?

- 🟢 installed
- 🔵 installing

http://project-emerse.org/presentations.html

Where is EMERSE?

installed
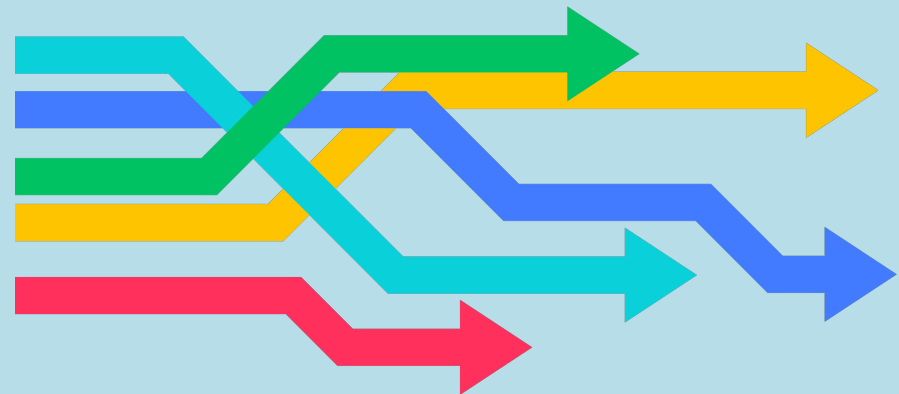
installing

EMERSE Research Informatics Network

The future…

Incorporation of NLP features
- negation
- uncertainty
- subject (patient vs other)
- named entity recognition/mapping to ontologies
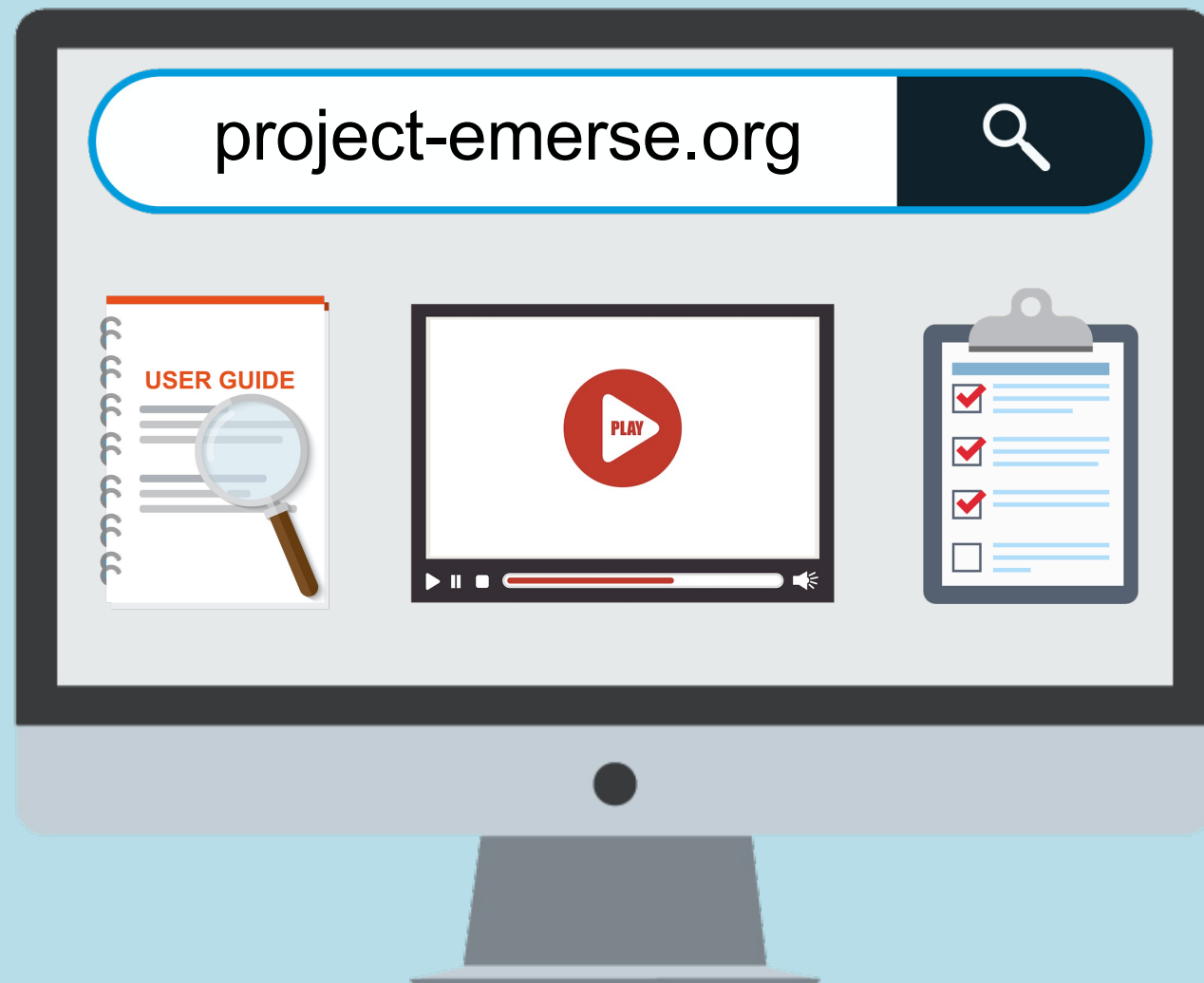
Data extraction from templated notes

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Ultrasonography displayed an inhomogeneous hypoechoic nodule measuring 20mm*17mm (Figure1). Biopsy examination of the lesion revealed scirrhous carcinoma. A chest computed tomography (CT) scan for metastases showed abnormal shadows in both upper lung fields. The patient was then referred to our department for definitive workup and treatment. She had no history of cough, sputum, or dyspnea. Our patient had no history of tobacco smoking and no exposure to any dusts associated with a high risk of lung damage. Her past history and family history were unremarkable. A chest X-ray showed slight peripheral infiltration shadows in both upper and middle lung fields (Figure2). A chest CT scan showed patchy peripheral ground-glass opacities and thickened interlobular septa in both upper lung fields (Figure3A). A peripheral blood cell count and serum and biochemical tests were normal. Autoantibody and vasculitis screening was negative. Testing for human immunodeficiency virus infection was negative. Serum carcinoembryonic antigen (CEA) and carbohydrate antigen 153 (CA15-3) were in the normal ranges (1.1ng/mL and 12.5U/mL, respectively), but granulocyte-macrophage colony-stimulating factor (GM-CSF) autoantibody was elevated (29.57?g/mL). Pulmonary function testing revealed normal lung volumes and diffusing capacity. Flexible fiberscopic bronchoscopy was then performed. The retrieved bronchoalveolar lavage fluid (BALF) was transparent; it did not have a milky appearance. However, BALF cytology showed alveolar macrophages with granular materials that stained positively with periodic acid-Schiff (PAS). Histological findings of a transbronchial lung biopsy specimen showed the alveolar spaces to be filled with PAS-positive granular materials (Figure4). As a result, this patient was diagnosed as having PAP.

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4140142/

From our NLP proof-of-concept system

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Contact us to schedule a time with your team for:

- Discussions about research strategies

- Training

- Live demonstrations

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Upcoming presentations

EMERSE Community Meeting Series
Date: Tuesday, February 7, 2023, 12:00 – 1:00 PM ET
Register: https://bit.ly/emerse-february-2023-register

NCI Emerging Technologies Seminar Series
Date: Tuesday, February 21, 2023, 2:00 – 3:00 PM ET
Register: https://events.cancer.gov/cssi/technology-seminar/registration

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