Assisting Data Retrieval With a Drug Knowledge Graph

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Prescription orders integration

1,452,616 prescription orders
6,978,586 atomic prescriptions
2011 → August 2021

Rouen University Hospital (RUH)

RUH Health Data Warehouse EDSaN
Patient information
id, age, gender, birthdate

Stay information
id, entry date, leaving date, units

prescription information
id, date

List of prescribed drugs
drug label, details, UCD codes

Lucene indexes ⇒ allow the search by metadata
Prescriptions metadata & Information Retrieval

Patient information
id, age, gender, birthdate

Stay information
id, entry date, leaving date, units

Prescription information
id, date

List of prescribed drugs
drug label, details, UCD codes

Search for prescription orders based on what drug were prescribed?

UCD = Common Dispensing Unit

⇒ Encoding and billing of administered drugs in France

⇒ Good quality of data

Selecting drugs
= Selecting UCD codes
Drug Knowledge Graph

Medical Subject Heading descriptors
Anatomical Therapeutic Chemical (ATC) concepts
International Non proprietary Names (INNs)
Virtual drugs from the MédicaBase
Pharmacological roots
Pharmacological specialties
**Drug components**
Drug components groups
UCD codes

HeTOP

131,277 vertices
703,807 edges

Conceptual graph of drug-specific concept

Health Terminology/Ontology Portal
> 90 terminologies or ontologies
> 2 million concepts

2. https://hetop.eu
Exploitation of the knowledge graph

**input term**

*Matching the input term against a vertex label*

**Vertex**

*Traversing the graph and selecting paths leading to UCD codes*

**Paths**

*weighting & classification of paths*

**Paths distributed over 7 relevance classes (C1 to C7)**

**Paths weighting**

Vertex 1

$w_{r_1}$

Vertex 2

$w_{r_2}$

Empirically assigned with a hospital pharmacist

Vertex 3

$w_{r_3}$

Vertex n

$w_{r_n}$

$w_{path} = w_{r_1} + w_{r_2} + \cdots + w_{r_n}$
Input term

Initial vertex matching the input term

Slider to adjust tolerance

Retrieved UCD codes
Evaluation

88 terms randomly drawn among the possible types of vertex.

System

Only the paths/UCD codes from the first three non-empty relevance classes were considered. More than 100,000 paths were retrieved.

Hospital pharmacist evaluation

Attribution of a score to each path/UCD code from 1 to 3:
1 unsatisfactory
2 could be improved
3 consistent result.
| Type of term                        | $C_1$ | $C_2$ | $C_3$ | $C_4$ | $C_5$ |
|------------------------------------|-------|-------|-------|-------|-------|
| Drug composition                   | 2.71  | 1.08  | 1.04  |       |       |
| Drug composition groups            | -     | 3.00  | 1.00  | 1.00  |       |
| MeSH Descriptors                   | -     | 2.94  | 1.49  | 1.05  |       |
| INN                                | -     | -     | 1.95  | 1.01  | 1.00  |
| virtual drugs                      | 3.00  | 1.23  | 1.28  |       |       |
| Medical indications                | -     | -     | 3.00  | 2.82  | 1.52  |
| ATC Code                           | 2.25  | -     | 3.00  | 1.00  |       |
| pharmacological specialties        | 2.50  | 1.59  | 1.89  |       |       |
| pharmacological roots              | 3.00  | 1.84  | 1.05  |       |       |

1. Overall, average scores of paths tends to decrease with level of relevance but exceptions can be found;
2. Highest score of 3 (or close to 3) reached for several types of terms;
3. Variability of the best possible relevance class.
Conclusion

Does the drug knowledge graph assist the user in selecting drugs of interest?

Yes: The ranking of resulting UCDs codes were overall congruent with the expert judgment.

But: Some inconsistencies remain.

⇒ A refinement of the weights assigned to the edges of the graph is necessary.
Thank you for your attention

Questions?