"Assisted Intelligence using Graphs"

GNUHealth Conference, 11 December 2021, Las Palmas
Etienne Saliez

Objectives

- Make medical knowledge better available for decisions.

- Interactive recommendations for the next actions, differential diagnosis and treatments.

Knowledge Base

- The medical knowledge is complex and can be represented by means of graphs.

- Graph include concepts and multiple relationships between these concepts, like neurons and synapses.

- Call for medical experts to write their know-how in graph format.

Concepts

- Concepts like infection, fracture, tumor, … are independent from any spoken languages.

- As far as possible use known identification standards. In principle ULMS, which can include most usual standards.

- UMLS concepts can be tranlated in many languages.

Concepts types

- Observations
  - Symptoms, measurements, … = The facts
- Problems
  - Abnormal finding, Diagnose, Riscs, … = need to pay attention.
- Actions
  - Exploration for more information or Treatments.

Relationships

- Concepts are related to many other concepts in a very large N-dimentional space.

- Relations have weigths:

  - Specificity, sensivity, …

  - Increase or decrease the likelihood of a diagnose.

 - A coefficient from 0.0 to 1.0 , in medicine nothing is perfectly true nor absolutely false !

Medical Knowledge

- In order to be useful for decisions, the medical knowledge need to be represented as graph.

- The best possible synthesis of the current knowledge.

From a symptom to suspected problems

- Every symptom like fever, chest pain, loss of weight, … may each suggest a list of possible problems.
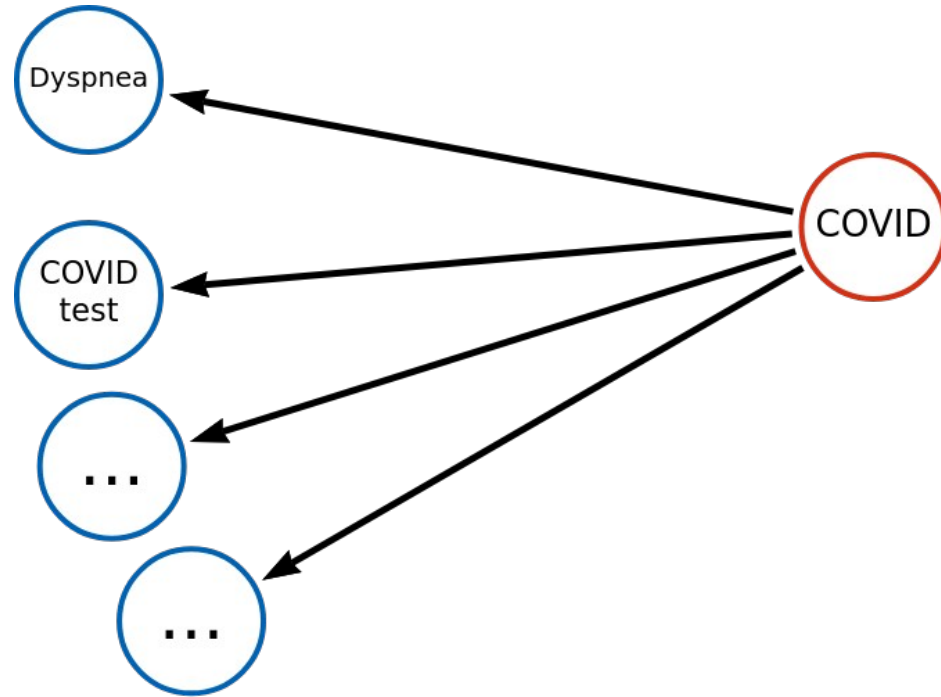
- The challenge is to quantify these relations.

Symptom --- Problem
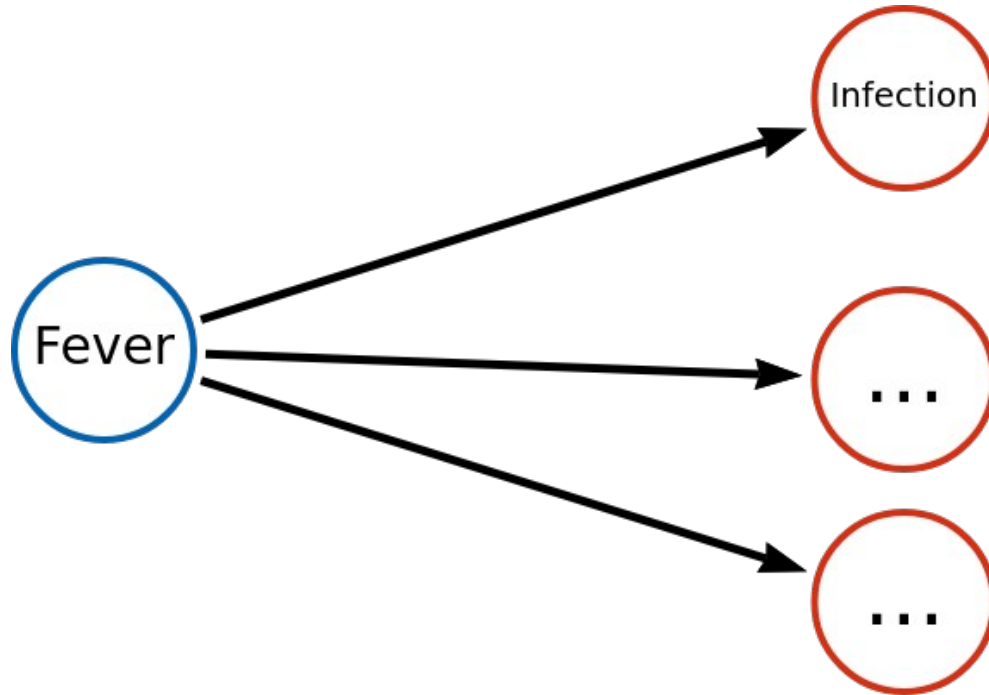
From a problem to usual symptoms

- Every problem, for example diabetes, pneumonia, Covid, is known to be associated with a set of likely symptoms.

- The challenge is here also to quantify these relations.

Problem --- symptoms

Patient record

- In order to be usful for decisions, patient information need also to be structured as graph.

- Traditional patient records are in text.
  To some extend NLP, Natural Language Processing, can help for this translation.

- The challenge is to ask the users to draw directly the information as graphs, by means of an interactive visual software.

Decision suport

- Assisted Intelligence, helping but not replacing the local responsible health professionals.

- The reasoning can be explained by means of a visual graphs showing relations with multiple decision factors.

- In begin all existing types of problems have a low probability.

- This will evolve in function of encountered observations.

If very low probability

- The problem can be considered as excluded and no further action will follow.

- The exact treshold may depend on the context.

If intermediate probability

- The reaction is here to recommend to seek more information in order to confirm or exclude the suspected problems.

- Ask more questions to the patient, more lab test, more images, retrieve the past history, …

- Relative priorities are critical.
 Since every action cost time and money begin with the most effective ones.

If very high probabitily

- The reaction is here to seek a treatment.

- The treshold may depend on the severity of the problem and potential consequences.
As well on the availabilty of effective solutions.

- Treatments will be evaluated on their relative expected usefulness and risks.

Evolution of the decision process

- Every time a new information arrive, the likelihoods are re-evalueted. A new ranking of the hypothesis is computed.

- This will be repeated until the suspected problems can be sufficiently excluded or confirmed, if possible.
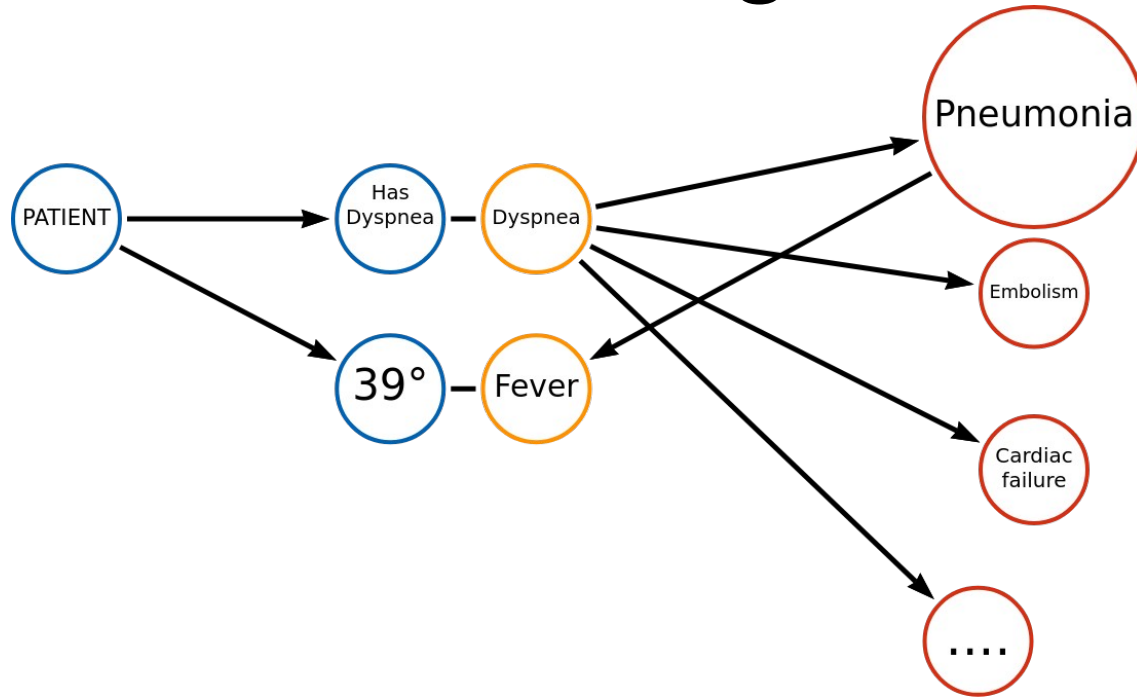See the evolution of the visual size of Problems.

Symptom and suspected problems
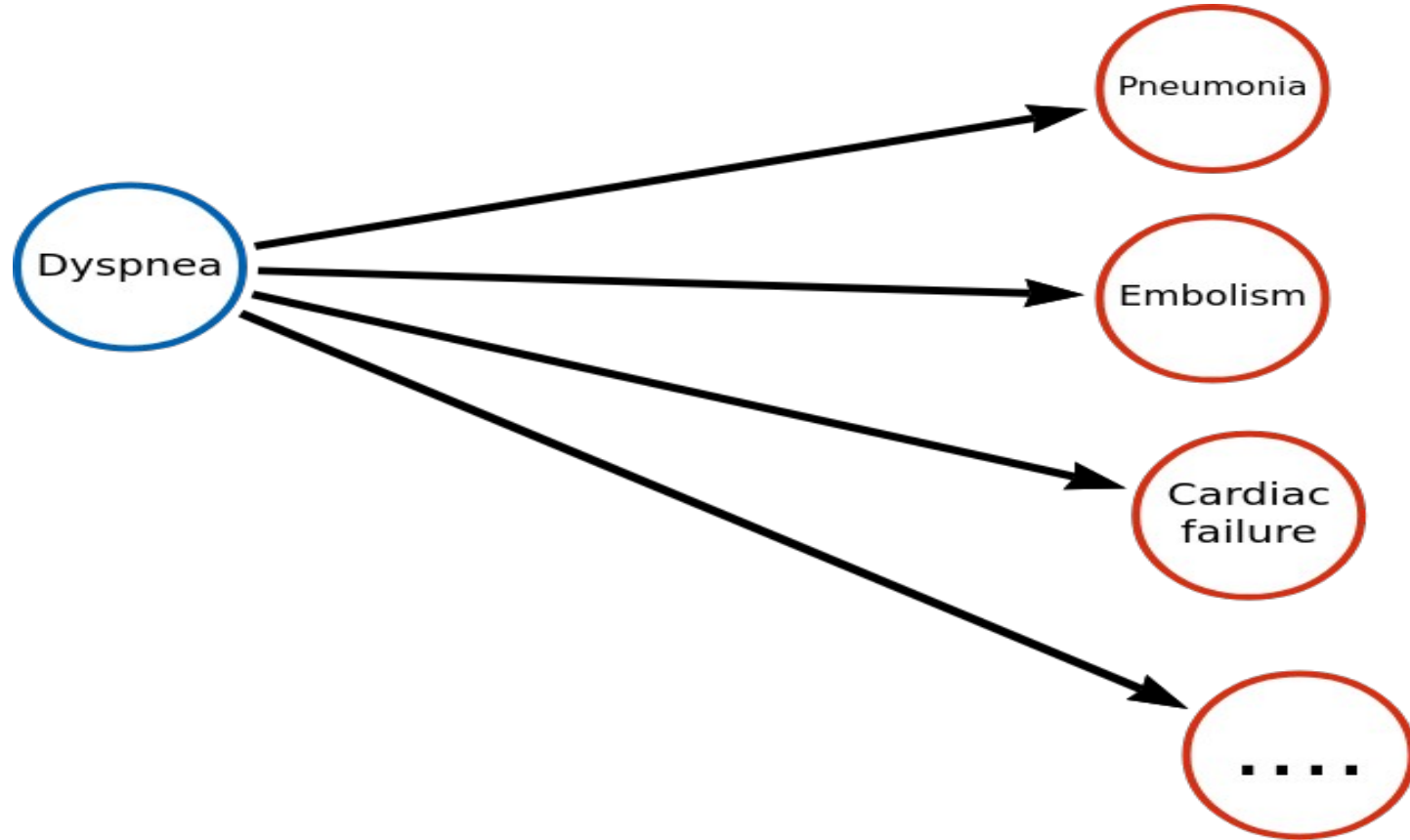
Knowledge about pneumonia
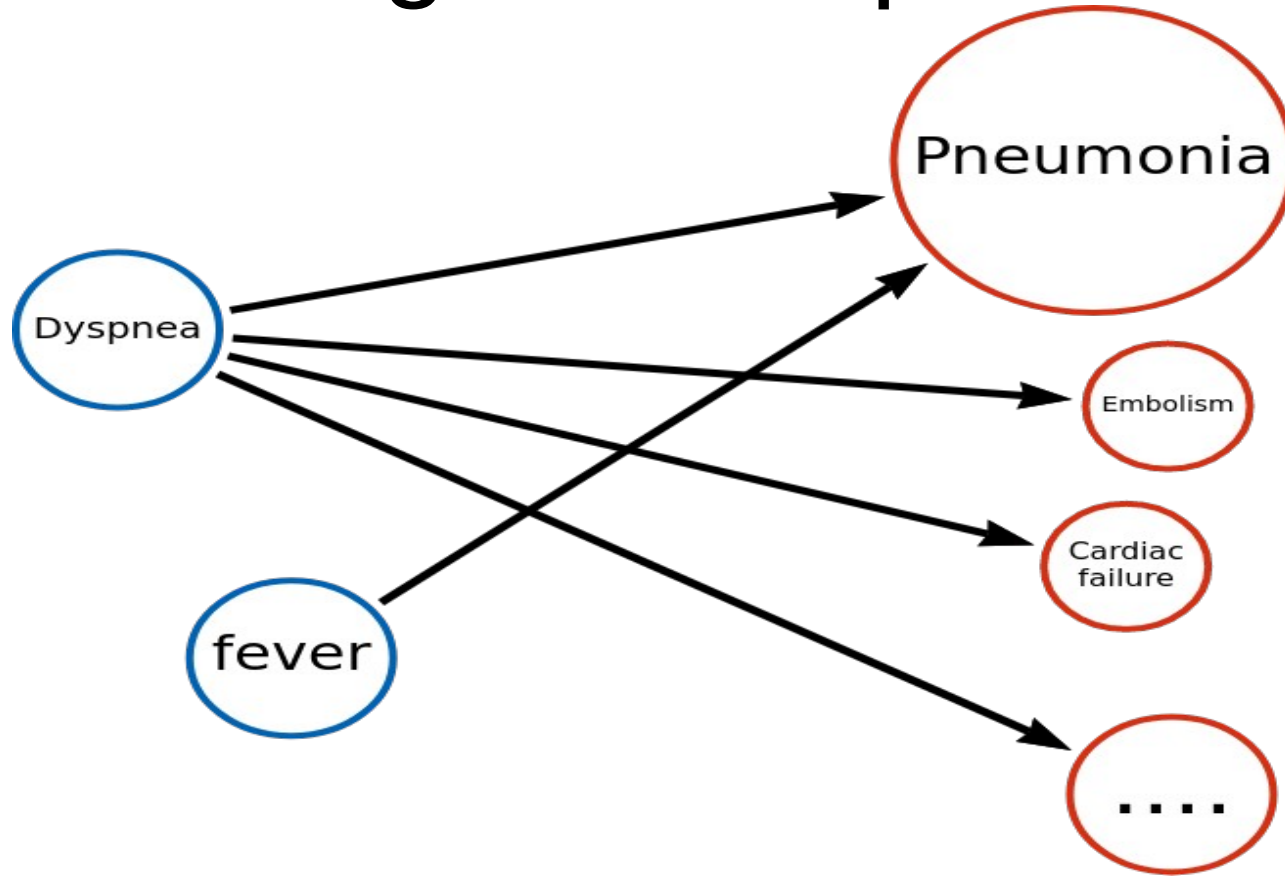
Patient actual values and knowledge

Comprehensive strategies

- Even when there are no specific complaints, the general wellness of the patient should always be briefly checked, by means of a few generic questions and routine tests.
Nowadays at entrance in hospital for any reason a COVID test is always required.

- Diagnosis are not exclusive. Any unexplained abnormal finding should be further explored.

Intended users of graphs

- In situations where there are limited local qualifications.
A large set of medical knowledge is alredy available and now the challenge is to provide assistance to use it everywhere accross Internet.

- Contribution to medical education and traininig.

Multi-disciplinary team

- Medical experts, data scientists and software developers.

- Joint the project accoding to your domains of interest.

Conclusion

- Making information available as in many existing systems is already excellent,

- But beginning to provide assistance will be even better !

- Welcome to a draft at http://www.chos-wg.org/Temp/WEB-GRAPH-AI/index.html

- etienne@saliez.be