Temporal Data Warehousing, OLAP and Mining in Pharmacology

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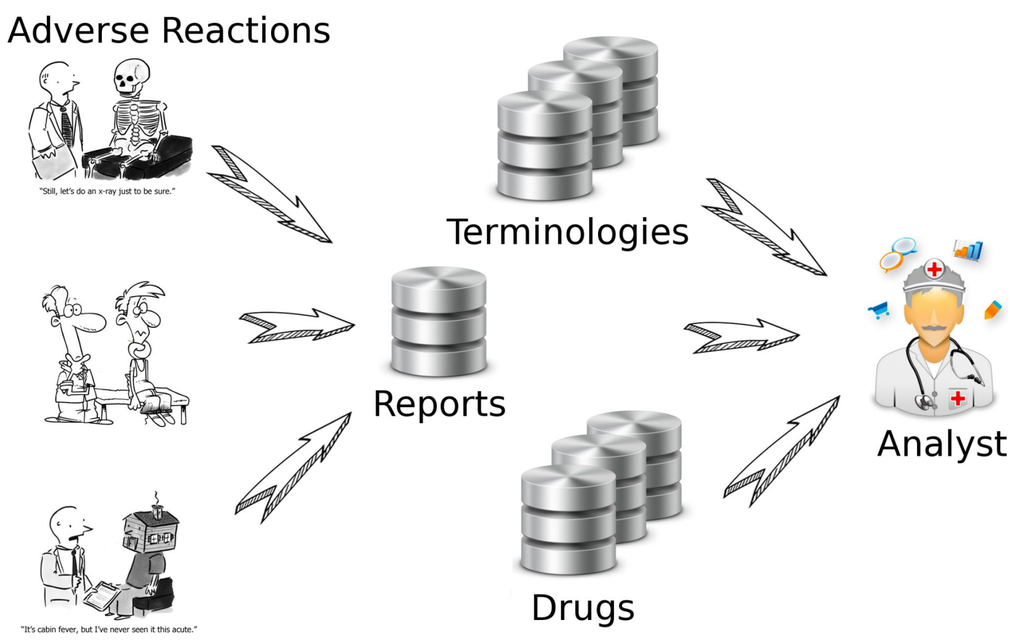
The Pharmacology Domain

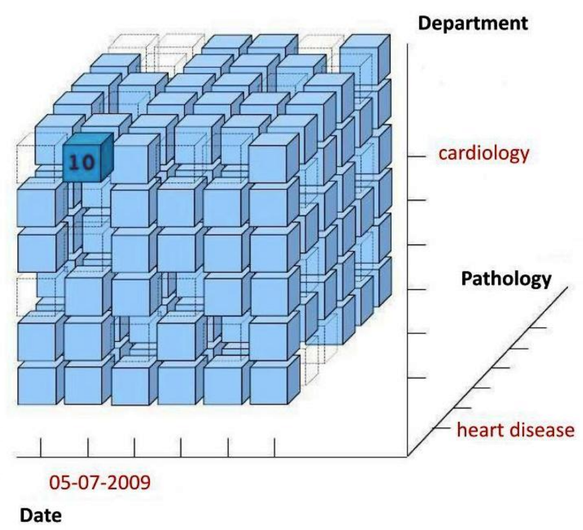
Pharmacovigilance is the activity related to the analysis of spontaneously reported event of *adverse drug reactions.*

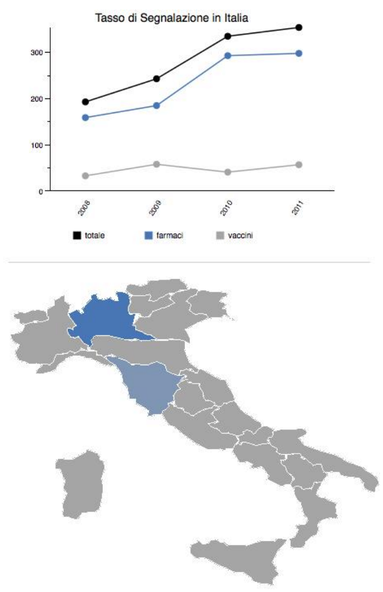


The clinical information used for the analysis evolves through time, both in its structure and in data. Moreover, there are many temporal aspects to consider, for example, *the date of a drug prescription, the reaction period and so on.*

Data Analysis in Medicine

We designed a Data Warehouse System, generally used in business context, to support the analysis activities of pharmacovigilance centers.



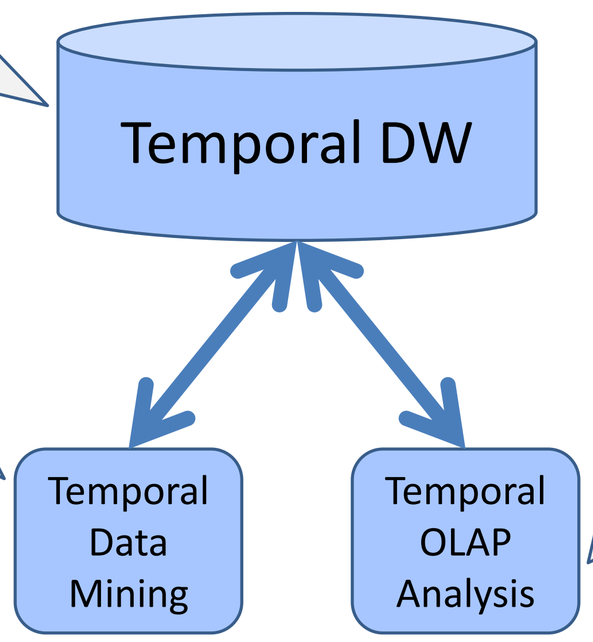


We want to extend it for discovering temporal relationships among events of drug administrations and adverse drug reactions, and thus answering questions like: *Which are the reactions overlapping an administration of paracetamol? For how long do they last?*

Temporal Data Warehousing Framework Approach

✓ **Temporal Data Model:** Allow users to create during the analysis, a custom time interval by combining timestamps: for example, the start of the drug exposure and the end of the reaction, hence create an interval based temporal dimension for the analysis.

✓ **Temporal Data Mining:** Allow users to define what kind of temporal rules they are looking for. As an example, having reports in the form DRUGS → ADRS, one may be interested in rules like: *bisphosphonates drugs → heart failures*. Users need also to explore the data set by moving along the hierarchies that classify drugs and adverse drug reactions: *bisphosphonates → cardiac disorders*.



✓ **Temporal aggregation:** Define an efficient implementation of the framework proposed by Böhlen and extend it to bi-temporal data, thus defining the combination of orthogonal temporal intervals, i.e. temporal region.

✓ **Visualization of Temporal Data:** Design new techniques, avoiding to show an excessive amount of information to a human agent, i.e. *Information overload*. Also, extend well known visualization techniques for association rules that deal with temporal aspects.

Discussion

- Data models focus on the evolution of the structure and the changes that occur in data
- Very little attention has been given to the analysis of temporal data, even more when there are multiple time dimensions
- Method developed for Business Intelligence purposes can be also used and improved for the medical field
- Pharmacovigilance will be the medical domain, motivating several aspects of the framework and providing useful application of the proposed framework

References

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Take Home Message

We are drowning in data, but starving for knowledge. There is a need in all fields for tools to perform powerful analysis that take into account the temporal aspects in the data mining, aggregation, and visualization phases.