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Dynamic Health Data Aggregation for the Research Purposes

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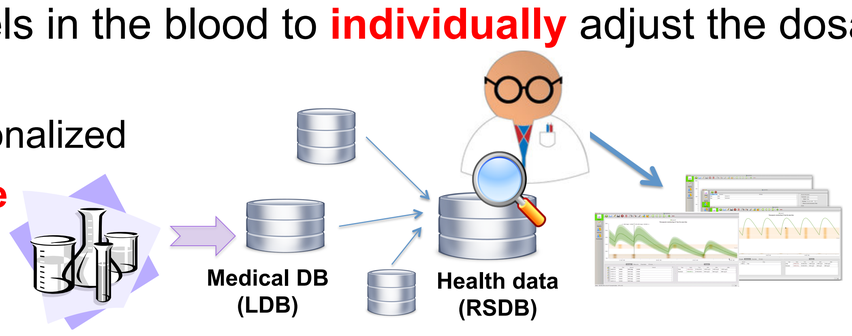
How to aggregate medical data dynamically adapting to the requirements of a research study?

Therapeutic Drug Monitoring (TDM) aims at improving patient care by monitoring drug levels in the blood to **individually** adjust the dosage.

Building mathematical models to provide personalized recommendations requires **medical data to be aggregated** and analyzed by researchers:

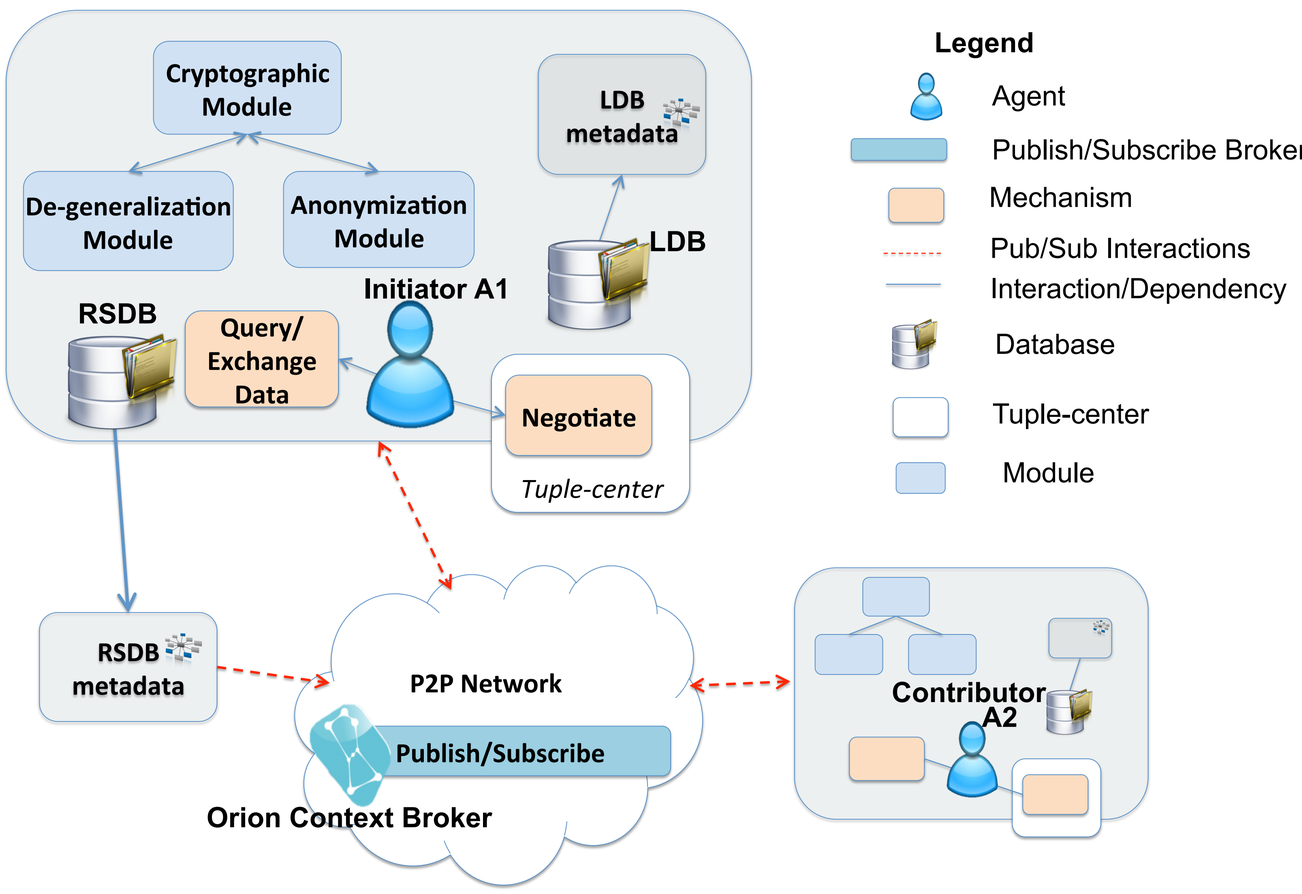


Challenges:

- *It is impossible to create a unique RSDB*
- *Medical data are sensitive & changing*
- *Privacy & Utility trade-off*

Multi-Agent System (MAS) for Dynamic Data Aggregation

Architecture



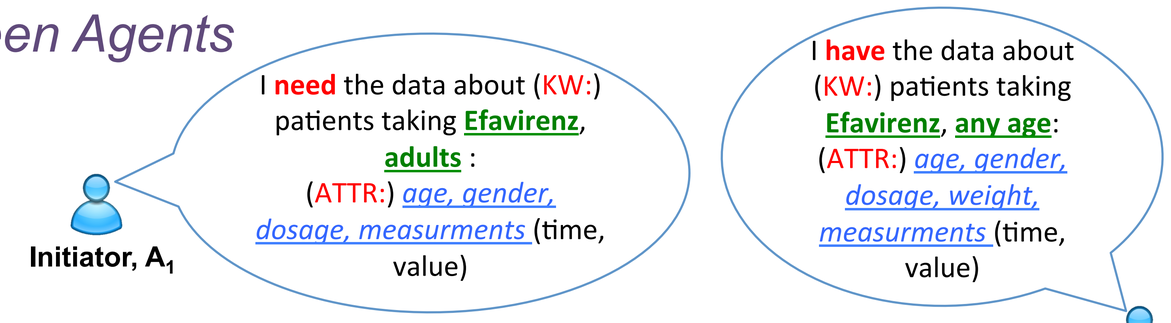
Characteristics

- *Dynamic*
  - ✓ Negotiation phase to adapt to the requirements of the study
- *Distributed*
  - ✓ Allows to collect more data during the shorter period
- *Takes into account data requirements*
  - ✓ Improves the utility
- *Preserves secure and privacy*
  - ✓ Medical data are protected
- *Boosts the utility with the growth of the DB*
  - ✓ Utility is **max** wrt the current state of the DB

- Agents are connected into P2P network through the **Publish-Subscribe Broker** (based on the KW (keywords))
- Negotiation is built using **TuCSoN** – a coordination model for negotiation and data exchange through the tuple centers

Negotiation Between Agents

- *Structure of the tuples:*
  t_1 ={KW(RSDB),{$range_{attr}$(RSDB)},N_{rec}(RSDB)},
  t_2 ={KW(LDB),{$range_{attr}$ (LDB)},N_{rec}(LDB)},
  …
- *Rules*
  reaction (out(t_1), condition_1, out(t_2)).
  condition_1:
  (KW(RSDB)⊂KW(LDB))∧($range_{attr}$(RSDB)⊂$range_{attr}$(LDB))∧
  ∧ (N_{rec}(LDB)>0).
  …



A_1 (writes t_1)>({Efavirenz; adults},{age, (18; 100); gender, any; dosage, any; measurments, any}, 1000)

A_2 (replies t_2)>({Efavirenz; any age},{age, (0; 100); gender, any; dosage, any; measurments, any}, 50)

Conclusion & Future Work

- A framework of MAS for dynamic health data aggregation has been proposed, it is currently being implemented
- MAS will be evaluated using the synthetic data and genuine patients data in the framework of Nano-Tera ISyPeM2 project
- Dynamic aggregation of medical data for research will help to put into practice TDM, that will be assisting medical doctors and will significantly improve patient care

References

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- E. Denti, A. Natali, and A. Omicini. On the expressive power of a language for programming coordination media. In Proceedings of the of the ACM SAC, 1998.
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