Detecting and Eliminating Bacteria UsinG Information Technology

Jörg Artmann, MSc, empirica GmbH, Bonn

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Outline

Introduction: setting the scene, defining the problem

1. Project funding and partners
2. The DebugIT process: collect, learn, store, apply
3. Expected outcomes

Conclusion

Introduction

- Information Technology for patient safety
  - incomplete or missing information as key cause of adverse events
  - potential of clinical information systems and decision support systems
- Patient safety problems in the hospital
  - adverse drug events
  - antimicrobial resistance
- Fighting antimicrobial resistance with information technology
  - learning about prescribing behaviour and outcomes
  - detecting new patterns in clinical information

The debugIT Project in short

- The project receives funding under the European Community's Seventh Framework Programme, grant agreement n° FP7–217139 (7M€) which is gratefully acknowledged
- Project period: from Jan 1st, 2008 to December 31st, 2011
- 11 Partners (next slide)

The Partners: research and industry

- **Agfa HealthCare**, Belgium (coordinator)
- empirica Gesellschaft für Kommunikations- und Technologieforschung mbH, Germany
- Gama Sofia Ltd., Bulgaria
- Institut National de la Santé et de la Recherche Médicale (INSERM), France
- Internetový Pristup Ke Zdravotním Informacím Pacienta (IZIP), Czech Republic
- **Linköpings Universitetet**, Sweden
- Technologiko Expedeftiko Idrima Lamias, Greece
- **University College London**, United Kingdom
- **Les Hôpitaux Universitaires de Genève**, Switzerland
- **Universitätsklinikum** Freiburg, Germany
- **Université de Genève**, Switzerland

The debugIT response to antimicrobial resistance

- The debugIT project
  - **collects** routinely stored data from clinical systems
  - **learns** by applying advanced data mining techniques
  - **stores** the extracted knowledge in repositories together with domain knowledge from external sources
  - **applies** the knowledge for decision support and monitoring

Collect Data

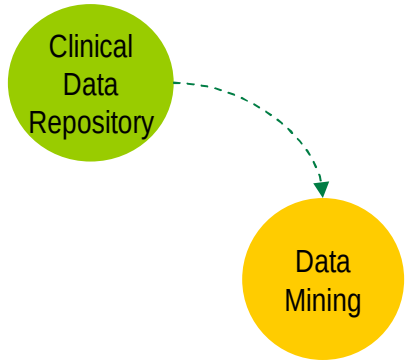
- Routinely stored clinical data is collected and aggregated across different hospitals, information models and jurisdictions

- **via**
  - commonly agreed data models (**minimal data sets**)
  - standards
  - mapping algorithms
  - **unified and enhanced ontologies**
- organized in a virtualized, Clinical Data Repository (CDR).

Learn

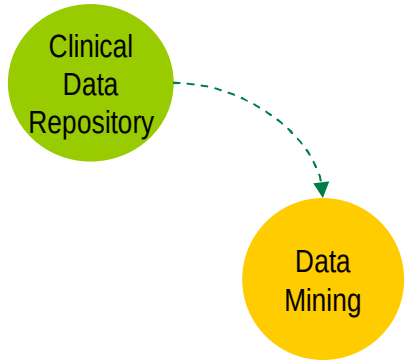
- debugIT learns by **detecting patterns**, relevant for patient safety and the better treatment of infectious diseases
- Advanced data mining techniques are used on
  - multimodal & multi-source data
    - structured data mining
    - text mining
    - image mining

  to create **new knowledge**



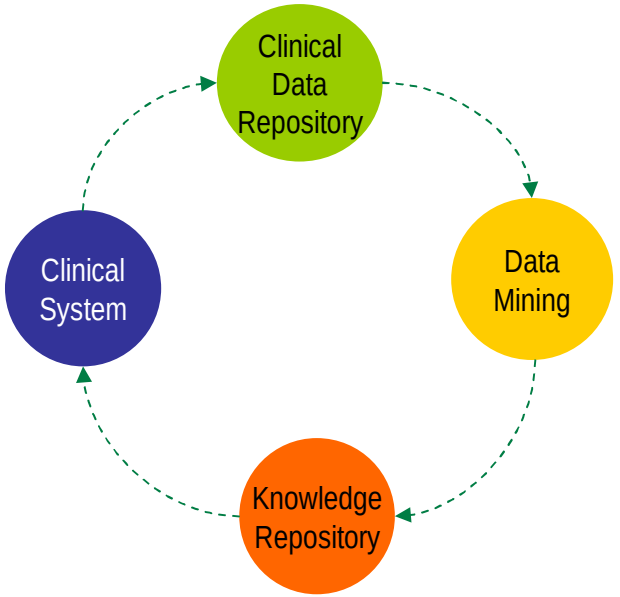
Data mining objectives

- develop models for predicting adverse events,
- to develop data mining tools adapted to the specific characteristics of data needed for adverse event prediction
- to draw practical guidelines based on the learned models



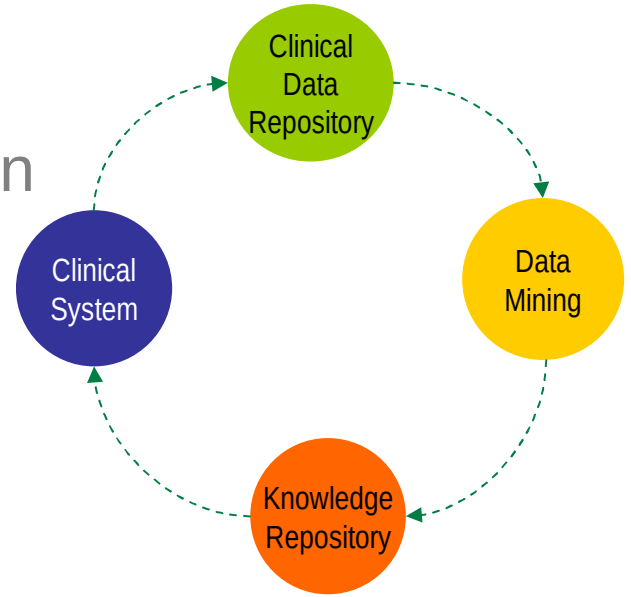
Apply

- Appropriate software tools are integrated into available clinical and public health information systems.
  - Decision support tools apply the newly generated knowledge
  - Monitoring tools analyze ongoing care activities and outcomes
- Integration in existing CIS enables the recording of activities
  - data are generated for a next cycle of learning.



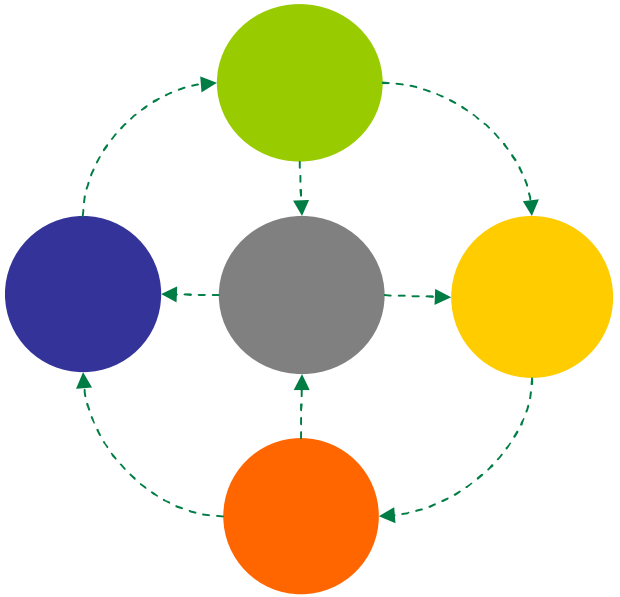
Evidence and Eminence Based Medicine

- The results of data mining include statistical figures on the found relationships
- These evidences are directly used in the decision support tool
- …together with expert knowledge



Expected Outcomes

- Improved patient care: LoS, complications
- New, advanced ICT applications and innovations will be marketed in the following domains:
  - virtualization of Clinical Data Repository information
  - data mining and distributed storage
  - use of machine reasoning
- A distributed Medical Knowledge Repository (MKR) integrated with domain knowledge
- Knowledge representation paradigms for both clinicians and IT experts



Conclusion

- A timely and innovative response to a growing problem
- Innovation for both public health and health informatics

Thank you …

More info ?

dirk.colaert@agfa.com

jose.verguts@agfa.com

christian.lovis@hcuge.ch

Current Status of the project

- First exchange of data-sets from different participating hospitals
- Agreement on elements of a minimal data-set for a year one demonstrator
- Definition of clinical questions for data-mining

Elements of the minimal data-set

Treatment Course

A course is everything that starts with a culture and contains at least one antibiogram and one treatment.

One course contains:

1. [1..n] cultures

date of culture, date of results, sample id

[0..n] bacteria identified

Name of bacteria + quantity

[0..1] antibiogram

date of results

table N x M, N= bacteria, M= antibiotic tested. Each cell will contain any of these

our possibilities: (-) not tested; (s) sensitive; (r) resistant; (i) intermediate

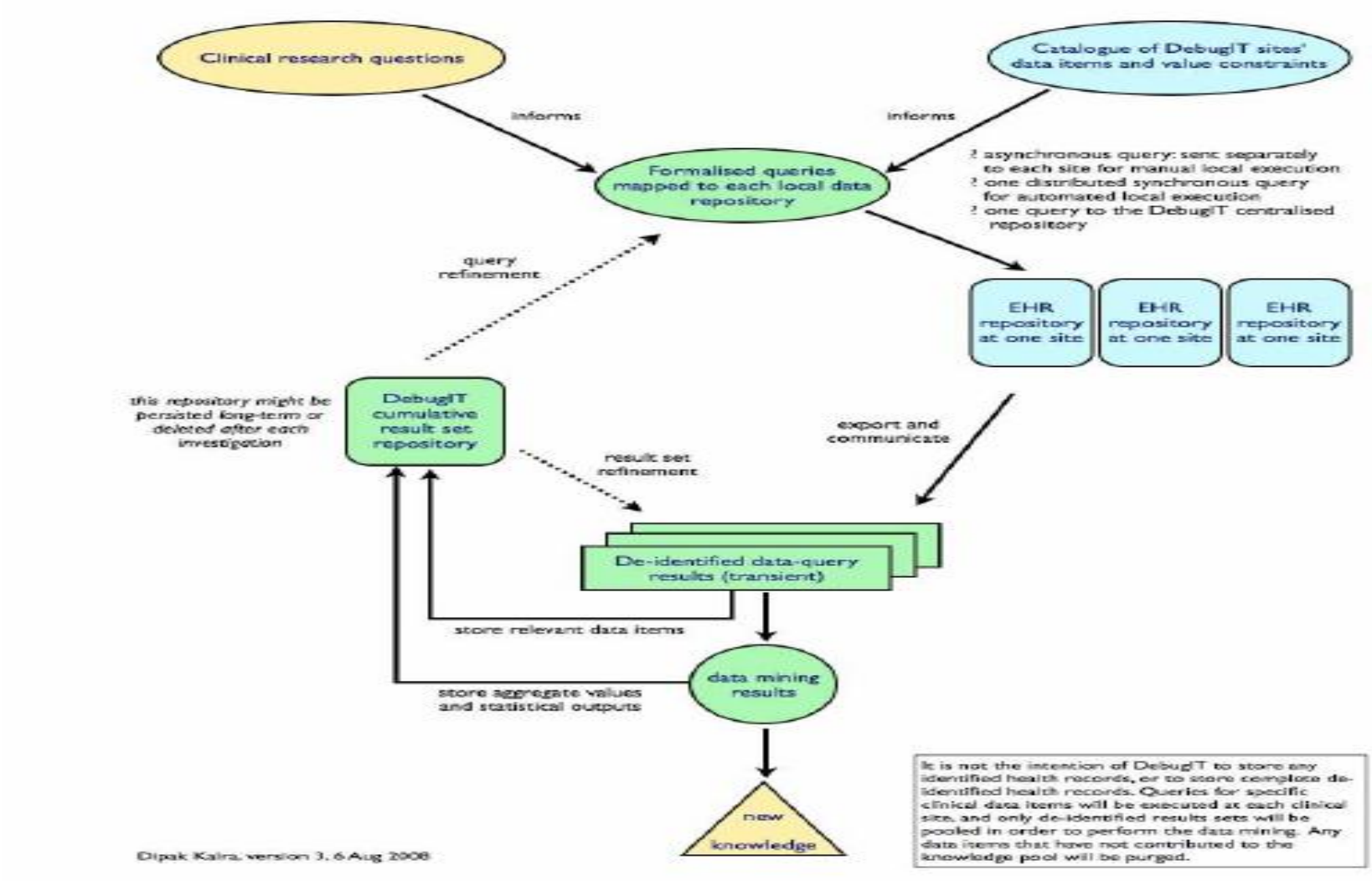
2. [1..n] antimicrobial treatments

drug name, drug dose, route, date begin, date end

Possible data-mining queries from minimal data-set

- “is antibiotic treatment following the antibiogram”
- “is antibiotic treatment adapted after obtaining the antibiogram results”.
- “what proportions of pathogens are treated with an inappropriate antibiotic”
- “what would be the most appropriate antibiotic”
- “can culture alone predict the best antibiotic

DebugIT Process



Features of the decision-support system

- Interoperable components capable in a formal knowledge representation language (RDF)
- A **recursive reasoning** approach in that it will first use reasoning to collect the needed pieces of knowledge and information and then do the actual reasoning;
- A **federated and distributed reasoning engine** with a smart selection of knowledge;
- A logic framework as an environment where **rules can be applied on facts and on rules themselves**, enabling higher order logic;
- Integration of **deductive as well as Bayesian logic**, combining deterministic reasoning with reasoning based on belief, uncertainty and statistical probabilities.