Paradigm Shifts in Health Informatics

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HEALTHINF 2013 - 6th International Conference on Health Informatics
11-14 February 2013
Agenda

1. **What is a paradigm?**
   - “Canon of proportions” => “Vitruvian Man”

2. **How can we use a paradigm?**

3. **New paradigms in healthcare**
   - “Pay for performance”, “Personalized medicine”, etc.
   - “Patient-Centered Care”

4. **Shift of paradigms from business to healthcare**
   - “Business Meta-Model”
   - “HL7 RIM Meta-Model”

5. **Paradigm shifts of from information engineering to ehealth**
   - “Interconnecting Health”
   - “Integrating health”

6. **New paradigms in health informatics**
   - Multi-agent system
   - “R2V2R - Real-to-Virtual-to-Real”
   - “Ecosystem”

7. **Conclusions**
Example of Paradigm Shift

- **Vitruvius** described the human figure as being the principal source of proportion among the classical orders of architecture.

- **Paradigm:**
  - **Canon of Proportions:**
    - *Human body proportions are the golden proportions of architectural styles*

- **Leonardo da Vinci** believed the workings of the human body to be an analogy for the workings of the universe.
What is a paradigm?

Definition:

A reference model of fundamental value widely accepted in a particular field because it is an expression of a comprehensive belief system or world view in that field.

- Usually a paradigm emphasizes relationships between some fundamental concepts that shape the thinking.
- A paradigm is derived from a specific way of thinking, communicating and viewing the world.
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How to use a paradigm?

- A paradigm influences how an individual perceives an area of the real world or reacts to this perception.
- A paradigm guides research and practice in the field of interest.
- It can be used as:
  - a structuring schema in both teaching and model-driven design processes;
  - a benchmark to assess methods or conceptual tools that are related to the paradigm goal or idea, and
  - as this research claims, we can use paradigms for transferring knowledge across domains.
Model-based design process

1. Choose a simple schema to be the first model of the future system

2. Validate the model against the design target

3. Refine the model

4. Describe the model in a design specification language

5. Use the model to implement the system
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New paradigms in healthcare

New paradigms are arising in healthcare to mark epochal changes in the domain:

- "pay for performance" focuses on cost control
- "personalized medicine" and "evidence-based medicine" focus on the quality of services
- "patient-centered care" and "patient empowerment" focus on the citizens’ perception concerning the quality and efficiency of healthcare.
“Patient-Centered Care” Paradigm

"Nothing about me without me“

Or:

The right care in the right way at the right time.

Method

• Four new communication behaviors:
  ◦ Understanding and validating the patients’ perspective
  ◦ Extension of understanding the patient to his / her global psychosocial context
  ◦ Shared understanding with the patient of his / her health problem and its treatment
  ◦ Partnership with “empowered” patients in decision making, power and responsibility.
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A business meta-model*)

A Business Model of Clinical Trials

Organisation: Coordinator Center (CC)
Agents: CT Coordinator, Statistical unit, Data Safety Board

Management of clinical trial

Management of statistical units

Organisation: Investigator centre
Agents: Chief investigator, CRF data collector

Medical treatment of enrolled patients

Environment: Clinical ward
Agents: Health care providers

Master File

Startup experimentation

Enrollment management

Investigator

Patient Information

Compiled CRF

Patient Information

Patient

Investigator

Compiled CRF

Experimentation closure

Resource

CT Protocol

Patient Information

The RIM HL7 V3 Meta-model *)

HL7 Domain Analysis Model (DAM) for the LuMiR Healthcare Domain
Domain Message Information Model (D-MIM) of the Contact concept
HL7 generated message
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The “Interconnecting health” paradigm

- Progress in IT has made possible the development of some new paradigms in health informatics.

- *Interconnecting health* focuses on the ability to connect health organizations and systems, and the role of IT as an enabler in achieving this connectivity.
  - The growth in importance of *electronic health records* in the last two decades marked a technological but also "cultural" shift.
  - The evolution of “Interconnecting health” was a continuous broadening of the horizon of interoperability in health.
Virtual Health Record

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Multi-Agent System (MAS)

- The MAS paradigm could be used to model, design and implement software platforms that integrate software applications in healthcare systems.
- MASs are a more natural way to represent many situations that often occur in medical settings, such as:
  - absence of a comprehensive control system,
  - limited or insufficient resources for a care provider to solve a given problem, and
  - geographical distribution of the needed information and knowledge.
- On the other hand, in health systems we can identify many recurrent features common to MASs:
  - delegation of responsibility,
  - re-allocation of tasks,
  - need to consider a large variety of user concerns and problems,
  - planning the collaborative work,
  - think and work in open spaces, etc.
In the case of “agentification” of a regional health information organization (RHIO), all stakeholders (care providers, professionals, patients and their relatives) from the real should be represented as avatars: highly proactive agents acting with own initiatives on behalf of an individual.

Other virtual entities in the system may represent real organizations but also virtual, temporary, ad-hoc created organizations as teams of professionals involved in the patient’s care process.
Ecosystem

- A *natural ecosystem* is a biological community of interacting organisms plus their physical environment.
- Correspondingly, a health ecosystem can be defined as a network consisting of a multitude of health service suppliers and consumers, and healthcare organizations, all of them supported by IT.
- *Digital business ecosystem* is a self-organising digital infrastructure aimed at creating a digital environment for networked organisations that supports the cooperation, the knowledge sharing, the development of open and adaptive technologies and evolutionary business models.
- *Digital health ecosystem* (DHE) is an IT infrastructure designed to work in synergy with the health ecosystem by mainly supporting health activities in the real world.
The health ecosystem and its digital ecosystem

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- This paper aims to open a discussion on the role of paradigms in our reasoning and proposes the use of innovative paradigm-based solutions in one or another field of activity.
- A paradigm better captures the nature of the differences between different approaches to solve a problem.
- Paradigm shifts in health informatics are good go-betweens in transferring knowledge to and from healthcare.
THANK YOU!

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This work was supported by the project ERRIC No. 264207, FP7-REGPOT-2010-1.