Avicena – Clinical processes driven by an ontology

Process Management Systems for Health Care

Alfonso Díez
What is Avicena?

- **Avicena is a Process Management System (APS) for the Health Care, aimed to:**
  - Guide doctors in real time at the encounter, providing them with all the relevant data about the process patient when needed, and facilitating the management of orders
  - Managing the care process along all its life cycle and across all attention layers
  - Approach new ways of providing health services to patients: enforce proactive approaches
  - Help to improve clinical process in costs, efficiency, cooperation, planning.

- **APS is the convergence of ontologies and live experience in BPMS:**
  - **Avicena Process Ontology**, that defines the rules of health care attention in an abstract way
  - **Avicena Process Management** system, that supports live execution of care processes based on the Ontology definitions

- **APS initial stages start in October 2004**
The players and the experience

**Adeslas**
Health Insurance Company, over 2.5 million customers
Making new approaches for preventive care for large number of customers
**Development of Cholesterol and Diabetes Programmes**

**Hospital de la Ribera**
Private Hospital in the region of Valencia: 250,000 patients
First European case of private hospital that offers universal public attention to all citizens in the area. Public attention is free and unlimited.
**Development of a pilot programme of processes based on guidelines**

**BET Value**
Private company specialized in Business Process Management Systems
We develop tools based on semantic definitions and declarative software to organize business processes.
**Leader and Developer of Avicena project**

**Universidad Autónoma de Madrid**
Public University
The NETS group has a large experience in the field of ontologies and semantic web
**Ontology development within the project**
Health organizations are complex by nature: they are chaotic systems, unpredictable

- Nobody knows the situation of the whole system in a given moment and in the next future
- The dynamic is based in arbitrary decisions taken in every instant: the state of the system and its evolution is composed of many individual and independent decisions
- Events and decisions propagate in cascade along the organization, patients, staff, and even other organizations
- It should be critical to have all the process history available when taking a decision. In general this is false
- Processes cross many layers: primary, specialized, surgery, hospital and clinic, emergency room… the patient is always the same
- The capability to track each every single decision is needed for the clinical sessions: the system has to learn from its own experience
Stressing our management capabilities

- To know what is happening now and likely will happen in the next future
- To help physicians to take decisions well based
- To effectively propagate the decisions along the organization
- To know all the relevant information for each individual process at any moment
- To make events and information flow transversally across organizational layers
- To learn from experience
The ‘social’ status of APS

- APS is a member of the health system, not a technical resource
  - APS is a core actor, with specific responsibilities helping humans to provide the most effective care
- **APS knows the business domain:**
  - The information relevant for each process
  - the rules (guides, pathways, organizational, others)
  - the actors and resources in the domain, and their roles
- The system manage individually each patient process (the ecosystem)
  - He applies the specific rules for that patient and process to evaluate the situation and dynamic
  - Manage the events and schedules for them
- Therefore APS helps people to make their duties
  - identifying work to be done,
  - coordinating people, and distributing activities
  - and thinking in advance to enforce planned and proactive care
Benefits using a process controlled care

- **Quality**
  - Reduce variability of care: quality of care is predictive. Rules are explicit and known
  - Give a 360° view of the patient@process information and evolution: everything at a glance
  - Compliance to rules (internal and regulatory) is easily obtained

- **Efficiency**
  - Cost-effectiveness strategies are enforced: avoid repeated or unneeded activities and make care efficient
  - Care becomes planned and proactive, detecting work to be done, and assigning resources efficiently.
  - Coordinate people and attention layers

- **Improve Evolution**
  - Spread quickly new knowledge and best practices (critical today!)
  - Obtain valuable clinical information about processes: learn from experience
Ontology covers the clinical rules:
- Composition of medical actions
- Dynamics of the encounter
- Mapping of data with CIS
- Clinical Strategies
- Reference lists
- Knowledge base linkage

Managed by physicians

Semantic covers technical implementation rules:
- Storage and Retrieval
- State Management
- User and System Interfaces
- Information flow management
- Alerts and control of schedules

Managed by technicians
A glance at the ontology

**Process**

- Policies attached to diagnosis, symptoms or techniques

**Actions**

- What is relevant what can be done: Domain

**Activities**

- Which are the side effects in the organization

**Guideline matrix**

- Actions that are meaningful at the encounter

**Encounter type**

- Stages of the attention

**Pathways**

- Paths between stages
1- The encounters

Managing the encounter is the most important objective of the Ontology. Health care works because doctors and patients meet

- **Two types of encounters**
  - Discrete (appointment)
  - Continuous (inpatient)

- **Encounters represent stages of attention within a process, e.g:**
  - Initial anamnesis and evaluation
  - Pre-surgey preparation
  - Post-treatment review
  - Periodical review, etc

- **For each Encounter Type we define:**
  - Its purpose or objective
  - Its specific guide: actions that are meaningful during the encounter
  - Other attributes
1- The actions

Actions are the bricks that build the encounter
Actions are the domain of information of the Process

- **Action classes**
  - Execute (generate order)
  - Data Registry (question and register)
  - Data Gather (review results)
  - Embedded Subprocess (perform)

- **Each action is fully described by the ontology**
  - Definition of Data Structures
  - Links to domain-related knowledge
  - Reference values
  - Pre/Post conditions
  - User interface attributes
The dynamics at the encounter

Encounter: Patient, Doctor, Process, stage

Ontology Rules

Actions
- User Interface
- Links to KB
- Data Structures

Prepare guide

Patient’s data
Process History
Tests History and values

Reference Data:
- Knowledge related
- Reference values

Perform encounter:
- Review info
- Get data from patient
- Order tests and prescriptions
- Take decisions

Launch Test orders to be processed
Push Data for EHR
Schedule appointments and referrals
Update Process Instance Control status
Plan the new stage of process
Generate Activities to be done by support areas
Example of an encounter (pilot)

At the HR system, the user interface follows a white form metaphor.
- Activities with patient
- Review tests history and results
- Order tests
- Prescribe treatments
Summary of encounter
- Summary
- Diagnosis and problems identified
- Actions delayed
- Orders for tests or treatments
- Pathway decisions
Capture patient’s data (anamnesis)
Review the Cardiovascular Risk Report
Select a treatment from an evaluated list
Order Tests and treatments

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2 – The attention strategy (pathway)

Pathways are the strategies that can be followed within the process, depending (a) on the patient situation and evolution and (b) on the medical decision.

- **The pathway is a network of:**
  - Nodes: Encounter types
  - Conditions on clinical values
  - Time conditions
  - Repetitions

- **Paradigm in the organization**
  - Pathway reflect the consensus in the organization: the sensible way of doing

- **Distribution of encounters**
  - Each encounter can take place in a different layer: GP, hospital, GP…
3- Planned care

Avicena manages follow up activities efficiently at low cost: facilitate performing activities without the need of a patient-doctor encounter.

- Planned care is extremely useful for preventive care, chronic diseases, and follow up of evolution of acute diseases
  - Manage the patient independent of process
  - Without physical encounter: telephone, email, paper mail, automated actions…

- Triggering the activities plan
  - Each action at the encounter can trigger a flow of activities to be done in the future
  - Activities are manual (assigned to doctors, nurses or staff people) or automated by the process instance

- It eliminates a very important workload and unneeded appointments and tests:
  - Follow up of prescriptions and patient’s indicators, prescription of diets, checking tests results, new appointments and adjustment of pathways, control of patient’s general evolution, calendar of patient’s testings, etc.
Freedom of action:

- Physician can always modify
- the structure of that specific instance of the guide, adding new actions
- Jump to any alternative stage
Review and modify workload for the next weeks
Review my today’s work
Task list to be done for a patient. Activities can include ‘encounters’
Current situation and open issues

**Current findings**
- The model has a wide range of applications in different HC scenarios
- Technical architecture guarantees efficiency, scalability, and adaptability to new requirements: landscape can be populated with new creatures more intelligent
- The model suggest new strategies in HC, stressing planned attention.
- A model could be generated in a matter of few weeks

**Live experience**
- APS is feasible: is working in live conditions at Adeslas and HR

**Open issues to be researched in the future:**
- Continuous encounters for hospitalization and emergency rooms
- Language for the evaluation of conditions (pre/post) on actions, pathways and activities
- Distributed processes that go across different organizations using a semantic web approach: Primary Care, Specialists, Hospital, Emergency, Clinic, etc.
- Reasoning within the ontology
That’s all

Thank you very much for your attention

We will be glad to share our experience and search for collaboration in the open issues

For any further contact: adiez@betvalue.com

Alfonso Díez, Alberto Cortés, Rafael Gil (BET Value, Spain), Pablo Castells, Fernando Díez, José Fuentes, Álvaro Valera, (Universidad Autónoma de Madrid, Spain)