Avicena – Clinical processes driven by an ontology

Process Management Systems for Health Care

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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**

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The players and the experience

adeslas	*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	*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	*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 proyect
UAM-NETS	*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

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The envision of the health system

- **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

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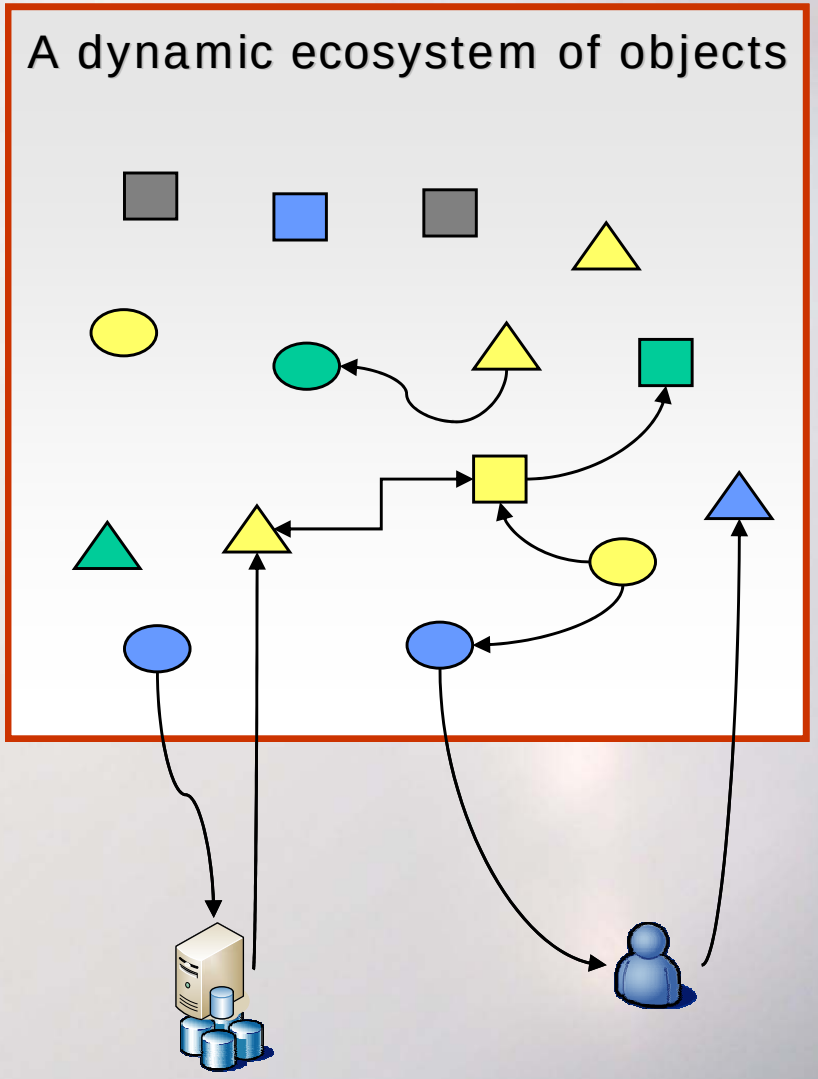
Stressing our management capabilities

- 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



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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 <u>knows the business</u> 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

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Benefits using a process controlled care

- **Quality**
  - Reduce variability of care: quality of care is predictive. Rules are explicit and known
  - Give a 360º 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

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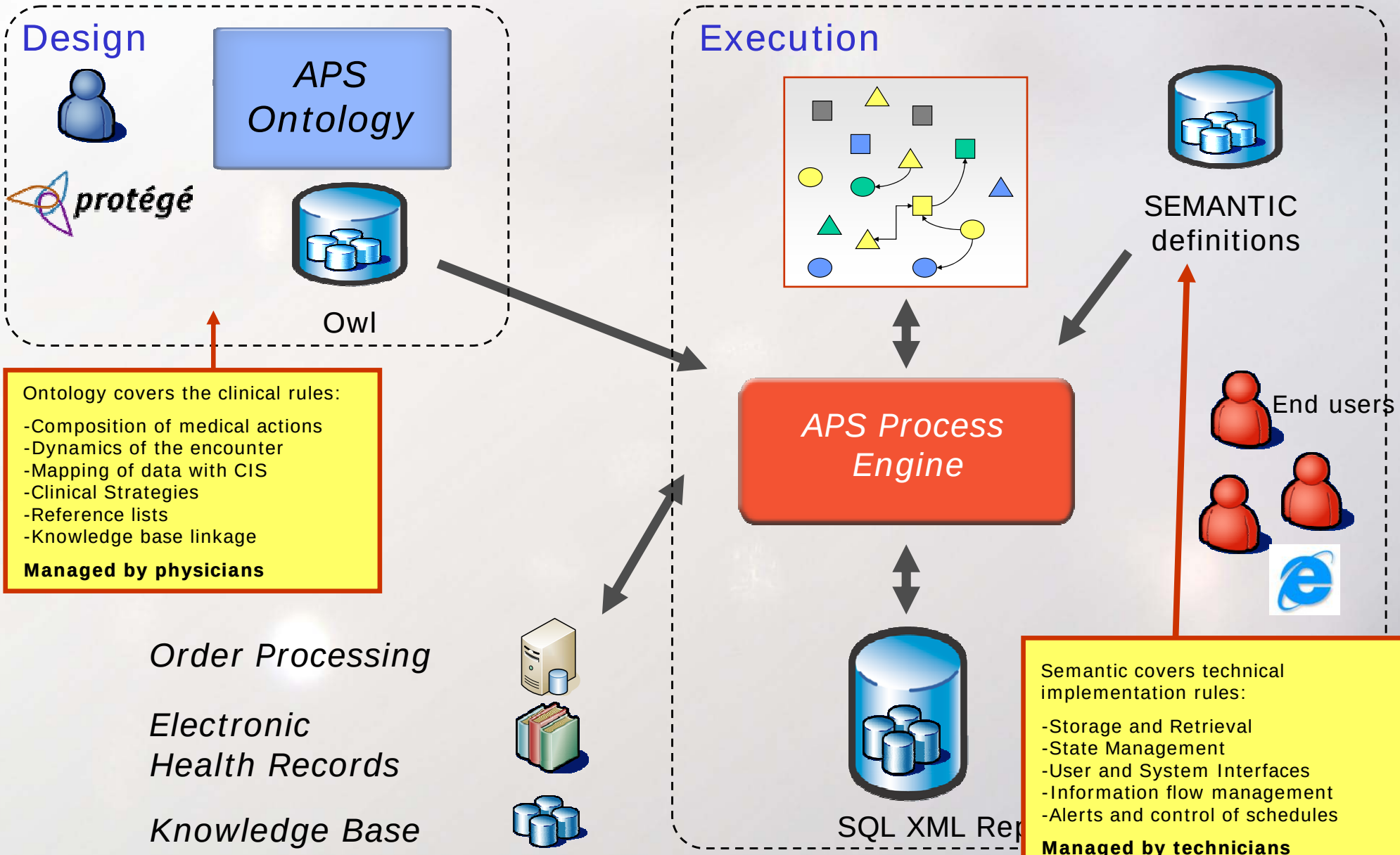
Technical architecture



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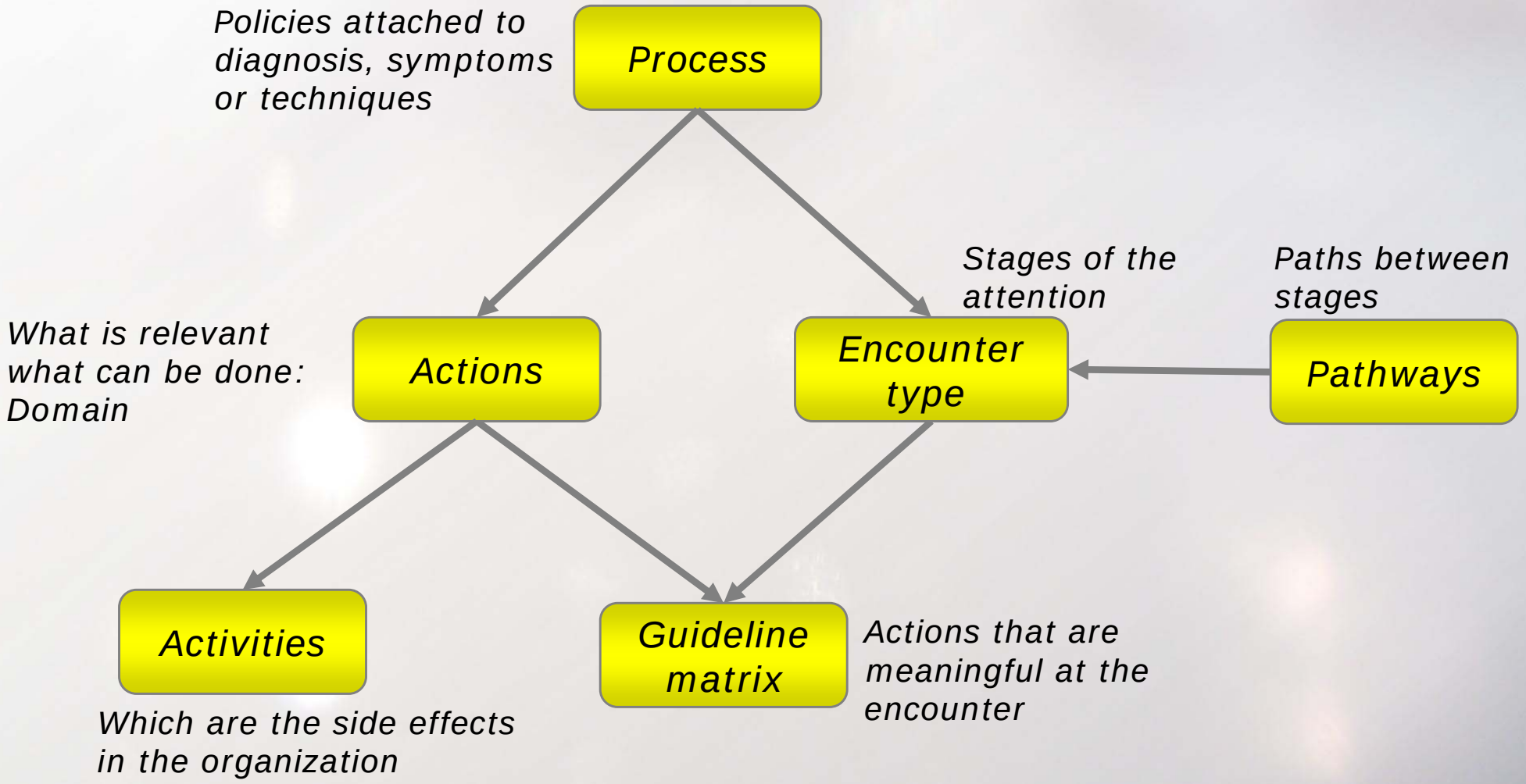
A glance at the ontology



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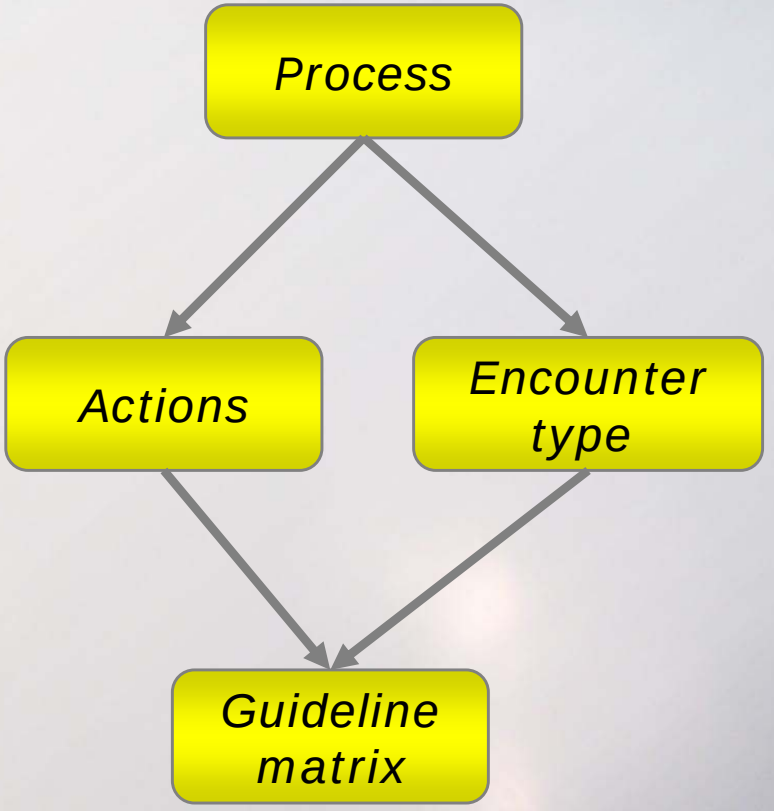
1- The encounters

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



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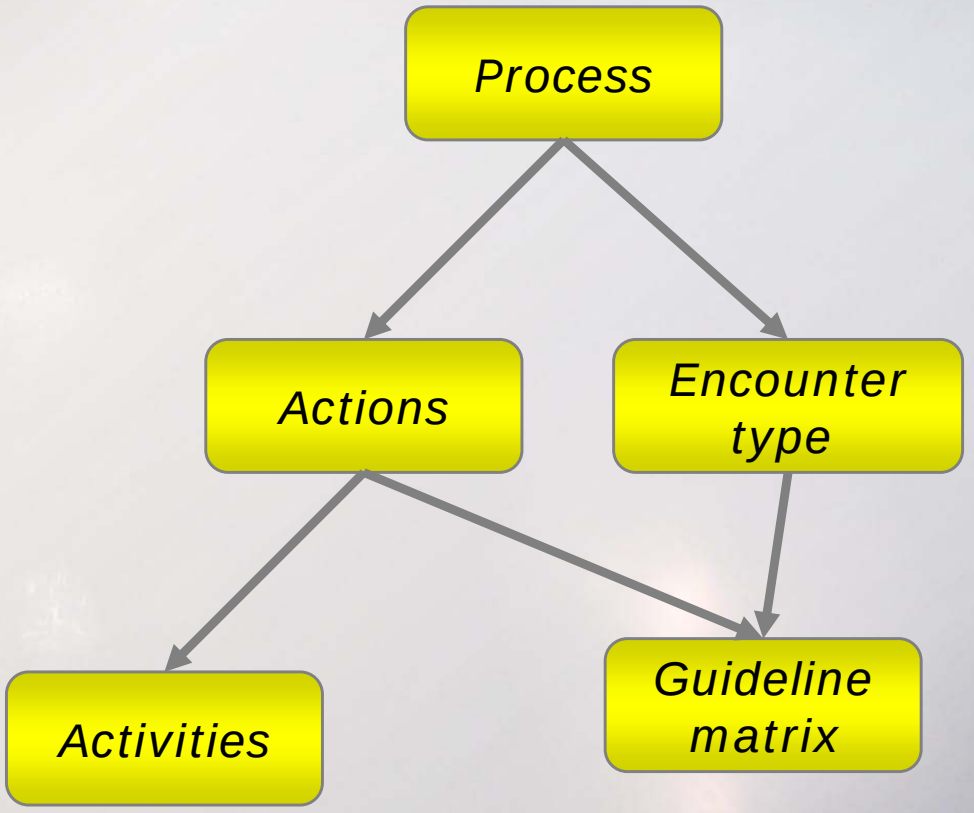
1- The actions

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



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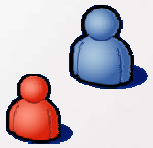
The dynamics at the encounter

Encounter: Patient, Doctor, Process, stage



Actions
User Interface
Links to KB
Data Structures

Ontology Rules

Patient's data

Process History

Tests History and values

Prepare guide

propagate

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 refereals

Update Process Instance Control status

Plan the new stage of process

Generate Activities to be done by support areas

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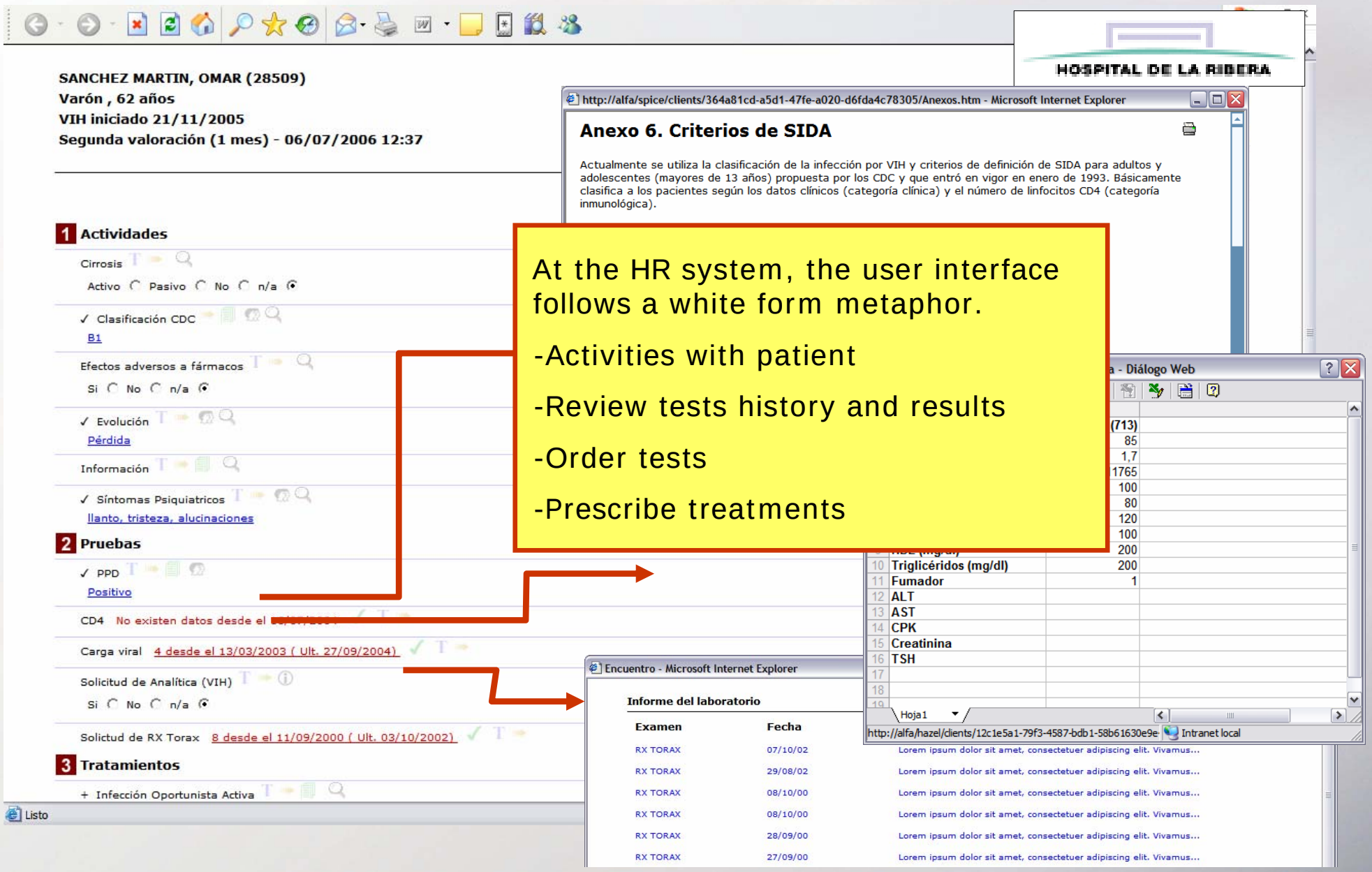
Example of an encounter (pilot)



At the HR system, the user interface follows a white form metaphor.

-Activities with patient

-Review tests history and results

-Order tests

-Prescribe treatments

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HOSPITAL DE LA RIBERA

SANCHEZ MARTIN, OMAR (28509)
Varón , 62 años
VIH iniciado 21/11/2005
Primera visita - VIH - 21/11/2005 11:44

Pediatria
06/07/2006
Hospitalizacion - 25/11/2002 - Trauma-Cirugia Ortop,dica

1 Resumen del Encuentro (inicio 29 nov 2004 11:20 Fin 29 nov 2004 11:32) Esconder

✓ Historia clínica
✓ Factores de Riesgo ADVP
✓ Infecciones oportunistas previas Pérpura trombocitopénica idiopática, Listeriosis, Enfermedad inflamatoria pélvica
✓ Antecedentes de Infección VHB
✓ Cirrosis
✓ Child A

Diagnósticos y/o factores de riesgo identificados
✓ Antecedentes de Infección VHC
✓ Antecedentes de enfermedad TBC

2 Acciones que quedan pendientes para nuevos encuentros

No existen acciones pedientes

3 Acciones a Realizar (Tareas SIAS)

Solicitud de examen de laboratorio [Lanzar a SIAS]
✓ Solicitud de Analítica (VIH)

Pautar tratamiento [Lanzar a SIAS]
✓ Tratamiento
peg interferon, ribavirina
✓ Tratamiento antiretroviral
Zalcitabina, Estavudina, Lamivudina, Abacavir, Tenofovir, Nevirapina, Delavirdina

4 Selección de Siguiente etapa del proceso

Seleccione la opción de proceso más adecuada:
○ Fin del proceso Alta
○ Segunda visita

Volver | Suspender | Finalizar

Listo | Intranet local

Summary of encounter

- Summary
- Diagnosis and problems identified
- Actions delayed
- Orders for tests or treatments
- Pathway decisions

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Citas | Pacientes | Centros

Citas
- Buscar
- Citas de hoy
- Citas de mañana

Anamnesis

Enfermedad cardiovascular previa	Si / No	(N, 20/07/06)
Hipercolesterolemia familiar	Si / No	(N, 20/07/06)
Hipertensión arterial estadio 3 o con lesión de órgano diana	Si / No	(N, 20/07/06)
Antecedentes Familiares de Enfermedad Cardiovascular Precoz	Si / No	(N, 20/07/06)
Hipertrofia ventricular izquierda electrocardiográfica	Sí / No	(N, 20/07/06)
Colesterol Total (mg/dl)	100	(100 mg/dl, 20/07/06)
HDL (mg/dl)	250	(200 mg/dl, 20/07/06)
Triglicéridos (mg/dl)	200	(200 mg/dl, 20/07/06)

- ***Eventos***

Descripción: - Angina de pecho

Fecha del evento: 20/07/2006

Observaciones: Simple

Añadir | Limpiar

Fecha	Evento	Observaciones
20/07/2006	CARDIOPATÍA ISQUÉMICA	(20/07/2006) Simple
20/07/2006	Angina de pecho	(20/07/2006) Simple

Comentarios

Procesar datos | Salir

Inicializar próxima llamada 2 | Desconectar | Reporte Técnico | Cambiar contraseña

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Capture patient's data (anamnesis)

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Citas | Pacientes | Centros

Citas
- Buscar
- Citas de hoy
- Citas de mañana

Inicio del Tratamiento Farmacológico
- Recalcular LDL objetivo

Informe de riesgo

Datos utilizados

Sexo	Hombre
Edad	60
IMC (kg/m2)	23.15
TAS (mmHg)	160
Fumador	No
Colesterol (mg/dl)	300
HDL (mg/dl)	100
LDL (mg/dl)	160
TG (mg/dl)	200
Diabetes	
HVI	

Multiplicadores del RCV

No existen Multiplicadores del RCV

Modificadores del nivel de RCV

No existen Modificadores del RCV

Situaciones especiales

No existen Situaciones Especiales

Cálculo del RCV

Algoritmo	*RCV*	*RCV a 10 años*	*Nivel RCV*
Heartscore	33.79%	59.90%	ALTO
Framingham	28.14%	35.64%	ALTO

Review the Cardiovascular Risk Report

Gestionar | Salir | Volver a Anamnesis

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Citas | Pacientes | Centros

Citas
- Buscar
- Citas de hoy
- Citas de mañana

Selección de tratamiento

Seleccione la presentación del fármaco.

		Fármaco	Dosis	Medida	LDL objetivo
◆	101%	Atorvastatina	10	mg.	99
◆	96%	Simvastatina	20	mg.	104
◆	95%	Pravastatina	40	mg.	105
◆	90%	Lovastatina	40	mg.	110
◆	77%	Fluvastatina	40	mg.	123
◆	0%	Rosuvastatina		mg.	

Fármacos Hipocolesterolemiantes: Resumen de efectos y característi

Select a treatment from an evaluated list

Grupo Farmacológico	Efecto sobre el metabolismo lipídico	Contraindicaciones	Interacci Farmacologicas/ Comida	Adversos		orización
Estatinas: Atorvastatina Fluvastatina Lovastatina Pravastatina Rosuvastatina Simvastatina	Son los fármacos más potentes para reducir el LDL-Colesterol, Triglicéridos y lograr ligeros aumentos del HDL-Colesterol	**Absolutas** Enfermedad hepática activa Embarazo Lactancia **Relativas** Cirrosis Biliar Primaria Abuso de alcohol	1. Ciclosporina, Fibratos, Macrólidos, Ketólidos, niacina, Imidazoles, Nefazodona, Inhibidores de la proteasa, diltiazem, verapamilo, zumo de uva y otros inhibidores del citocromo CYP3A4: Aumento del riesgo de radbomiolisis/miopatía. 2. Pueden potenciar el	1. Molestias gastrointestinales moderadas. 2. Insomnio 3. Dolor de cabeza 4. Miopatía (Rara en Monoterapia <0,1%). El riesgo aumenta con tratamientos combinados. 5.	**Mol.** / **Inicio** / **Mant.** Atorva 10-40 10-80 Fluva 20-40 20-80 Lova 20 10-80 Prava 40 10-80 Rosu 5-20 5-40 Simva 20-40 5-80 Dosis en mg **Ajuste de dosis:** 1. Insuficiencia renal severa.	-Antes de iniciar Tratamiento: Perfil lipídico, ALT o AST y CPK -6 semanas después: Perfil lipídico, AST o ALT. -Si AST o ALT aumentadas por

Seguir | Cancelar | Volver

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Citas | Pacientes | Centros

Citas
- Buscar
- Citas de hoy
- Citas de mañana

Informe de riesgo | Gestión

PRUEBAS

- Solicitar prueba de Colesterol Total ☑
- Solicitar prueba de Colesterol-HDL ☑
- Solicitar prueba de Triglicéridos ☑
- Solicitar prueba de EKG ☑
- Solicitar prueba TSH ☑
- Solicitar prueba AST ☑
- Solicitar prueba ALT ☑
- Solicitar prueba CPK

Imprimir Informe RCV

Order Tests and treatments

MODIFICACIÓN DE ESTILOS DE VIDA

Descripción	F.Modificación	Estado
Pérdida de peso	06/07/2006	A

TRATAMIENTO FARMACOLÓGICO

Patología	Fármaco	Desayuno	Comida	Cena	Total	F.Inicio	F.Fin	Estado
Hipercolesterolemia	Simvastatina 20 (mg.)	1	1	1	3	06/07/2006		A

Finalizar consulta | Salir | Volver a Anamnesis

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Listo | Intranet local

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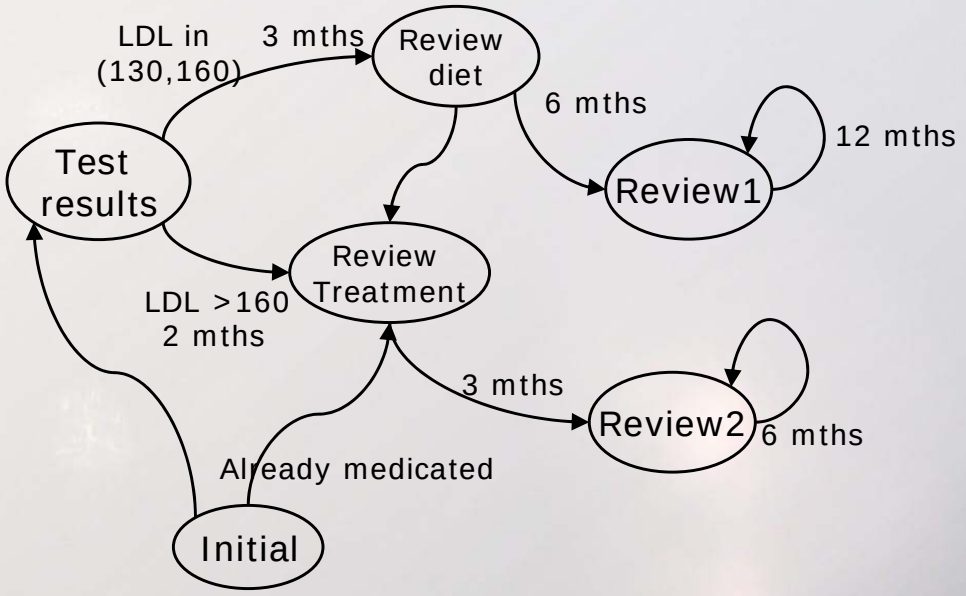
2 – The attention strategy (pathway)

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…



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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, chronical diseases, and follow up of evolution of acute deseases**
  - 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.

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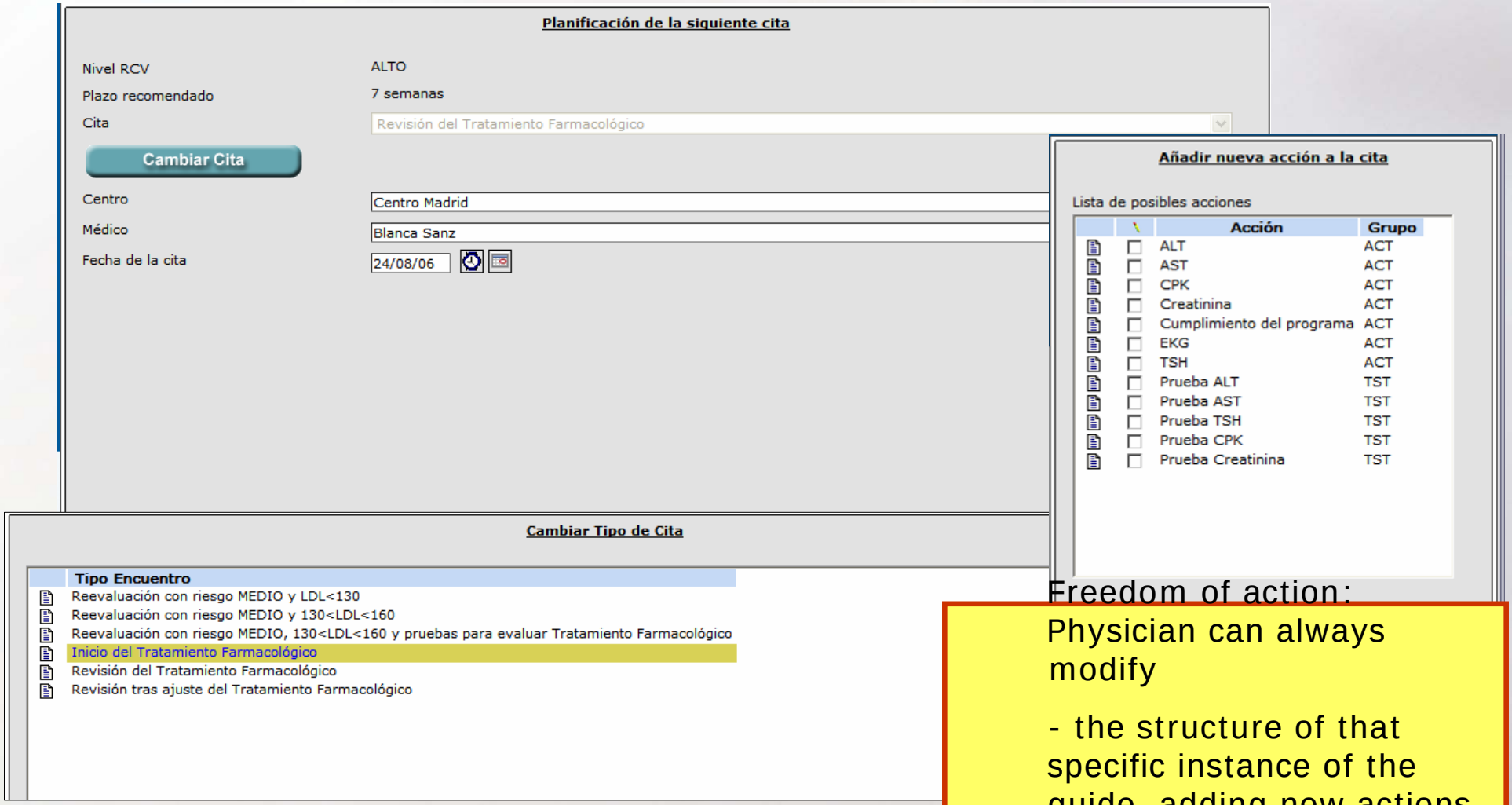

Freedom of action:

Physician can always modify

- the structure of that specific instance of the guide, adding new actions

-Jump to any alternative stage

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Pacientes | Actividades | Citas | Plantillas

Pacientes

- Buscar
- Carga de trabajo
- Mis pacientes
- Pacientes no asignados
- Pacientes no contactados
- Pacientes sin llamadas previstas
- Trabajo de hoy
- Trabajar con...

Carga de trabajo

Carga de trabajo de... Rafael Gil2

Semana	L	M	X	J	V	S	D	Total
1 - 03/07/2006 al 09/07/2006	0	0	0	0	1	0	0	1
2 - 10/07/2006 al 16/07/2006	0	0	0	0	0	0	0	0
3 - 17/07/2006 al 23/07/2006	0	0	0	0	0	0	0	0
4 - 24/07/2006 al 30/07/2006	0	0	0	0	0	0	0	0
5 - 31/07/2006 al 06/08/2006	0	0	0	0	0	0	0	0
6 - 07/08/2006 al 13/08/2006	0	0	0	0	0	0	0	0
7 - 14/08/2006 al 20/08/2006	0	0	0	1	0	0	0	1
8 - 21/08/2006 al 27/08/2006	0	0	0	1	0	0	0	1
9 - 28/08/2006 al 03/09/2006	0	0	0	0	0	0	0	0
10 - 04/09/2006 al 10/09/2006	0	0	0	0	0	0	0	0
11 - 11/09/2006 al 17/09/2006	0	0	0	0	0	0	0	0
12 - 18/09/2006 al 24/09/2006	0	0	0	0	0	0	0	0

Review and modify workload for the next weeks

Salir | Actualizar

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Pacientes | Actividades | Citas | Plantillas

Pacientes
- Buscar
- Carga de trabajo
- Mis pacientes
- Pacientes no asignados
- Pacientes no contactados
- Pacientes sin llamadas previstas
- Trabajo de hoy
- Trabajar con...

Carga de trabajo

Carga de trabajo de... Rafael Gil2

Semana	L	M	X	J	V	S	D	Total
1 - 14/08/2006 al 20/08/2006(M, 9:00h - 13:30h)	0	0	0	1	0	0	0	1
2 - 14/08/2006 al 20/08/2006(C, 13:30h - 15:30h)	0	0	0	0	0	0	0	0
3 - 14/08/2006 al 20/08/2006(T, 15:30h - 18:00h)	0	0	0	0	0	0	0	0

Pacientes del día 17/08/2006

Horario

Review my today's work

	Paciente	H.Pref.	Act.	F.Llam.	H
!	LOPEZ GONZALEZ, ANTONIO	M	2	17/08/2006 09:00:00	M

Salir | Volver | Actualizar

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Pacientes | Actividades | Citas | Plantillas

Actividades
- Buscar
- Actividades de Hoy
- Actividades Programadas
- Llamada entrante
- Modificar Datos
- Nueva Actividad

LOPEZ GONZALEZ, ALVARO
- Asignármelo
- Dar de baja
- Historial
- Modificar
- Seleccionar

Datos Personales | Datos del Programa | Actividades a realizar | Envíos | Llamadas | Resumen

F.Planificación	Tipo
13/07/2006	**Modificación del estilo de vida**
Asunto	Plan para pérdida de peso
Comentarios	
Envíos	Dieta - La obesidad.doc - 20/07/06 10:57:24 - SG - ?
04/09/2006	**Seguimiento del tratamiento farmacológico**
Asunto	Revisión del tratamiento
Comentarios	El tratamiento se sigue correctamente
20/07/2006	**Actividad**
Asunto	Cambio de Cita
Comentarios	Modificar la cita para adelantar la citología

Task list to be done for a patient. Activities can include 'encounters'

Contacto y comentarios de la llamada — no localizado — con éxito

Aceptar | Cancelar

Inicializar próxima llamada 2 | Desconectar | Reporte Técnico | Cambiar contraseña

Listo — Intranet local

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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

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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

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