

# Functional and Technological Description of a Real-Time Data Management System for Telehealthcare

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# Outline

- Introduction
- Functional analysis of the Data Management System
- Architecture of the Hybrid Management System
- Technological aspects of design
- Discussion & Summary
- Future work

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# Motivation

**An emergence of new types of data and new technologies that allow continuously monitoring the status of patients**

**New Clinical Decision Support (CDS) subsystems can identify trends in medical data to improve patients' diagnosis and treatment.**

**Current knowledge management solutions are specific, proprietary and closed and not perform real-time analysis**

**No solutions that integrate the large number of heterogeneous data, now available in health environments, to generate knowledge in real-time**

## Introduction

Functional  
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Future work

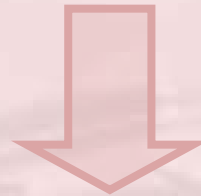
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# Objectives

- **A preliminary study of a new approach to design a data management system in a telehealthcare system with specific constraints on knowledge acquisition and generation:**
  - Main features of the system architecture
  - A preview of the technological solution



- **Case of study: Nefrotel**
  - A novel personalized telehealthcare system for nephrology under development by the Biomedical Engineering Group at University of Seville

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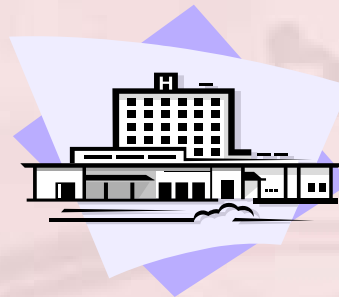
Future work

# Nefrotel, the scenario of the telehealthcare system

- Objectives:
  - Advanced monitoring of the patient & therapy machines
  - Quantification of the adequacy of dialysis
  - Integration of multiscale biomedical knowledge
  - Accessibility, reusability, interoperability & scalability



Points of Care  
(POCs)



Telehealthcare Center  
(THCC)



Professional  
User Interfaces  
(PUIs)

Patient Physiological Images  
(PPIs)

SCADA (Supervisory Control  
And Data Acquisition)

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# Functional analysis of the Data Management System

- Types of data to store:
  - Off-line & real-time health data
  - Devices and system processes configuration
  - Patient demographic information
  - Information about professional users
  - Medical & mechanical alarms
- Three data processing layers:
  - Sensors → clinical information & devices' configuration data
  - PPIs → new knowledge about the patient
  - Clinical & Technical Decision and Analysis Support
- Requirements:
  - Real-Time monitoring data acquisition & knowledge generation
  - Open Architecture features

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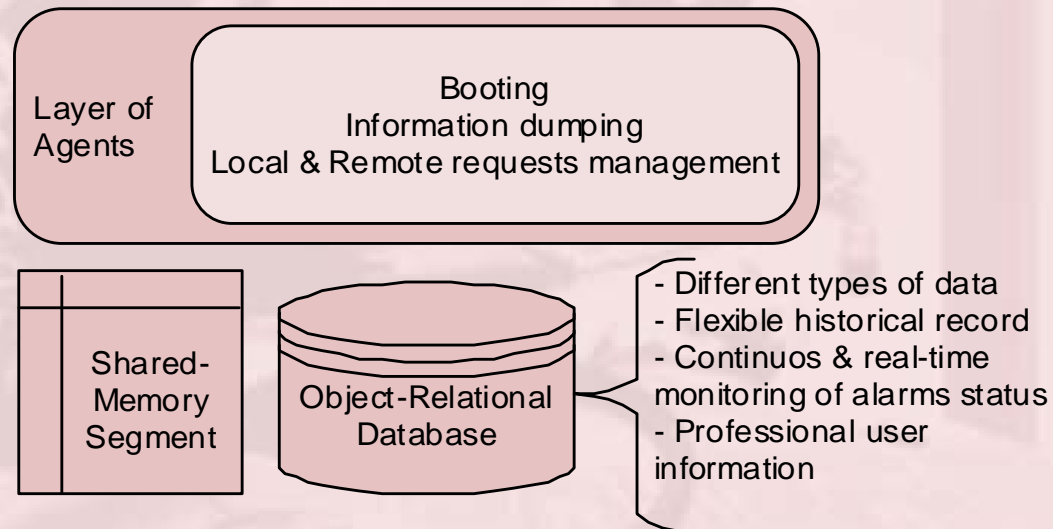
**ICMCC Event 2008**  
Patient Empowerment - The Power of Information

June 9-11, 2008



# Architecture of the Hybrid Management System

- Problems to cover:
  - OR-Databases not designed for real-time operation
  - Current real-time databases not provide functions for the processing and permanent storage of the data
- The hybrid solution proposed:



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# Technological aspects of design

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## Design

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- General requirements
  - Open-Source tools
  - Portable to any operating system
  - Easily scalable
- Operating System
  - Etch: Debian Linux Distribution
    - Robustness, quality & stability
- Database management system
  - PostgreSQL
    - Data consistency
- Programming Language
  - C language
    - CPU time & memory usage
  - POSIX system calls for the shared-memory management

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# Discussion & Summary (I)

- Alternatives studied:

## Databases integrated in SCADA systems

- Two storage systems: static & real time data
- Short life cycle for real-time
- Periodic & synchronized transfers from real-time to static storage system
- All requests management

## Embedded databases

- Raima Database Manager
  - No features of an OR-database
- Streambase
  - Processing, mixing & matching stream of real-time data

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# Discussion & Summary (II)

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- **The Hybrid Management System proposed:**

- Overcome problems raised by the alternatives studied:

- Integrated Databases → real-time data maintenance
- Embedded Databases → OR-databases functionality

- Adaptation of real-time databases concepts from industrial SCADA systems to a telehealthcare field

- A large amount of a very heterogeneous data maintenance

- Real capability to integrate patient knowledge

- Management of all the requests from: SCADA system, PPIs, sensors, CDS modules, etc.

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# Future work

- Closure of the management system implementation

## Data Model

Mathematical Models

Professional users needs

## Layer of Agents

Triggers & Procedures

Optimization algorithms

## Communication

SCADA system

PPIs

PUIs

Remote health centers

Etc.

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## Future work

- A benchmark study comparing the HMS solution with other data management systems

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# Thanks for your attention

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