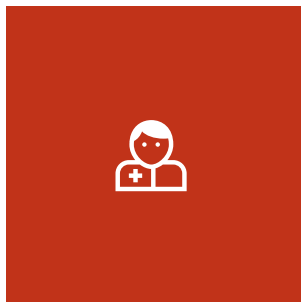
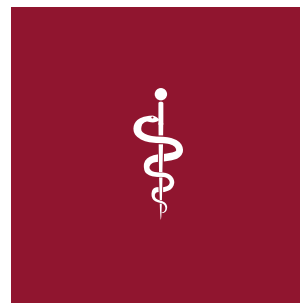
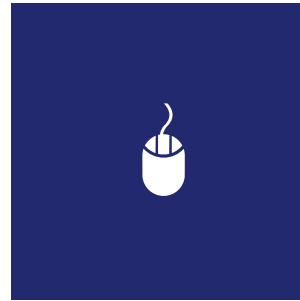


# 5<sup>th</sup> MEDICAL INFORMATICS SYMPOSIUM



<http://mim.med.up.pt>

## LOCATION

**Faculty of Medicine of the University of Porto**

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**Prof. Luis Antunes, PhD**  
**Prof. Miguel Coimbra, PhD**  
**Prof. Pedro Rodrigues, PhD**  
**Prof. Ricardo Correia, PhD**



## Foreword

The Symposium in Medical Informatics is a joint initiative from the Faculty of Medicine and the Faculty of Sciences of the University of Porto.

This is the fifth edition of this event, in which we have aimed for a balance between new thesis proposals and already finished thesis. This covers the various stages of research associated with a master course in Medical Informatics, showcasing the achievements of some of our best students. Furthermore, we also have a presentation from outside the master course, which will certainly widen the scope and discussion of this year's event.

Abstracts submitted to this event were reviewed by the elements of the organizing committee, and will benefit from a posterior review by an international committee.

Once again, we must congratulate the students for the excellent work in the various stages of their thesis and for their achievements in medical informatics, in the form of indexed publications and prototype implementations and deployments. Finally, we would like to thank the international scientific committee and the support from faculty and staff of this program, as an important contribution to the success of this symposium.

Porto, 9th November 2012

Pedro Pereira Rodrigues  
Miguel Tavares Coimbra

Members of the Scientific Committee of the  
Master Program in Medical Informatics



## Scientific Committee

Alberto Freitas, PhD

Altamiro Costa Pereira, MD PhD

Luis Filipe Antunes, PhD

Miguel Coimbra, PhD

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## Table of contents

<b>MSC THESIS.....</b>	<b>9</b>
Otimização de um sistema de recolha de dados clínicos, baseado em agentes .....	11
Development and assessment of an eLearning course on senology for radiographers: a stratified randomised controlled trial .....	13
Refining pre-polysomnography suspicion of Obstructive Sleep Apnea Syndrome: Logistic and Bayesian analysis of clinical factors.....	15
Enabling agents to retrieve openEHR-based health data through implementing HL7 communication with departmental information systems.....	17
Conception of a system for monitoring and management of patients with infection HIV/AIDS - SaveCare .....	19
Serviços de estimação da relevância de relatórios clínicos para otimização das interfaces gráficas e do armazenamento .....	23
An instructional game for biology classrooms .....	25
<b>PROJECTS .....</b>	<b>27</b>
Support System in Gastroenterology .....	29
Pharmacy medication stock optimization – Theory of Constraints .....	33
(in)Security in Electronic Prescribing .....	35
Comparative Study of Electronic Stethoscopes .....	37
Developing an openEHR Data Repository .....	39
<b>EVENT PROGRAM.....</b>	<b>41</b>
FRIDAY, November 9 <sup>th</sup> .....	43
SATURDAY, November 10 <sup>th</sup> .....	44





# MSc THESIS

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# Otimização de um sistema de recolha de dados clínicos, baseado em agentes

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*José Hilário Almeida*

## Resumo

Em 2005 um Registo Clínico Virtual foi instalado no Hospital de S. João (HSJ). Um dos seus módulos é um sistema multiagente para a integração de dados - MAID - que executa a recolha automática de relatórios de diversas proveniências departamentais.

A versão atual do MAID usa um intervalo de tempo estático na recolha das listas de referências dos relatórios pelos agentes. Dado que cada departamento difere no ritmo de produção de relatórios ao longo do dia houve a necessidade de otimizar e adaptar as ações de recolha das referências dos relatórios ao perfil de cada departamento.

Dada a natureza sensível do contexto em que o MAID se encontra instalado esta otimização não poderia ser feita usando o sistema em produção. Devido a isto, um ambiente de simulação foi desenvolvido, permitindo o teste e a comparação de diferentes soluções de otimização usando como referência dados anonimizados da produção real de relatórios dos diferentes departamentos.

As principais contribuições deste trabalho foram o desenvolvimento de um ambiente de simulação de agentes e o desenvolvimento de um agente de agendamento adaptativo que permite que as ações dos agentes de recolha de listagens se adaptem aos padrões de produção de relatórios de cada departamento. Também foi desenvolvido um interface web que permite a configuração do MAID.

Um piloto do ambiente de simulação foi instalado e ativado com o agente de agendamento e as modificações necessárias feitas no MAID, permitindo a execução de simulações e a comparação de dados de simulação entre a versão atual do sistema e possíveis opções de otimização.

O uso de um ambiente de simulação é uma opção viável no desenvolvimento e teste de algoritmos de otimização dado que permite a comparação de variáveis relacionadas com o processo de otimização. O uso de dados passados de produção de relatórios de maneira a otimizar é também uma opção viável dado que permite a adaptação das ações dos agentes aos perfis departamentais. O

desenvolvimento e ativação do agente de agendamento permitem a otimização dos comportamentos de obtenção de relatórios.

# Development and assessment of an eLearning course on senology for radiographers: a stratified randomised controlled trial

*Inês C. Moreira, Sandra Rua Ventura, Pedro Pereira Rodrigues*

## Abstract

**Keywords:** Breast neoplasms, Mammography, Distance learning, Continuing education, Evaluation studies

**Introduction:** Breast cancer is a serious public health problem, and screening is a critical tool to combat the mortality rate of the disease. Mammography technique is considered the best imaging examination for this screening and the radiographer plays a crucial role in this process, hence the need to be properly prepared.

**Aims:** To develop an easy-to-use course in eLearning environment about Senology for radiographers, assessing its efficacy, effectiveness and users' satisfaction.

**Methods:** A stratified randomised controlled trial was performed with radiographers and radiology students, using pre- and post-knowledge tests for efficacy measurement, and individual satisfaction questionnaires. Intention-to-treat and per-protocol analysis were considered in the statistical analysis.

**Results:** A total of 54 participants were included in the intervention group (20 students and 34 radiographers) and 53 in the control group (19 students and 34 radiographers). The majority of participants (81%) in the intervention group agreed to take the course, although 9% of them did not attend the full course. The intention-to-treat analysis showed a mean improvement of 21 percentual points (pp) in the intervention group, with 4pp in the control group ( $p<0.001$ ). Radiographers clearly improved with the intervention (23pp vs 4pp;  $p=0.004$ ). Although the effect was not clear in students (18pp vs 5pp;  $p=0.098$ ), we found differences in post-test results between intervention and control (88% vs 63%;  $p=0.003$ ) whereas such difference was absent in the pre-test (63% vs 63%;  $p=0.106$ ). The per-protocol analysis resulted in a higher effect (26pp vs 2pp;  $p<0.001$ ), both in students (25pp vs 3pp;  $p=0.004$ ) and radiographers (27pp vs 2pp;  $p<0.001$ ). Overall, 85% were satisfied with the eLearning system and 88% consider that the system is successful.

**Discussion:** The unclear result in students could be explained by some students enduring self-learning after performing the pre-test. Regarding the radiographers, the positive evolution reveals the importance of continuing education throughout their working lives. The per-protocol analysis enhances the influence of the course on both groups. Nevertheless, the real effect is probably in between the two analyses.

**Conclusion:** The course is efficacious, especially for radiographers, which highlights the need for continuing education, foreseeing also eLearning as an increasingly viable alternative to the traditional method. The course is also effective, since only 10% of the learners dropped out during its performance. Moreover, the course showed a high level of satisfaction.

# Refining pre-polysomnography suspicion of Obstructive Sleep Apnea Syndrome: Logistic and Bayesian analysis of clinical factors

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*Liliana Leite*

## Abstract

**Key-words:** risk factors, obstructive sleep apnea, diagnosis, clinical model, Bayesian network, sensitivity and specificity.

**Introduction:** Obstructive Sleep Apnea (OSA) is a disease that affects 2-4% of the population around the world. The standard method for OSA diagnosis is polysomnography (PSG), an expensive exam, limited to urban areas and, consequently, with high waiting lists.

**Aim:** Define an auxiliary diagnostic method that prioritizes patients during pre-polysomnography consultation according to their probability of OSA diagnosis.

**Methods:** A prospective study was conducted, including adult patients with OSA suspicion that performed PSG at the sleep laboratory of Vila Nova de Gaia/Espinho Hospital Center. Studied variables were defined from literature review and collected during consultation. Two samples were collected: a training cohort to build the models and check internal and cross-validation (CV) and a validation cohort to check the resultant models in clinical practice. With the significant variables achieved with univariate logistic regression (LR) we used two different techniques, multiple LR and Bayesian networks classifiers- Naïve Bayes (NB) and Tree Augmented Bayesian network (TAN) - to build models that predict OSA diagnosis. The sensitivity and specificity was analyzed to determine their performance.

**Results:** We studied 86 patients to build the models, 52% with OSA diagnosis. Univariate LR analysis showed six variables with significant influence on the outcome: male gender (OR=7.259, 95%CI=[1.096;27.651]), body mass index (OR=1.159, [1.030;1.303]), neck circumference (OR=1.341, [1.159;1.550]), abdominal circumference (OR=1.076, [1.025;1.129]), witnessed apneas (OR=4.725, [1.772;12.599]) and alcohol before sleep (OR=3.307, [1.350;8.100]). We tested two different cutoffs for sensitivity. Aiming 100% of sensitivity we used a 10% cutoff on LR achieved after a ROC curve analysis (AUC=80% [70%;89%]), 7% on NB and 2% on TAN while aiming 95% for sensitivity the cutoffs were 25% on LR, 10% for NB and 22% on TAN. The CV validation of LR model estimates that he

was robust for both cut-offs: 98%-11% and 89%-34%, respectively. On NB using 7% as cutoff the results were 98% for sensitivity and 18% for specificity and with the higher cutoff (10%) the results were 93% to sensitivity and 30% for specificity. On TAN using 2% as cutoff the results were 88% to sensitivity and 23% for specificity and to 22% were 84% to sensitivity and 25% for specificity. These models were tested on a separate comparable 33-patients cohort to evaluate their performance on clinical practice. Results of LR supported the expectations for both thresholds: 100%-0% and 88%-15%, respectively. The 7% and 2% cutoffs obtained the same sensitivity (94%) for NB and TAN respectively, but TAN achieved better results on specificity (7%) than NB (0%). Using the higher cutoffs of 10% on NB and 22% for TAN, the two classifiers obtained one more time the same sensitivity (89%) but better results for specificity on TAN (13%) than in NB (7%).

**Discussion:** Neck circumference and witnessed apneas information suffices to a clinical model based on the LR results. If we use a BN we need more than these two variables: gender, body mass index, abdominal circumference and alcohol before sleep. For both models using the respective cutoffs we can provide three levels of priority given the probability of the patient have OSA diagnosis, non-priority group, an intermediate level and, finally, a priority group. Besides these results, the use of BN reveals two main advantages that traditional LR can't solve. First, BN can deal with missing information; second, the graphical representation can be more interesting to the physician. We consider that the use of these models on sleep consultation can be a helpful tool to screen patients to perform PSG and eventually reduce the number of normal results PSG.



# Enabling agents to retrieve openEHR-based health data through implementing HL7 communication with departmental information systems

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*Paulo Ferreira*

## Resumo

Proporcionar a todos os profissionais de saúde o acesso aos dados de saúde dos pacientes de forma completa, transparente e em tempo real é um grande desafio para as organizações de saúde. Portanto, a entrega eficiente e integrada de registos de saúde electrónicos, a fim de melhorar a qualidade do processo de comunicação entre profissionais de saúde é um grande compromisso.

A integração de sistemas de informação de saúde com o propósito de melhorar a comunicação de dados, a pesquisa e gestão desses dados é um grande esforço. A razão para a enorme dificuldade na resolução destes problemas de interoperabilidade entre diferentes instituições de saúde, nomeadamente em Portugal, pode estar relacionada com a mesma dificuldade encontrada dentro de cada instituição ao nível departamental. Atingir uma ampla interoperabilidade dentro de cada instituição de saúde em Portugal é um problema relevante.

Há um crescente interesse e implementação de normas de saúde. O HL7 tem uma aceitação global e é atualmente e amplamente utilizado. O foco na interoperabilidade aumenta a capacidade do openEHR para responder e se adaptar à evolução tecnológica.

Este trabalho tem como objetivo definir uma arquitetura que permita que os agentes pesquisem e extraiam dados de saúde a partir de um sistema de informação em saúde baseados em HL7 presentes numa instituição de saúde externa, contribuindo para a melhoria na disponibilização de dados de saúde no local de prestação de cuidados de saúde.

É descrita uma forma de integrar pesquisas de dados baseadas em openEHR a partir de mensagens HL7 para consultar um repositório local de informações dos pacientes numa instituição de saúde externa, permitindo um sistema multiagente desenhado para a obtenção de dados multi-institucionais procurando e extraindo dados essenciais no processo de prestação de cuidados de saúde.

Com as normas de saúde e tecnologias livres foi desenvolvido um modelo de modo a melhorar a descoberta e extração de dados de saúde do paciente. Este

modelo harmoniza a fonte de dados de saúde (HL7), a qual é modelada através de modelos metabólicos com a mesma estrutura de um modelo de arquétipo, concebendo composições openEHR. Consequentemente, a construção de um repositório openEHR com as várias composições permite aos agentes a utilização de Archetype Query Language para pesquisa e extração de dados clínicos baseados em arquétipos.

# Conception of a system for monitoring and management of patients with infection HIV/AIDS - SaveCare

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*Carla Esteves*

## Abstract

**Keywords:** Human Immunodeficiency Virus, Acquired Immune Deficiency Syndrome, HIV, AIDS, health information system, electronic health records, computerized system, patients.

**Introduction:** Portugal in the European Union occupies one of the top places in the incidence and prevalence of HIV infection. From 1983 until December 31, 2009, HIV has infected a total of 35 thousand Portuguese, killing 25 million people worldwide.

Proper monitoring of care provided under the HIV/AIDS, as it is a disease so complex, is essential for the survival and quality of life of patients. Following this, it is fundamental the implementation of electronic registration systems that, among other purposes, allow reducing the time required for the provision of patient information, reducing the risk of errors arising from lack of essential information to the professional during clinical decision, increasing the quality of life of patients.

**Objective:** The main objective of this thesis is to describe the conception of an information system designated SaveCare (System for AIDS Virtual Evaluation), to allow the management and monitoring of patients with infection HIV/AIDS. Additionally, this system should provide a structured database that enables the extraction of data in form of reports, charts, or the discovery of new knowledge through indicators.

**Methods:** It was performed a systematic review of information systems for HIV/AIDS described in the scientific literature. Alongside this work, we studied the SI.VIDA and SDIEST systems and, we performed an analysis of requirements through complementary survey of user needs. Additionally we built the archetype "Diagnosis HIV/AIDS" obeying the model specifications which taking advantage of the existing openEHR archetype "Diagnosis", introduced in it the specifics of the disease itself.

**Results:** It was obtained as a result the prototype of SaveCare system and a registration form Diagnostics HIV/AIDS resulting from the implementation of the openEHR archetype "Diagnosing HIV/AIDS."

**Discussion:** The elaboration of the SaveCare system resulted from agglomerating of all tasks performed during this hard work and the acquired and intrinsic knowledge that allowed the final solution presented.

This tool by allowing, among other factors, the raising levels of quality and speed of services and reducing measurement errors arising from lack of information has set up a window of hope for improving the quality of life of patients.

**Conclusion:** The objectives outlined were achieved and exceeded, with the commitment that this subject deserves. Through the conception of the SaveCare system, however, the challenges facing the disease itself and the feeling that much remains to be done in this area, entails the system's constant adaptation and evolution so that it fulfills the purpose of efficient management of the disease.

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# Serviços de estimação da relevância de relatórios clínicos para otimização das interfaces gráficas e do armazenamento

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*Bruno Santos*

## Resumo

**Enquadramento:** A identificação da relevância dos dados clínicos pode permitir uma melhoria nos interfaces para o utilizador, bem como na gestão dos respetivos repositórios de dados. Um estudo piloto apurou que diferentes tipos de relatórios têm longevidades distintas, para além do facto de existirem diferenças significativas em relatórios criados em tipos de episódio hospitalar distintos. O estudo concluiu que o uso de dados passados do utente variou significativamente de acordo com a definição de cuidados de saúde e de conteúdo, o que contradiz a definição estática de "dados antigos" usada em outros estudos. Esta contradição foi a motivação necessária para o projeto de investigação OPTIM, que partiu à descoberta de um mecanismo capaz de modelar este comportamento da informação clínica.

**Objetivos:** Este trabalho de investigação propõe como objetivo a construção de um protótipo capaz de integrar um modelo matemático de previsão da relevância clínica e fornecer, através de uma camada de interoperabilidade, serviços que permitam a classificação de documentos clínicos. Propõe ainda a colocação deste protótipo em ambiente hospitalar real, com a finalidade de validar o funcionamento e avaliar a sua integração com outros sistemas.

**Arquitetura e implementação:** A solução desenhada passou pela construção de um protótipo dividido em duas grandes partes: OPTIM Core e OPTIM WebUI. O primeiro representa todas as camadas, desde a lógica de negócio, passando pela integração do servidor de estimação e terminando na disponibilização de serviços, através de uma camada de *webservices*. O segundo representa uma interface rica e intuitiva que opera com o primeiro, invocando os seus serviços.

**Avaliação:** Foram realizados testes e simulações do protótipo a integrar com um sistema de informação em ambiente similar ao hospital real. Os resultados foram animadores, no entanto relevaram falta de segurança como um dos seus pontos fracos. Desde o lançamento da primeira versão do protótipo até à última foi registada uma melhoria na performance em cerca de 93%. Tem a capacidade de

classificar 19 documentos em menos de 2 segundos, o que representaria cerca de 38K documentos por hora.

**Discussão:** A evolução registada ao longo das versões dos protótipos foi notável. Seria impensável que um médico tivesse que aguardar cerca de 30 segundos, como inicialmente, para ver uma listagem classificada de documentos do utente. Apesar de estar sobre capacitado, é importante ter em conta que os testes apenas evidenciaram a performance do OPTIM em funcionamento exclusivo com o sistema de armazenamento.

**Conclusão:** Fica clara a ideia que a integração de funcionalidades complexas, como o caso do cálculo da relevância clínica baseada em modelos matemáticos, é exequível mesmo em *softwares* tecnologicamente menos capacitados. O uso de normas potencia a interoperabilidade entre sistemas.



# An instructional game for biology classrooms

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*Teresa Futscher de Deus*

## Abstract

**Keywords:** computer graphic visualization, biology classrooms support, cell life, cell energy flow.

**Introduction:** Through digital video games, players learn to view the virtual world as images and/or sounds valuing and assimilating their experience understanding the concepts of each matter (1) (2). The work presented in this thesis is the development of a new biology game. The players need to have the basics knowledge of a living cell and the game context is the following: cell constitution, transport mechanisms, metabolic reactions, protein biosynthesis, growth and cell division. All the player tasks and objectives are conditioned by the energy flow in the life of the cell.

The artwork is very similar to the diagrams and schemes of biology manuals and the objectives of the game are complex, specific and concrete and distributed in five different mini-games. Developed in Adobe Flash®, it is a 2D game with more than 10 different original and interactive scenarios, created from basic elements adapted from Wikipedia (3) (free license).

Tests and questionnaires were performed to individual persons who gave their feedback which contributed to a final and stable version of the game. The content of the game was scientifically validated and approved by two biological researchers, two biology teachers and a medical doctor.

**Aim:** The purpose is to elaborate a project which embodies a new interactive educational game and knowledge of biology concepts to the 10th and 11th degrees. The game content follows the biology manuals (4) (5) given in classrooms.

**Method:** Design Science Research

1. Problem Identification and motivation: a game about biology;
2. Define the objectives: illustrate the cell constitution and its functions, its transport mechanisms, its metabolic reactions, its protein biosynthesis and its division;
3. Design and Development: 5 mini-games and 5 quizzes;

4. Demonstration: to youngsters who are studying biology, have biology knowledge or graduation;
5. Evaluation: based on field testing and appreciation of the testers feedback;
6. Communication: the game content was scientifically validated by biologists Helena Deus (6) and by Janet Iwasa (7).

**Results and Discussion:** There was no opportunity to test the developed game in a classroom context. The learning process has significant variations from one person to another and it would be important to test more and apply the game to different environments.

**Conclusion:** A distinctive game was built based on a careful investigation and focused on the learning content objectives. This biology game has emerged as a proof of concept that games can be used to support biology classrooms. The work developed in the context of this dissertation has achieved a level of complexity that biology teachers considered very complete, highly adequate and in line with the programme contents the students are supposed to learn.

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# PROJECTS

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# Support System in Gastroenterology

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*Celina Gomes*

## Abstract

**Keywords:** Decision Support System, Clinical; Gastroenterology; Data collection; User Computer Interfaces;

**Introduction:** New interactive technologies have the potential to aid clinicians in their daily routines. Besides improving their ability to assess a patient's health condition, they also allow them to perform their tasks in a simpler and faster way. Furthermore, these technologies may be used to improve the learning and training of specific procedures more effectively by medical students. However, to design this type of technology to be intuitive and incorporating it to existing clinical routines is a challenging task. The recent technological advances in digestive endoscopy allows it to play a more interventionist role in clinical situations that are difficult to resolve, often avoiding the use of intrusive procedures, and resulting in better patient care.

**Aim:** In this thesis we will study and model the various potential users of interactive gastroenterology systems using Human-Computer Interaction methodologies, paving the way for the design of such systems in this clinical environment. The focus users include patients undergoing elective exams, clinicians and nurses.

**Methods:** User studies and technology analysis: This task will focus on the clinicians profile characterization, identifying his needs, difficulties, routines and associated environments. This will be accomplished by a contextual study methodology, meaning that a combination of observational sessions and interviews will be performed to create not only a user profile, but also to produce an action model of his daily routine.

Computer assisted decision system: For the creation of a Computer Assisted Decision (CAD) it is essential that we define two fundamental things: the technology and the user interaction model.

Without the results of Task 1, it is too early to predict how the user interaction model will differ for different scenarios

- Research adequate conceptual models and system images for different scenarios.
- Deploy the system and perform its usability evaluation.

**Preliminary Results:** Contextual studies are currently being developed in two different hospitals, with results showing that although clinicians' techniques are very similar, there are important differences in the functionalities of the equipment and its environment.

The main contribution of this thesis is to design an interactive computer decision support system for gastroenterology. In order to fulfil the proposed objective, user studies will result in a report detailing a full description and analysis of Gastroenterology exam room environment, user needs and restrictions, and theoretical viability of deploying specific hardware devices in these environments. Methodologies will include ethnography-based research and contextual inquiries.

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# Pharmacy medication stock optimization – Theory of Constraints

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*Luís Lima*

## Abstract

**Keywords:** Pharmacy, Medication Stock, Supply Chain, Theory of Constrains

**Introduction:** The pharmacy sector is under pressure in Portugal. Due to the financial crisis, the Portuguese government is reducing public expenses on medications [1], so the pharmacies and distribution companies have been forced to reduce their profit margin. Other measure implemented by the government was the removal of all entry barriers for generic medications [2].

Nowadays, 20% of the pharmacies have no funds to replenish their stock. Besides, pharmacies have been exporting medications to other countries due to better prices. The result is more conflict between the pharmacies sector and government, and shortage of medications available [3,4].

**Objectives:** The aim is simulate and analyse the possible financial and operational effects of implementing the Theory of Constraints (TOC) managerial philosophy, most specifically the replenishment solution, into the medication supply chain and compare with current practices.

**Methods:** The Theory of Constraints (TOC) replenishment adopt a policy where the replenishment lead time (RLT) is based on sales [5]. This change implies daily delivers or more, to restore the stock according to the sales in the previous period. Collect and analyze sales data from pharmacies. Based on these data, will be simulated a daily scenario replenishment using TOC. To monitor the stock buffer size will be used TOC dynamic buffer management (DBF) tool [6,7]. The actual and simulation scenarios will be compared based on some accountability data. Based on this scenarios will be developed a program to implement this Supply Chain Theory based on TOC.

**Expected Results:** Reducing the RLT will allow the achievement of expected results, which are (1) the reduction of the amount of stock to cover demand during the lead time; (2) reduction of the amount of stock to cover uncertainty due to the shorter lead time; (3) a more accurate forecast, once the time to demand predict is shorter; (4) increased responsiveness to actual demand; and

(5) improvement of the financial measures for the whole system. These achievements can change the actual scenario, considerably improving pharmacies throughput, stock turnover, Return of Investment (ROI) and decreasing medications delivery ruptures and investment.

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# (in)Security in Electronic Prescribing

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*Hugo Rodrigues*

## Abstract

**Keywords:** Medical Informatics; electronic prescribing; computer security; confidentiality; privacy

**Introduction:** Previously, medical prescriptions were handwritten, often difficult to read and potentially susceptible to several levels of fraud. The evolution of medical knowledge, preventive medicine and pharmaceutical industry, exponentially increased the number of prescriptions and its certification became a very hard and expensive task. The Electronic Prescribing System (EPS), as a National Health Service (NHS) resource, proved to be a valuable asset by motivating the medical adhesion and increasing the prescription management and control. Since 2011, it's mandatory to prescribe through an electronic system. The NHS institutions may use the Internal Health Network (IHN) to transmit the prescription data. Because private institutions are not allowed to connect with IHN, the Health Ministry negotiated with the service companies to provide prescription software/interfaces and act as gateways to transmit the prescription data from the private practitioners to the Health Ministry. The use of those companies in this circuit weakens the security level of EPS and compromises the confidentiality and privacy of doctors and patients' personal data.

**Aim:** The aim is to describe an EPS model that protects the prescription data, certifies its intervenient and, at the same time, keeps confidential their identity.

To achieve the main objective, the actual Portuguese prescription system will be described in order to identify its security flaws that may compromise the personal data of the involved people. There will be also a comparison of the prescription systems in some European countries and how they deal with the security problems.

**Methods:** The description of the actual prescription system was based on information provided by medical practitioners, legislation and normatives published by the Health Ministry. Other tools as questionnaires were also used in order to obtain the medical opinion about the security of the actual prescribing systems and to portray the other countries prescribing systems. The proposed system was based in the actual security protocols and methods available and possible to be implanted.

**Expected Results:** Excessive personal information demanded from the medical professionals by the services companies, shared personal codes, non-authorized prescribing, easily replicable prescriptions, non-real-time validation, potential use of patients' information by software companies and lack of confidentiality during the dispensation at the pharmacies are some of the problems expected to be solved with the proposed model.

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Plataforma Medquest (FMUP):

<http://newdbserver.med.up.pt/projext/medquest/verprod>

# Comparative Study of Electronic Stethoscopes

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*Márcia Pinto*

## Abstract

**Introduction:** Used by an experienced physician, a stethoscope provides important clinical information that may help on a first evaluation of a patient healthcare status, giving insights of more specific MCD requests. The stethoscope importance on Cardiology and Pulmonology, is one of the main reasons for its critical role on nowadays medicine. However, auscultation is a task hard to perform. Cardiac sounds are low frequency sounds and their pace is between milliseconds time, which demand many practice until the human ear is able to distinguish the differences between a normal and a pathologic heart sound.

**Aim:** The aim of this thesis is to collect cardiac sound with electronic stethoscope building a noted database on pathologic and non pathologic heart sounds. It is also included on our purpose to compare the sound quality of different chosen pathologies among the six electronic stethoscopes available in the market.

**Methods:** For this study to take place, the researcher's intervention will be needed as well as the collaborating doctors and the pediatric and adult cardiology services where patients will be recommitted. The research will be possible using the six different models of electronic stethoscopes acquired by the faculty of Medicine of the University of Porto.

Sounds will be collected three diseases in children and adults in two pathologies. Ideally thirty patients will be required for each pathology, further thirty normal study will have two different phases with different results, but with a goal.

Stage 1: Creating an annotated database of heart sounds collected with electronic stethoscopes.

The first stage of the research methods used by well-defined team that will always be present. Each patient will be auscultated with 6 different electronic stethoscopes, will always listen 5 points each for 15 seconds. The physician should determine and mark the exact location of each point of sounding using their acoustic stethoscope. Data will be collected for general patient use later in the second phase. This phase will take approximately 15 minutes per patient.

Stage 2: Evaluation of the sounds of electronic stethoscopes through a blind test.

**Preliminary Results:** There are few comparative studies of electronic stethoscopes, once that medical devices are still little used and don't exist many documentation

published relating to their qualities yet. This thesis main contribution is the conception of a cardiac sounds noted database using six electronic stethoscopes and to start a comparative study from the achieved results.

# Developing an openEHR Data Repository

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*Egídio Samuel Frade*

## Abstract

**Introduction:** OpenEHR is an open standard specification in health informatics that describes the management and storage, retrieval and exchange of health data in electronic health records. A database is a collection of related data, which are organized so that useful information may be extracted. In this work, we present the study and performance comparison of the various databases available, with different frameworks (object, relational and XML), all storing the same openEHR information in their data types.

**Objectives:** The aim of this work is to find the most suitable database to store, manage and retrieve EHR data. To achieve this overall goal it is required the accomplishment of the following objectives: (1) study the different database systems available and choose the ones more reliable within different framework types, (2) define the data models for the different frameworks, (3) devise effective comparison methods of evaluating databases performance, (4) develop a basic set of services to allow the management and querying of the information.

**Methods:** The study will consist in setting up several databases using different data frameworks (object, relational, xml), store the same openEHR standardized information in them. This information will consist of electronic health records of several patients. And measure the performance in normal use conditions. The software used to retrieve and store the data will be the same, through the development of several web-services necessary according to the framework.

**Expected results:** This work is intended to study and compare data retrieval and store performance between different databases technologies, in order to develop an optimal EHR repository. The database and architectural approach determined will be recommended together with the use of openEHR standard, in order to obtain a patient centric, flexible health information repository.

**Keywords:** openEHR; EHR, Database; Health Informatics; Database, Performance

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# EVENT PROGRAM

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## FRIDAY, November 9<sup>th</sup>

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### 14h00 - 14h30 Opening of the Symposium

### 14h30 - 15h30 MSc Thesis

14h30 Otimização de um sistema de recolha de dados clínicos, baseado em agentes

*José Hilário Almeida*

15h00 Development and assessment of an eLearning course on senology for radiographers: a stratified randomised controlled trial

*Inês Moreira*

### 15h30 - 18h10 Projects

15h30 Projects Presentation

*(Professors of the MSc in Medical Informatics)*

### 16h00 - 16h30 Coffee Break

16h30 Support System in Gastroenterology

*Celina Gomes*

16h50 Pharmacy medication stock optimization – Theory of Constraints

*Luis Lima*

17h10 (in)Security in Electronic Prescribing

*Hugo Rodrigues*

17h30 Comparative Study of Electronic Stethoscopes

*Márcia Pinto*

17h50 Developing an openEHR Data Repository

*Samuel Frade*

## SATURDAY, November 10<sup>th</sup>

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### 09h30 - 12h30 MSc Thesis

09h30 Refining pre-polysomnography suspicion of Obstructive Sleep Apnea Syndrome: Logistic and Bayesian analysis of clinical factors

*Liliana Leite*

10h00 Enabling agents to retrieve openEHR-based health data through implementing HL7 communication with departmental information systems

*Paulo Ferreira*

### 10h30 - 11h00 Coffee Break

11h00 Conception of a system for monitoring and management of patients with infection HIV/AIDS - SaveCare

*Carla Esteves*

11h30 Serviços de estimação da relevância de relatórios clínicos para otimização das interfaces gráficas e do armazenamento

*Bruno dos Santos*

12h00 An instructional game for biology classrooms

*Teresa de Deus*

### 12h30 Closing of the Symposium



