Improving the Decision-Making Process in a Hospital Environment With New Interactive Visualization Methods

Cristiana Neto, University of Minho, Algoritmi Research Center, Braga, Portugal
Diana Ferreira, University of Minho, Algoritmi Research Center, Braga, Portugal

ABSTRACT
A large number of medical errors occurring in hospitals happen in the diagnostic process, such as the use of outmoded tests and the failure to perform on test results, leading to delays in the diagnosis. Thus, fast and efficient access to the patients’ exams and test results is essential to provide them adequate treatment. This need demands solving problems that exist during this process of consulting the results in order to reduce clinical risk. Therefore, an analysis of the problems in the visualization process of the exams in Centro Hospitalar do Porto was carried out, leading to the development of a new platform - AIDA-MCDT, whose main objective was to fill the gaps verified, making the access to exams’ results more efficient and intuitive. This platform has significantly improved the system’s usability, including several features designed to help healthcare professionals make decisions more quickly and securely.

KEYWORDS
Centro Hospitalar do Porto, Clinical Risk, Electronic Health Records, Health Information System, Healthcare, Information Technology, Medical Errors, Medical Exams, ReactJS

INTRODUCTION
One of the main contributions to the improvement of the quality and the effectiveness of healthcare delivery over the years was undoubtedly the integration and progression of Information Technologies (ITs) in health services (Jardim, 2013). The implementation of Information Systems (ISs) became increasingly critical to clinical care and hospital operation since the mid-1960s. Initially, these systems were used for the automation of the financial and accounting functions. Later, some Hospital Information Systems (HISs) included patient diagnoses and other patient information (Pai & Huang, 2011).

Thus, a HIS can be described as a system designed to assist in the management of a large amount of clinical and administrative information of a health institution, automating, collecting and analyzing it, and, consequently, helping to support the decision making. It is crucial for all hospital institutions to have good HIS in operation, because it is essential to manage the number of resources that a hospital has in the best way possible, so hospitals can not only offer the best possible service to the
patient, but also have financial profitability (Haux, Ammenwerth, Winter, & Brigl, 2004; Bertolini, Bevilacqua, Ciaparica, & Giacchetta, 2011).

The implementation of the Electronic Health Records (EHR) system marks a new cycle of investments in HIS. EHR is a computerized health system where professionals record patients’ clinical information. It is important to note that EHR goes far beyond the computerization of paper records. These systems help to provide health care, assist the clinical decision-making, evaluate the quality of care provided, assist in research and medical education and bring together all the information about the health care provided to a patient. An EHR may also contain data related to physical examination, hospitalization progress, diagnoses, surgical interventions, introduced and visualized in a structured manner, as well as results of complementary diagnostic tests, as imaging (X-ray, ultrasound). In addition, EHR is being integrated into new and more advanced mechanisms of decision support systems (Carter, 2008; Neto, Dias, Santos, & Peixoto, 2019; Salazar et al., 2013).

These systems integrated/implemented in hospitals are normally distributed and present a high degree of heterogeneity, arising the need to share and exchange information in heterogeneous environments. In this context, interoperability plays a fundamental role, as it allows transparent communication between heterogeneous, autonomous and distributed systems and environments, ensuring the understanding of the process and the exchange of data on both sides (Oliveira, Duarte, Abelha, & Machado, 2018). In this sense, the Agency for Integration, Diffusion and Archive (AIDA) was created and implemented in some Portuguese hospitals. AIDA is a platform developed to ensure the interoperability between HIS and beyond, it also ensures the confidentiality, integrity and availability of data, allowing the dissemination and integration of information generated in a healthcare environment, including information on Complementary Means of Diagnosis and Therapeutic (MCDT) (that includes medical exams and tests results) presented by the AIDA-VIEW platform (Duarte et al., 2010; Duarte, Portela, Abelha, Machado, & Santos, 2011).

There are several studies that point out some practices that could improve the display of test results for health professionals, such as highlighting the exams that still have to be visualized and the existence of groupers so that related exams could be seen together. These practices emerge to overcome the problems occurred in the access to diagnostic tests addressed in previous researches, leading to failure when reviewing and acting on the test results accurately and properly. An accurate reporting of results is always important to ensure that the right decision is made, regardless the various reasons for the exams’ requests (Poon et al., 2004; Singh, Naik, Rao, & Petersen, 2008).

In this sense, with the main objective of addressing the issue of patients’ safety and quality of care, the project described in this paper emerged to help health professionals analyze and act on test results in a safe, reliable, and efficient way. The next section of this paper presents a background contextualization, followed by a related work section. After this, the development section is presented, where the phases of this project are explained. The last two sections present, respectively, the discussion of results, and the conclusions and future work.

RELATED WORK

An Information System (IS) can be considered a system, automated or manual, that incorporates people, machines, and/or organized methods to collect, process, transmit and disseminate data that represents information to the user (Platt, 2006). Having this definition in mind, a HIS can be easily defined as a subsystem of a hospital with a socio-technological development, which covers all hospital information processing (Duarte et al., 2010; Kuhn & Giuse, 2001). Its main purpose is to contribute to the quality and efficiency of healthcare. This objective is primarily oriented to the patient after being directed to health professionals as well as the functions of management and administration (Duarte et al., 2010; Duarte et al., 2011).

The projection and implementation of a HIS should focus on ensuring the efficient production of information in order to provide clinical decision-making resources. Thus, this implementation requires
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