TOWARDS AN IMPROVEMENT OF PATIENT SAFETY: A FRAMEWORK FOR CLINICAL DECISION SUPPORT SYSTEMS

Mario Macedo PhD[1], Carol Jabari MPH, RN[2], Mohammad Moreb MSc[2]

[1] University Atlantico, Barcarena, Portugal
[2] Hebron University, Palestinian Territory

Abstract

Patient safety is a very important issue. The patient's expectations are a correct diagnosis and an efficient and effective treatment plan, while healthcare providers are balancing costs with the quality of the services. The payers are interested to getting the maximum return for their investments and operational costs. All these issues point to the fact that healthcare providers should follow best practices and resources allocation of resources must be planned according to the predicted needs. Clinical Decision Support Systems (CDSS) can recommend practices according to accepted guidelines that have been previously defined, validated and approved and these systems should be the "compass" for health professionals. The guidelines should be uploaded to the health facility computer systems and written in languages that can be shareable and processed by different software applications. This paper presents a case study that includes a review of the main features of a syntax to describe clinical guidelines and a framework of concepts, methodologies and technologies to improve the clinical decision support systems (CDSS).

Keywords: clinical decision support systems; guidelines; ontologies; Portugal; Palestine

Introduction

Approved, accredited clinical guidelines are very important and useful. Their use by healthcare providers and health managers is an important issue for quality, efficiency and effectiveness of healthcare services. Clinical Decision Support Systems (CDSS) have architectures that are composed of clinical guidelines and inference models which can facilitate accuracy and efficiency. The inference models can identify patterns and predict events, status, values of clinical data or recommended actions. The quality of the data entered in health records, accessibility of the records, interoperability among information systems, and appropriate human interfaces are essential to their application. Damiani et al concluded, in a systematic review of the literature, that that the usage of computerised clinical guidelines had positive results.[1]

According to the National Guideline Clearinghouse of Agency Healthcare and Quality an American Federal agency charged with improving the safety and quality of America's health care system, there are 52,484 guidelines for pharmacists, nurses, physicians, and other health professionals and healthcare organisations. According to the "Clearinghouse", the use of clinical guidelines has reduced hospital acquired conditions (HACs) in the USA by 17% (2010-2013). (Figure 1)
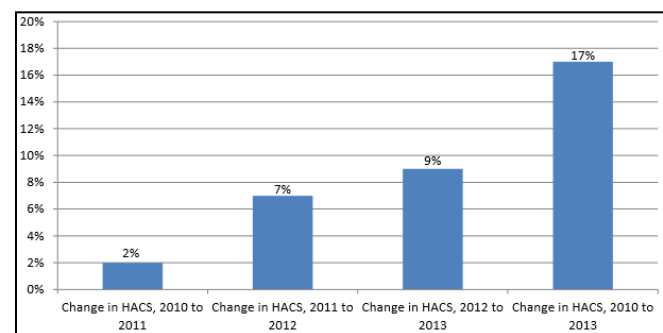

Figure 1. Total Annual and Cumulative HAC Reductions (Compared to 2010 Baseline), Source: Agency for Healthcare Research and Quality (2013).[2]

The reduction of HACs has a direct impact on the reduction of deaths. (Figure 2) Some of these HACs are hospital acquired infections.

In 2014, 4,500 people died in Portugal as a result of a hospital acquired infection and the economic impact was €300 million.[3] The Portuguese numbers are very similar to the other European countries.

In a recent online survey we conducted in January 2017 of health professionals in Palestine, N=27 and in
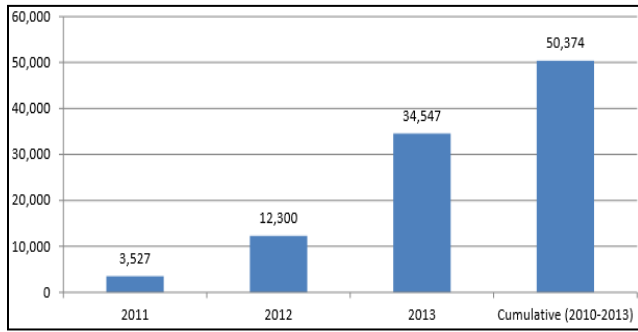
Figure 2. Total Annual and Cumulative Deaths Averted (Source: Agency for Healthcare Research and Quality (2013)).

Portugal, N=12 found that physicians, nurses, nutritionists, etc are not familiar with computerised guidelines in the workplace, but more than 60% felt that they would decrease clinical risk while 70% mentioned CDSS would improve operational management. They reported that having approved and accredited guidelines on workplace computers would be useful, 63%. The professionals thought a CDSS would improve the quality of the services, 63%, while 67% stated that better records would be help them develop more knowledge and promote precision.

Despite the positive responses, 50% of our colleagues report not having ready access to guidelines, while 46% report a lack of technology, improper computer interface 38% a lack of education and training of health professionals to use computer systems. Over 40% of respondents report a lack of financial resources in their organisation.

Proposed Framework to implement computerised guidelines
Various models and frameworks are used worldwide. We propose using a framework which uses an object constraints language called Gello to describe medical data.[4] This language has an XML syntax and is suitable to store any kind of Medical Objects and clinical knowledge repositories. The data types of Gello are compatible with the ISO 21090 standard which defines the different data types to represent numeric, date and literal values.

Another important feature of Gello is the possibility of representing sets of values that are retrieved from database repositories. The following

```
Context observations: Observations
Let potassium: Observations = observations->select (code.name = "Potassium")
    potassium.value
```

The assignment of the potassium variable is done with the result of a selection of all observations which code name is potassium. The last sentence will print all sets of potassium values searched in the previous instruction.

In addition with Gello, there is Glif (Guideline Interchange format). It is possible to describe clinical guidelines using GLIF to define the workflows with activities and fork conditions as well as including the archetypes of Gello to enter the clinical data.

The following figure presents an example of a Glif guideline. The Glif language is itself an XML like syntax that models the clinical process. (Figure 3)

A prototype of the Medical-Objects GELLO was developed to the VA (Veterans Association) in USA to interface with their system named VISTA. The whole system is a Clinical Decision Support System and it uses a REST API to connect with a GELLO repository.

The platform also uses the ISO 21090 standard to normalise the datatypes,[5] and a terminology service module, to interface with a SNOMED and LOINC taxonomy repositories, GELLO (2016).[6]

The proposal of this framework is the adoption of ISO 12967-Service Architecture[7] in conjunction with ISO 13606- Electronic health record communication[8] and ISO/IEC 10746 - Open Distributed Processing[9] to develop a model capable to integrate normalised with different Hospital Information Systems.

Regarding GLIF, concepts of Service Level Agreement developed for Business Process Management by the Object Management Group[9] as well as events alert should be included to leverage the possibility of guidelines which are oriented and compliant with models based on asynchronous actions.

A CDSS should also have an inference engine to identify patterns and predict deviations from the guidelines. The knowledge of the inference models can be stored and shared among different systems. The inclusion in this framework of Predictive Markup Model Language (PMML) from the Data Mining Group is very relevant.[11] With PMML it will be possible to train models formed by neural networks, support vector machines, association rules and Bayesian trees and to deploy the knowledge.

Discussion

We have shown that computerised approved and accredited health guidelines are useful. It has been
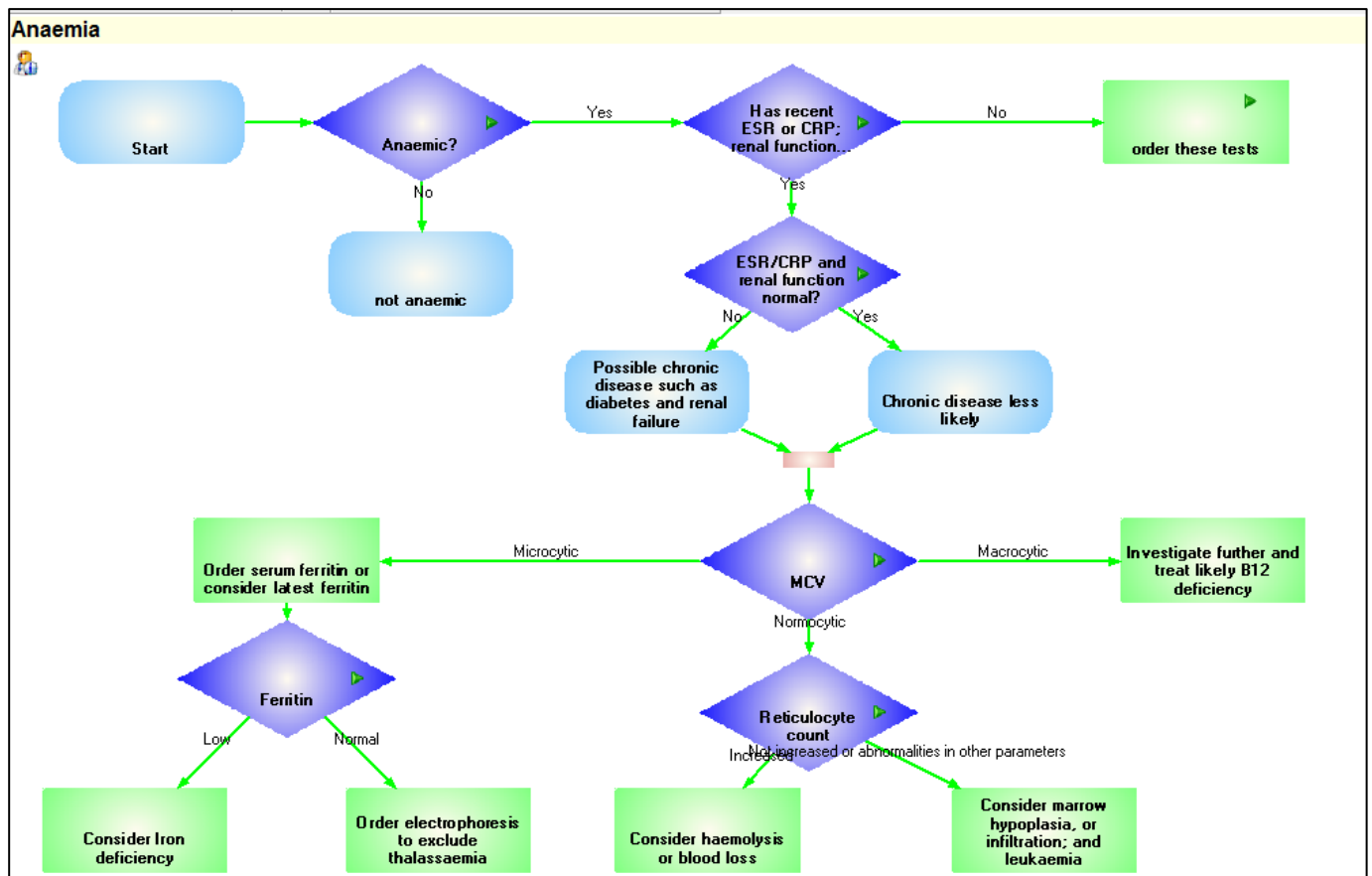
Figure 3. Anaemia Guideline, Source: Medical Objects Knowledgebase Sample.[12]

demonstrated that when they are posted and used there are positive effects in health outcomes and savings for providers.

The adoption of international norms and standards published by standardisation organisations like ISO, CEN, IEEE, W3C, OASIS and others are very important issues to share guidelines and improve CDSS.

Regardless which framework is implemented it is important to promote to policy makers and management the approval and accreditation of health care guidelines and their becoming part of CDSS. Patients, their families and health care providers should expect and deserve no less.

Some of the technologies and norms are developed but other new features and specifications must be included make possible the implementation of fully interoperable CDSS.

Corresponding author:
Mario Macedo
University Atlantico
Barcarena
Portugal
eMail: *mariojcmacedo@gmail.com*

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