International Journal of Integrated Care

Baladini, J et al 2019 A tool for improving the delivery of integrated intensive health care performance. *International Journal of Integrated Care*, 19(S1): A222, pp. 1-8, DOI: dx.doi.org/10.5334/ijic.s3222

CONFERENCE ABSTRACT

A tool for improving the delivery of integrated intensive health care performance

19th International Conference on Integrated Care, San Sebastian, 01-03 April 2019

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Introduction: In intensive and intermediate care units, patient data consists of lower frequency asynchronous clinical data and higher frequency synchronous physiological data streams generated by medical equipment. Traditionally, nurses manually fill out forms, recording clinical data, and physiological data observed in each equipment at hourly intervals. At the end of the day, the physicians exhaustively analyse the data of the forms and give nurses the treatment indications. This methodology can produce delayed and inaccurate diagnosis, and is prone to human errors due to the large volume of data to analyse.

We propose a cost-effective system for automatic and real-time analysis of patients data that increase the quality of care and quantity of treated patients. The system improves the horizontal integration between nurses and physicians, and gives medical staff the ability to plan and begin treatments sooner or potentially stop the progression of a condition. The treatement costs are reduced and the number of patients are increased by reducing the length of stay. Furthermore, the system can be made more intelligent by extracting new medical knowledge from historical patients data. Significant technical challenges are related to data extraction from medical equipment, and the development of the real-time big data analysis infrastructure.

Methods: Our system is based on clinical rules. Each rule defines the conditions, relating parameters and values, which must be met to generate an alert indicating posible risk (current or future) in the patient's health. Each patient can be associated with a particular set of rules, created from knowledge of experts or clinical guidelines.

Our system acquire data from medical equipment and the electronic health record system. The clinical rules associated to each patient are continuously evaluated, and an alert is issue when a rule match. Historical patient data from multiple hospitals are used to create new clinical rules.

Results: We have implemented a prototype at Hospital Francisco Lopez Lima. It includes: 1) a validated embedded device that extracts the electrocardiogram signal from an analog output

of a medical monitor, 2) a real-time big data infrastructure capable of processing a complete set of clinical rules of different types in time and form, using Apache Kafka, Flink and Cassandra.

Discussions: Unlike other approaches, our findings suggest that it is possible to develop the system using mature Free Software products. They offer a high level of security for sensitive data and at a lower cost. Furthermore, when possible, interfacing with analog outputs of medical equipment produces portable and cost-effective solutions, avoiding the use of expensive additional devices provided by manufacturers.

Conclusions: A system for real-time analysis of high frequency physiological data is possible with the current technology. This tool can improve the delivery of integrated intensive health care performance. Our system tries to be a low cost solution to be adopted by a greater number of hospitals, benefiting more people. We find that the techniques and technologies used grant solid foundations for the construction of a reliable, secure and cost-effective system, able to scale and support an increasing number of patients and captured data.

This research has been supported under contract TIN2017-84875-P, (AEI/FEDER,UE).

Keywords: clinical decision support system; intensive care unit; medical rules processing; big data; embedded system

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