An Intelligent Platform for Personalized Remote Monitoring of the CIED Patients

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Abstract and Objective

Over the last decade, we have witnessed exponential growth in the number of Cardiovascular Implantable Electronic Devices (CIEDs) and their electronic and software complexity widening their function and application. However, due to limited processing capabilities restricted by size and power considerations, CIEDs need to be supported by standalone software running on data centers for remote monitoring. The objective of this work is to introduce the high level architecture of iCARDEA, an intelligent platform to semi-automate the follow-up of CIED patients through context-aware adaptable computer interpretable guideline models. CIED data and legacy Electronic Health Record (EHR) data are exposed through standard interfaces so that information about a patient's medical history can be used in the clinical follow-up workflow. An adaptive care planner employing clinical guidelines automates risk assessment generating alarms as appropriate. CIED patients are empowered with integrated Personal Health Records (PHRs) that enable informed and responsible participation in their health care and education. In this way, they may feel more secure and in control of their life.

Keywords:

Remote monitoring, Interoperability, EHR, PHR, CIED

Introduction

Since their introduction in the late 50's for the treatment, diagnosis and monitoring of bradycardia, tachycardia, and heart failure, CIEDs have gradually become more widespread and complex. It is estimated that ~2million people worldwide have a cardiac implant, which translates to 5.8 million follow-up visits per year [1], a significant burden to the health system and frequently an unnecessary inconvenience to patients.

Recently, most CIED vendors have introduced new implants which support remote, day-to-day wireless automatic monitoring of CIED implants. Remote sensors are located in patient's homes transfer stored data from the implant (i.e. cardiac status and device function data) to a remote monitoring service center operated by the device manufacturer in collaboration with mobile phone and internet service provider. Healthcare professionals may access patient data or receive alerts in case of unusual persisting data variations in e-mail, fax or short-message service (SMS) format. In other words, data coming from the CIEDs are collected, analyzed and stored at the data centres operated by the vendors, and only in case of emergencies, alerts are sent to responsible parties. The iCARDEA architecture aims to addresses the problem that remotely captured CIED data is not integrated with personalized healthcare processes, EHRs, or with PHRs. Thus, it is not possible to ripe the benefits of collaborative and participatory care.

Methods

The iCARDEA architecture leverages standards to integrate CIED data and patient reports as machine processable data input to personalized health pathways. Currently, clinicians accessing follow-up information transmitted via CIEDs, need to use multiple vendor-specific systems and interfaces, combined with manual and paper processes: a complicated time-consuming situation compromising efficiency and quality of healthcare workflows.

The proposed architecture automates the follow-up of the CIED patients with adaptable computer interpretable clinical guideline models which access data seamlessly in legacy EHR systems via HL7 CDA, CIED data via HL7, ISO/IEEE1173, IHE IDCO and PHRs via IHE xPHR profile. Adaptable computer interpretable guideline models will be designed from reusable building blocks to easily personalize the patient and device follow-up. Then, these guideline models are converted to executable clinical workflows, which perform the follow-up activities and automate risk assessment via integrative models. Special consideration is given to security and privacy standards, since trust is the key to participatory care.

Results

Today's standards can support the design of an intelligent interoperable platform to support integrated care. Deployment and clinical validation of this architecture is planned for 2011.

Conclusion

Making remote monitoring of CIEDs an integral part of collaborative patient care, requires interoperable systems, but can

save physicians time, while contributing to higher patient comfort, safety, and quality of life.

References

[1] Wilkoff, BL et al. HRS/EHRA Expert Consensus on the Monitoring of Cardiovascular Implantable Electronic Devices (CIED), Europace 2008 10(6):707-725