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Towards Digital and Personalized Healthcare and Well-Being Solutions for the Workplace

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Abstract. Promoting wellbeing at workplaces has the potential to significantly improve the health of workers and to benefit the enterprises and organizations. This multi-factor feat has become a priority in many countries policies, concerning the challenge of active ageing population. Digital transformation enables us to incorporate new technologies in the measurement and analysis of agents in occupational health and the design of schemas to improve employee's wellbeing. Among the different digital solutions that can be implemented to foster a healthy and productive workforce, wearable and environmental sensors together with mobile apps have high levels of acceptance among workers/employees. In this project we have studied how the digital health solution provided by Pocket mHealth conceived and developed by ATOS, can be used to enhance wellbeing and health status in working environments. Pocket mHealth enables patient empowerment in the management of its own medical information, bringing their Electronic Health Record (EHR) and health data coming from different Hospital Information Systems (HIS) to the smartphones. Pocket mHealth solves the need of current healthcare organizations about the adoption of healthcare data openness, following a patient centered design and taking advantage of the potential benefits of this paradigm. Instead of having standardized repositories at the hospital facilities, the patient becomes the driver of the change by means of distributed interoperability.

Keywords. p-Health, m-Health, Digital Ergonomics, Intelligent Workplace

1. Introduction

There is a growing recognition of the need to consider the importance of workplace well-being, which implies a complex blend of people's physical and psychological aspects during their working live, determined both by their tasks and by workplace interventions. The idea goes beyond the concept of wellness or healthy living, considering that making work sustainable over the life course could be a viable solution to face the challenge of ageing populations, as the workers would retain health, engagement, motivation and productivity more time.

The advancement of technologies brings the opportunity to transform current workplaces into digital workplaces, offering services with seamless and secure

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technologies that promise to change user experience and boost the collaboration and productivity[2]. Going further, integrating mobile data acquisition, sensors and wearables with cloud based people-centric services and collaborative and connected digital solutions we can also enhance individual health and increase efficiency and happiness of workforce.

Creating digital workplaces able to enhance healthcare, safety and well-being at workplace [1], and therefore employees performance, entails deployment a holistic approach, starting from analyzing the environmental and work tools [2]. Staff diversity regarding capabilities and needs have to be considered in the implementation of this kind of programs too. There is not a solo solution to fit every person at work [3,4].

We@Work initiative [5] is an example about how to tackle this situation, as it is shown in Figure 1. The project aims to develop a digital tool for workers and employees to ensure well-being, healthy and safe working life. It combines wearable sensors, big data analytics and ergonomics and a compliant cloud-based platform, based on Atos Codex technology[3]. The final outcome is a platform that allows real-time data collection at workplaces that is fed with sensors and questionnaires. Analytics turn gathered data into useful information to prevent work injuries, accidents and in general support healthy working life [6,7].

We@Work leverages the high penetration of mobile technologies in workplaces, which allows employees to be available, work on the go, collaborate easier and have a ubiquitous control on their tasks, agenda and contacts, etc. These possibilities have their appliance in healthcare and well-being services provision too. Time and space barriers limited the classic style of healthcare, where a patient always had to visit a doctor in hospital or clinic. Information and communication technologies (ICT) are a powerful tool to break these barriers [8]. Health data-driven solutions are transforming the way in which healthcare is delivered and also the way in which we work, make sport, and in general, take care of ourselves.

Figure 1. We@Work approach.

[2] https://atos.net/en/solutions/atos-digital-workplace

[3] https://atos.net/en/solutions/atos-codex-insight-driven-outcomes

In the context of We@Work, the gathered data conduct to a definition of the core value of the well-being program, so to enhance individual health, happiness and to build enduringly healthy work.

Physical and psychological health is a basic input for wellbeing, so it is remarkable to consider that expectations around the kind and quality of healthcare services are changing. Users are looking for more personalized services, self-management of their health status and a continue and seamless experience anytime, anywhere [9].

Mobile applications and wearable can boost the necessary change in this direction, giving citizens tools to monitor and manage their health data (as final owners of this information) [10]. Furthermore, the lifestyle, behavioral and health data collected from mobile devices can be used to produce a data model for the individual from several scopes. However, setbacks related to the interoperability with Health Information System (HIS) difficult citizens and healthcare providers to take advantage of this kind of tools [11,12].

The next section presents Pocket mHealth, an application conceived to bring the Electronic Health Record (EHR) to mobile. It consists in the mobile application for smartphones and a set of software tools installed at healthcare systems with access to the HIS using specific designed connectors. Pocket mHealth offers the portability and accessibility that are representative features of its mobile orientation and takes part of the We@Work system thanks to its scalable design, allowing customization and implementation according specific needs. To develop this solution, healthcare standards (e.g. HL7 FHIR) and well-known clinical terminologies (e.g. SNOMED) have been used. The connectors installed at the hospitals allow normalizing the clinical data and transferring data coming from the EHR (or other health systems) to the smartphones. Citizens are empowered within the healthcare loop: the individuals own their health data and it can be combined with data coming from other sources to produce accurate risk assessments at workplace, prompt detection of capacity-loss and self-management of a healthy working life.

2. Pocket mHealth System Description

Pocket mHealth consists of two main elements, an application for smartphone oriented to the interaction with the end user and a set of desktop software components deployed in the systems of clinics and hospitals with access to the connectors that use HIS. This favors the direct communication between the user and the actors involved in the provision of a social health service.

The main objective of the mobile application is to serve the user of means of transport, access point and method of transferring personal clinical information. Interoperability is a key concept to facilitate this task. The clinical information is managed in the form of standardized EHRs following the specifications of widely adopted modern standards of medical care such as openEHR/EN13606 and HL7 FHIR, and well-known terminology such as SNOMED-CT.

Pocket mHealth has been designed following a modular approach based on connectors, as shown in figure 2. These connectors allow processing information and data from different sources. In particular, Pocket mHealth manages information from health systems in the form of EHR, questionnaires on the current state of the user managed by insurance companies and data from wearable devices. These connectors,

specific to each information source, transform and formalize this following the known and accepted standards such as the current security and privacy guidelines.

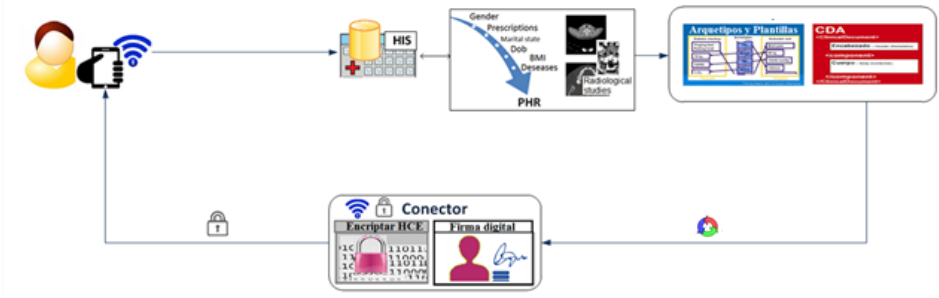

Figure 2. Pocket mHealth interactions and connectors for standardization.

Apart from the management of clinical information, the mobile application makes possible a second objective: to create an interaction method for socio-health services related to the user. In this way, the mobile application offers a channel of direct communication with the user, being able to display interactive alarms or interventions based on the information managed and the activity in which the user is immersed.

Figure 3. Pocket mHealth extension for well-being data.

3. Boosting the Healthcare Transformation

The delivery model of healthcare is transforming from the present hospital and career-centric to the in-home and patient-centric healthcare. Internet of Things (IoT) technology is promising for the ICT industry and for the traditional healthcare as well, because it is ubiquitous and personalized.

The typical functions expected of a Health solution using IoT technology are related to tracking, monitoring, information management, remote service and cross organization

integration [13]. These requirements are met in Pocket mHealth with different HISs acting as health information sources in a seamless manner with the tools installed at the hospitals, that allow accessing the HIS using configured templates, normalizing the clinical data and transferring the record to the smartphone using wireless technologies, such as Bluetooth. The mobile application can then store and carry the clinical information coming from different HIS in a totally transparent way. The solution not only provides the benefits of a connected practice or organization such as clinical efficacy improvement, healthcare cost savings and increase of overall care quality, but also supports the care transformation that is enabled by a patient centered design.

In this sense, the advantages and benefits offered by Pocket mHealth focus on the following points:

- Distributed interoperability: thanks to the use of some of the best-known and most widely-used health standards, which allow the interconnection between different systems and promote the exchange of information between the systems directly through the patient from the lowest level and without affecting the clinical information systems and established.
- Information shared, safely, between patient and (occupational) health professionals.
- Continuous care reshaping access to data allows patients.
- Mobility of the user: allows to move and travel with the medical information stored safely in the mobile device; this also favors the possibility of choosing the professional to whom he wishes to go.
- Diagnostic improvement, since Pocket mHealth maintains the patient / citizen's clinical information in a reliable, integrated and updated way. It also facilitates the process of asking for second medical opinions.
- Savings in management costs: allows insurers or private clinics to save costs derived from duplication of tests and errors caused by incomplete or erroneous information. The offered service will be faster and more efficient, and visits to the specialist or primary care can be reduced.

4. Application to the Workplace

Pocket mHealth bridges the communications between the clinical actors and the prevention system (import/export clinical data) and between the end-user and the prevention system (sensors, algorithms, notifications, etc.). The development of more efficient and effective services can be driven by the characteristics of Pocket mHealth, since it is close by the end user in his day to day. In the case of workplaces the services developed to promote occupational health and digital ergonomics can benefit from Pocket mHealth, which favors the supervision of the parameters extracted from user's work activity. This supervision or digital intervention aims to correct or prevent harmful behaviors according to the clinical information of the user, and thus reduce the risk of accidents or damage. In addition, Pocket mHealth may be connected with Hospital Information System and other digital health services, allowing a continuous self-monitoring during the different entire day. This is not only beneficial for the user of the service, but also for the employers and insurance companies, since fostering a safe and careful workspace causes long term effectiveness and minimizes the costs associated with work absences.

By providing feedback, warnings and risk assessments, Pocket mHealth allows employees to get a proactive role in ensuring health at work and organizations to implement effective and personalized health programs at work.

We@Work project implements these previous ideas. Data from wearable sensors are collected in a pervasive manner and processed in conjunction with context information about the daily working tasks being executed. The data stored in the cloud from different job sites and several workers are analyzed with ergonomic algorithms. As a consequence, personalized recommendations are generated, at different stages, automated at first but also made by experts if required, to improve the ergonomics and occupational health of the workers.

Another potential use would involve people with chronic conditions to adapt their daily working routine to their specific capacities in an optimal way. The possibility of the Pocket mHealth to interact with the EHR opens the door for combining the work context information with the actual physiological performance of the worker to accurately detect the work situations that might impact more negatively to the work because of their condition, e.g. hypertension. Pervasive monitoring at work, home and the health care center can be used to detect which work tasks and assignments should be avoided in order to preserve the health of the worker.

Finally, Pocket mHealth can support also the active ageing at work, monitoring older employees performance to adapt their daily activity to their health needs.

5. Future Work

The new Regulation of Global Data Protection (GDPR) is a long and expensive task that will involve numerous changes in the business model of those services that use private and protected data. To face this new horizon, the integration of technologies and tools for identity management and management of access to private data is being studied. In this sense, Pocket mHealth is especially suited to meet the requirements raised by the GDPR since it is integrated with Envidian IAM Suit, enhancing the security and privacy capabilities of the solution.

In addition, Pocket mHealth can offer services for pharmacovigilance, becoming a tool to support semi-automatic reporting of Adverse Drug Reactions (ADRs) to regulatory authorities.

Finally, other potential advances will be targeted to enhance communication among healthcare stakeholders. In this case the integration with other Atos technologies such as Unify[4] will address some of the challenges related to clinical communication and workflow. On the other hand, Pocket mHealth is a patient-centred solution, but we are making advances to offer tools to share specific on-demand health information (e.g. data interesting for public health management or clinical trials) in a secure way to authorize healthcare providers.

6. Conclusions

Health and well-being have an intrinsic value that is strongly associated with job quality. Mobile apps combined with heterogeneous collection of work context

[4] https://www.unify.com/ourpartners/products-services/industry-solutions/healthcare.aspx

information and its analysis can predict risks and identify bad habits and performances at a workplace, covering from wellbeing to individual´s risk prevention of work-related injuries. Protection of workers and adapting the working environment could be achieved with a realistic cost for the main working environment actors and different stakeholders, e.g. occupational health services and companies. Benefits as absenteeism reduction extended working life, motivation and productivity come together with a healthier worker.

Pocket mHealth is based in a paradigm shift needed for person-centric health care: it provides access to EHRs with emphasis on interoperability standards. This way, other types of services or devices with the aim of building more complex applications can be integrated to create a personalized and updated service. As an example, Pocket mHealth takes part in We@Work to target the digitalization of workplaces and developing healthy working habits, giving employees a practical and effective tool to manage their health. Interoperability capabilities of Pocket mHealth allow taking advantage of rapid developments in non-intrusive sensor technology, mobile data acquisition and improved risk assessment methodologies combined with big data. The challenge is to exploit the potential of health mobile apps for the health self-management and integrating health and well-being solutions in the workplaces.

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