PERSPECTIVE ARTICLE

The SMART healthcare solution

Basil H. Chaballout[1*], Ryan J. Shaw [2], Karin Reuter-Rice[3]

[1] Trinity College of Arts and Sciences, Duke University, Durham, NC, USA
[2] School of Nursing, School of Medicine, Center for Applied Genomics and Precision Medicine, Duke University, Durham, NC, USA
[3] School of Nursing, School of Medicine, Department of Pediatrics, Duke University, Durham, NC, USA

Abstract: Substitutable Medical Apps Reusable Technologies (SMART®) on Fast Healthcare Interoperability Resources (FHIR) is an open, standards platform that allows third parties to build health applications that interact with electronic health record (EHR) systems. This can allow for aggregation of unique data ranging from genomics to lifestyle, thereby promoting the emerging precision medicine approach. It is also the first to provide a way to successfully incorporate interoperability in EHRs and precision medicine implementation.

Keywords: electronic health record (EHR); precision medicine; data visualization

*Correspondence to: Basil H. Chaballout, Trinity College of Arts and Sciences, Duke University,95847 Durham, NC, USA; E-mail: b.chaballout@duke.edu

Received: April 17, 2017; **Accepted**: September 16, 2017; **Published Online**: November 23, 2017

Citation: Chaballout B H, Shaw R J, Reuter-Rice K, 2017, The SMART healthcare solution. *Advances in Precision Medicine*, vol.2(1): 213. http://dx.doi.org/10.18063/APM.v2i1.213

Introduction

Precision medicine is an emerging approach for health promotion, disease treatment, and prevention that takes into account individual variability in genes, environment, and lifestyle. Payment models are shifting towards population-based models where health systems are required to monitor individual patient data beyond patient visits. However, many data types, including environmental, behavioral, and biological, are not being recorded in real-time between office visits. In part, this is because there are limited ways to record real-time data in electronic health records (EHRs). This lack of data prevents clinicians from viewing health data across their patients' lifespans. A standardized application platform that can pull a variety of health-related data into any EHR system would allow for aggregation of this unique data ranging from genomics to lifestyle, thereby promoting the emerging precision medicine approach.

SMART on FHIR

Substitutable Medical Apps Reusable Technologies (SMART®) on Fast Healthcare Interoperability Resources (FHIR) is an open source platform that allows third parties to build health applications that interact with EHR systems – or data repositories that supports SMART standards[1]. After the application is built, it can be used with any other SMART-compatible EHR or health repository, allowing users to create apps that seamlessly and securely run across healthcare systems and different EHRs (Figure 1). SMART apps can be acquired from the SMART app gallery. An EHR that supports SMART gives clinicians an access to a library of apps to improve clinical care, research, and public health. Moreover, it allows healthcare providers to view data that is unlikely to be collected together, such as biomarker and environmental sensor data, which could be used for precision medicine interventions. A physician can download SMART apps most relevant to his or her patients and use them to enhance treatement. This enhancement can be achieved through several means, such as recommending treatment plans specific to a patient's conditions, displaying valuable and hard-to-access data, or conveniently aggregating various data metrics on a single template.

Environmental Data

Precision medicine is built on the idea that we can tailor treatment to an individual by understanding his or her

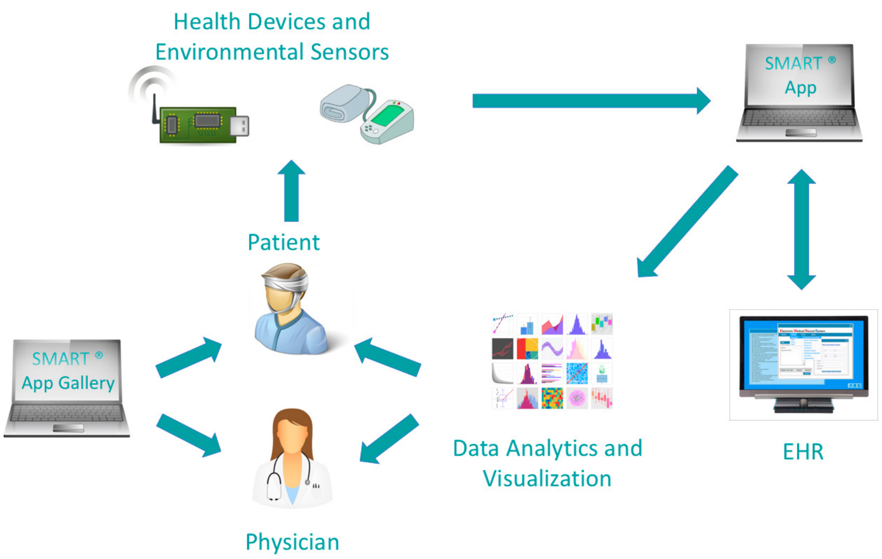

Figure 1. Flow diagram of a physician using a SMART® app to enhance her practice. Diagram shows the SMART® app being downloaded by the clinicians and patient. Health devices and environmental sensors are used to output relevant health data to be inputted into the patient's EHR *via* a SMART® app. The data is also used in a double feedback loop from the SMART® app and EHR to produce helpful information to both the physician and patient through analytica.

genetic makeup. Genetic analysis and biomarkers have proven to be helpful in cancer oncology and targeted therapies[2],but genetic analysis alone is not enough. Genetic associations have much smaller effect sizes in contrast to behavioral and social factors[3]. Changing environmental conditions alone has been shown to correlate to better health outcomes with conditions such as Alzheimer's disease[4]. This is why the environment in which patients reside and how they behave within it must be taken into account along with their unique biological traits. One way to gather environmental data is by using tools provided by vendors or even consumers for self-tracking, such as wearable devices, cell-phone apps, or wireless environmental sensors. These can also track sleep, nutrition, exercise, and vital sign data that is individualized to the patient.

Data Efficacy

Gathering such data is just the first step in an effective precision medicine approach. Raw data of this magnitude is considered "Big data" and poses the challenge of taming volume, velocity, variety, and veracity. The data must also be converted to something usable, readable, and intuitive. The ability for SMART apps to be built in any form would accomplish these goals. It enables algorithmic calculations on the data to be made in statistical coding environments such as R Studio, allowing analyses to be conducted on live health metrics. For example, if a patient has congestive heart failure, a SMART app could transmit this data to the EHR on real-time weights from a cellular scale. The app could analyze this live incoming data along with environmental data, such as weather during a heat wave, using appropriate and medically proven algorithms to recommend a healthcare provider proactively intervene.

While collecting data this way is possible, the variety and volume in which data are entered into EHRs presents several challenges[5]. Information overload can lead to misinterpretations, incorrect diagnoses and missed warning signs of imminent changes in a patient's condition[5]. However, since the applications that can be made with SMART are open to outside developers, this provides the opportunity to implement data analytics and use special visualization software to improve the process. One interactive data visualization product, Tableau®, allows developers to visually interact, analyze, and customize the layout. This, when used with SMART apps and EHRs, allows healthcare providers to collect, aggregate and make sense of a variety of health data to meet the goals of precision medicine.

Privacy and Security

Of course, this transfer of data and incorporation of several devices must be treated with utmost care. Privacy and security are among the most frequent concerns of healthcare systems or patients when it comes to implementation of precision medicine. For security, SMART uses an authorization model based on the widely-used and all-encompassing OAuth standard. This ensures patients and providers have full control over their data[1]. Reliability and consistency across apps are also concerns for effective implementation. To address this issue, SMART applies a set of "profiles" that provides developers to a list of "ground rules" that define which data fields are required *versus* which fields are optional. These profiles give developers an expectation of which terminologies are to be used to express certain data such as medications, problems, labs, and other clinical data[1]. This means that tools adopted from the SMART app gallery are familiar and the adjustment period between tools is minimized.

Conclusion

Precision medicine is still evolving and many challenges still exist. Nevertheless, SMART on FHIR is addressing some challenges and is the first to provide a way to successfully incorporate interoperability in EHRs and precision medicine implementation – particularly around data from patients' everyday behaviors, biological processes and environments. This may allow for these tools to be tied with emerging payment models that are based upon population health management and the prevention of for example hospital readmissions. SMART is picking up steam. Its developers have recently teamed up with the five largest EHR vendors and have received a four-year $15 million contract from the U.S. government. It is just one example of the beginning of a truly smart healthcare solution.

Conflict of Interest

There was no source of support in the form of grants, equipment, or drugs. This piece has not been submitted to another journal or published. There are no conflicts of interest from any of the authors.

References

1. Warner J L, Rioth M J, Mandl K D, *et al*., 2016, SMART precision cancer medicine: A FHIR-based app to provide genomic information at the point of care. *J Am Med Inform Assoc*, vol.23(4): 701–710. http://dx.doi.org/10.1093/jamia/ocw015
2. Collins F S, Varmus H, 2015, A new initiative on precision medicine. *New Engl J Med*, vol.372(9): 793–795. http://dx.doi.org/10.1056/NEJMp1500523
3. Khoury M J, Galea S, 2016, Will precision medicine improve population health? *JAMA*, vol.316(13): 1357–1358. http://dx.doi.org/10.1001/jama.2016.12260
4. Zeisel J, Silverstein N M, Hyde J, *et al*., 2003, Environmental correlates to behavioral health outcomes in Alzheimer's special care units. *Gerontologist*, vol.43(5): 697–711. http://dx.doi.org/10.1093/geront/43.5.697
5. Caban J J, Gotz D, 2015, Visual analytics in healthcare – Opportunities and research challenges. *J Am Med Inform Assoc*, vol.22(2): 260–262. http://dx.doi.org/10.1093/jamia/ocv006