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Integrating Web Services/Applications to Improve Pediatric Functionalities in Electronic Health Records

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abstract

The past decade has seen a substantial increase in the use of electronic health records (EHRs) by health care providers caring for children. However, gaps in pediatric-specific functionalities continue to exist in some EHR systems, including population-specific growth curves, immunization clinical decision support, weight-based medication dosing with rounding, calculation of pediatric hypertension percentiles, age-specific developmental assessment, newborn bilirubin nomograms, anticipatory guidance reminders, and other functionalities described elsewhere. Implementing pediatric functionalities into EHRs is critical to the provision of safe pediatric care. As an alternative to direct implementation in EHRs, EHR vendor agnostic Web applications, Web services, and application programming interfaces offer an opportunity to provide pediatric functionalities and eliminate the need for each vendor to develop these functionalities. Successful implementation of Web services and related technologies requires responsible attention from both EHR vendors and developers of Web services, Web applications, and application programming interfaces to the use of data terminology standards, adherence to privacy and security requirements, rigorous testing, change management processes, and robust system support and maintenance. Education of health care providers about opportunities to improve pediatric functionalities in EHRs by using these services can facilitate discussions in EHR user groups in which vendors can be lobbied to implement them. This policy statement emphasizes the need to address pediatric-specific functionalities in EHRs by providing insight and recommendations into the development, maintenance, integration, and support of these novel solutions.

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BACKGROUND

Between 2008 and 2015, adoption of a basic electronic health record (EHR) by children's hospitals increased from 10% to 55%. The percentage of acute care hospitals using a certified EHR by 2015 was 96%.[1] The percentage of office-based physicians in the United States using a certified EHR system was estimated to be 77.9% in 2015[2] and 94% in 2016.[3]

Many EHR systems lack pediatric functionalities, including plotting growth charts, computing anthropometric percentiles, tracking adherence to well-child visits and immunization schedules, and supporting weight-based dosing.[4,5] These core pediatric functionalities have been described for both the outpatient[6] and inpatient[7] settings. More recently, as part of the 21st Century Cures Act, additional core pediatric functionalities were recommended by the Health IT for the Care Continuum Task Force in conjunction with the Office of the National Coordinator for Health Information Technology as pediatric EHR certification criteria.[8] As an alternative to implementing these core features directly as core functionalities in EHR systems, Web services and Web applications offer opportunities to integrate and thereby increase the use of pediatric functionalities across multiple EHR systems by using standard technologies and terminologies for those EHR systems that provide access to Web services and applications.

STATEMENT OF THE PROBLEM

Emerging evidence supports continuous development and modification of guidelines and clinical policies. Examples include:

1. In October 2016, the Centers for Disease Control and Prevention released a new recommendation to the human papillomavirus vaccine schedule. The novel recommendation required only 2 doses spaced at least 6 months apart if the first dose was administered before age 15 years.[9]

2. In August of 2017, the American Academy of Pediatrics (AAP) published a clinical practice guideline that included "significant changes" in the screening and management of high blood pressure in children and adolescents, new normative pediatric blood pressure tables, and an action statement to include flags for abnormal blood pressure values both when the values are being entered and when they are being viewed.[10]

3. In February of 2017, the AAP published the fourth edition of *Bright Futures: Guidelines for Health Supervision of Infants, Children, and Adolescents,* containing a periodicity schedule of screenings and recommendations for 31 age-specific visits, from the newborn visit through visits for 21-year-olds.

These are but a few examples of pediatric-specific clinical guideline changes that provide significant challenges to EHR vendors who want to keep their clinical content up to date. In the current product development model, every vendor has to invest development resources to implement these new functionalities, guidelines, and clinical decision support. Often, vendors instead deploy content development tools with which each customer maintains embedded clinical content at a significant cost. Web services and Web applications offer solutions that can be shared among multiple EHRs and health care settings.

Examples of Current Web Services and Web Applications

A Web service is software that resides on a server that can be accessed by multiple applications and computers and provides functionality that does not involve user interaction, such as credit card authorization or medical calculations. A Web application can be accessed through a browser and has a user interface. There are pediatric examples that could serve as models for the integration of Web services and Web applications into existing EHRs.[11–18] It is important to apply the key considerations listed below when using these Web services and applications, especially those related to accuracy, testing, and transparency. Because Web services are smaller, more specialized software modules compared with EHRs, they have the advantage that they are easier to develop, test, and augment in a more rapid development cycle and do not have to rely on vendors to prioritize functions for development.

Key Considerations in the Development, Integration, and Use of Web Services

As these resources continue to be developed and implemented, several key issues need to be considered by developers, vendors integrating these tools, organizations, and end-users:

1. Dependability, access time, and speed: The use of a Web service or Web application introduces an external dependency, which needs to be reliable. Vendors must ensure that EHRs fail gracefully when the Web service or Web application is unavailable and allow users to complete their tasks.

2. Privacy, security, and confidentiality: Developers of these tools and the EHR vendors that integrate them need to be compliant with all relevant Health Insurance Portability and Accountability Act regulations. Business associate agreements between developers and vendors may need to be

developed. Because health care providers assume responsibility, as per Health Insurance Portability and Accountability Act security rules, to "ensure the confidentiality, integrity, and availability of all e-PHI they create, receive, maintain, or transmit,"[19] it is important that vendors provide security information documenting this compliance. Audit logs of data sent to and received from the Web service should be maintained in the EHR.

3. Accuracy, testing, versioning, and change management: Developers need to rigorously test the performance and accuracy of their tools. The developer, in collaboration with the EHR vendor, should test the system in a production environment using exhaustive testing scenarios to ensure that (a) the Web service is available and functions properly and its performance is acceptable to users; (b) the Web service fails gracefully, informing the user and allowing tasks to be completed later (eg, if the Web service is not available, the health care provider can still use the EHR); and (c) the version of the Web service and data used to generate calculations and/or recommendations are recorded with each use. The latter will allow retrospective validation of past calculations and/or recommendations once an upgrade of the Web service becomes available. As new versions are developed, a versioning history should be in place so that end-users are aware of changes, and EHR vendors should have a clear process to communicate those changes. Before going live, health care provider end-users must have an opportunity to test the system using realistic patient data.

4. Standards in technology and terminology: There are well-established technical and terminology standards related to data structure, data transport, and medical vocabularies (such as SNOMED CT, LOINC, and RxNorm) that should be adopted by Web services and Web applications.

5. Usability and transparency: Particularly with tools that deliver clinical decision support, Web application and/or service developers should provide, and EHR vendors should display, "show your work" functionality that allows end-users to understand underlying algorithms and how and why alerts and recommendations are generated.

6. Business models: Several business models exist for the use of Web services and Web applications by EHR vendors, including a subscription model, a per-use model, or a hybrid of the two. Vendors should be transparent if these costs are being transferred to end-users.

RECOMMENDATIONS

The AAP recommends the following basic principles for the ideal integration of Web services, Web applications, and application programming interfaces into EHR systems:

1. Health care providers and other users of EHRs should know how to access their EHR vendor user groups, through which requests for additional pediatric functionalities can be addressed. Within these user groups, they should research whether Web services or Web applications exist that can be used without the vendor redeveloping the same functionality (eg, in application marketplaces).

2. EHR vendors should support the ability to integrate Web services and Web applications within their systems, consistent with current standards for data terminologies, transport protocols, and privacy and/or security compliance. Vendors should be encouraged to make their interfaces uniform so that services can be available to different EHRs simultaneously.

3. Qualified health system or EHR vendor staff should consider integrating a Web service or Web application if:
   a. pediatric functionality provided by an available Web service or Web application is not present in the EHR or
   b. the functionality provided by the Web service or Web application enhances existing EHR functionality; and
   c. uptime, privacy, and security are within acceptable parameters.

4. EHR vendors that integrate Web services and Web applications should actively communicate and be transparent with users about any changes in the content or delivery of these tools. For example, vendors should inform users when an integrated Web service or application has been updated and allow end-users the opportunity to steward Web services by providing feedback to mitigate any issues with accuracy.

5. Web service developers should demonstrate sustainability and support continued development and maintenance as clinical guidelines and technical standards change.

6. Web service developers should employ current standards for data terminologies, transport protocols, and privacy and/or security compliance in a uniform manner so that Web services do not need to be customized for various platforms.

7. Web service developers should engage pediatric subject matter experts in the creation and testing of Web services with pediatric clinical content. In addition, physician groups should make it easier to identify informaticians

who are willing to work with these developers and EHR vendors.

CONCLUSIONS

Web services, Web applications, and application programming interfaces offer opportunities to extend and improve pediatric functionalities of existing EHRs. An increasing number of EHR vendors are making access to these tools possible. Pediatricians' awareness of these tools can facilitate discussions with EHR vendor user groups to implement these solutions where useful and feasible.

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ABBREVIATIONS

AAP: Academy of Pediatrics
EHR: electronic health record

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