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Image-Enabling the Patient Portal of an Electronic Health Record

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Abstract
Today, radiology departments still rely on compact disks to share imaging studies with patients. This practice is outdated as the majority of modern computers do not possess optical drives. In effect, hospitals are providing disks to patients to enable a single use, physical transport between two locations. This practice contrasts with the original goals of providing patients with their images: to empower ownership and provide transparency about their healthcare. The purpose of this manuscript is to implement an online platform for patient image viewing through an electronic health record patient portal. The number of study viewers was recorded daily over the first 90 days on our platform. During this time, the patients viewed 12,257 imaging studies. This represents 22% of the 56,413 imaging studies performed in our department. On average, there were 136 imaging studies viewed/day (range 52–250). We determined that an online platform enabling patients to view their images is feasible. At our hospital, a large percentage of patients quickly identified this feature and began using it to view their imaging studies.

Keywords Enterprise imaging · Patient portal · Enterprise viewer

Introduction

Patient-focused healthcare has become increasingly valued in healthcare [1]. The recent shift toward more patient-focused care in radiology has coincided with the availability of reports within electronic health record (EHR) patient portals [2]. Today, nearly 92% of hospitals offer patients the ability to view their medical records online [3, 4]. This allows patients to consume their medical information rapidly, reliably, and remotely. While radiology departments now routinely publish results to the patient portals, most departments do not have the capability for patients to view their images via the portal. In prior work, we described how we configured our patient portal to allow patients to communicate directly with radiologists [3]. Interestingly, one of the most common questions that our patients ask the radiologist is how they can view their images [3].

Historically, radiology departments have allowed patients to view their imaging studies only if requested. In the film era, patients would have to request a copy of their imaging study. The radiology file room would then locate the film and make a film-based copy of the imaging study. As departments moved digital, this process was replicated. However, instead of making a film-based copy, departments shifted toward making copies on physical disk media such as compact disks (CDs) or digital video disks (DVDs). While this process worked well for the first decade of the 2000s, this practice has now been outdated for over a decade. In 2008, Apple first began manufacturing personal computers without an optical disc drive [5]. This trend has progressed to today where most computers are manufactured without a built-in optical drive. In 2018, Best Buy, a national consumer electronic store, announced that as of 2018, they would no longer sell CDs as a storage medium [6].

Despite this shift in the consumer electronic market, hospitals and radiology departments continue to provide patients their medical information on physical media. The use of physical media has several consequences. Most importantly, because the barrier to acquire the previously obtained imaging studies is high and the resultant copy is

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unusable, patients often forgo getting a copy of their imaging study. Rather than getting the images, patients may undergo repeat imaging studies so that the information is available at the second site of care. Some estimates show that more than 30% of patients transferred between hospitals underwent repeat diagnostic imaging [7]. Further estimates indicate that between $3 and $10 billion a year is wasted on redundant imaging [7]. This practice contrasts with the original goals of providing patients with their images: to empower ownership and provide transparency about their healthcare.

We hypothesized that patients request their imaging studies for one of two reasons, either to provide their imaging information to a different provider or to view the images themselves. In this project, our goal was to address the second reason by designing a solution to improve a patient's ability to view their radiology studies by image-enabling the EHR patient portal.

Materials and Methods

Setting and System Used

This project took place in the radiology department of a large, free-standing children's hospital. Our department performs approximately 220,000 imaging studies per year. Patients access the EHR through a patient portal (MyChart, Epic Systems, Verona, WI). All images are archived to a vendor neutral archive (iConnect; IBM Watson Health Imaging, Cambridge, MA) and viewed using our hospital's enterprise viewer (iConnect Access; IBM Watson Health Imaging). As of March 30, 2020, approximately 125,000 patients have registered to use our EHR patient portal.

The project was led by the Radiology Informatics team composed of a physician leader (AJT), the Director of Radiology Informatics (TJO), the lead technical specialist (JAM), and four systems analysts (LAP, JR, DH, ES). The radiology informatics team collaborated with the hospital-based information technology division including a senior systems analyst (JB) who manages the EHR patient portal and an information technology project manager (E Slavik). Finally, the team included a medical student imaging informatics fellow (AD).

System Requirements

Initially, the multidisciplinary project team met and defined the system requirements needed to image-enable the patient portal. As the team devised the requirements, they focused on the principles of ease-of-use and system security for the two major components of this project: the patient portal and the enterprise image viewer. At a base level, the patient portal needed to provide patients with a link to view images (Fig. 1). This link was designed to reside within the results report and would launch images in the hospital's enterprise viewer (Fig. 2). Most importantly, this link needed to be secure. The link could not contain any protected health information or be reusable.

The team identified four requirements for the enterprise viewer. First, the enterprise viewer had to be accessible via the internet and usable on any operating system or through any internet browser. Initially, the team decided to focus on use of the application through the computer-based patient portal rather than a mobile application. Thus, mobile operating systems were deemed less important for success of the project. Second, when the images were launched, the team thought that the viewer should contain a limited toolset so that patients could easily learn how to view their images via a simple, user-friendly experience. Third, the team thought that institutional guidelines for embargoed reports should be followed. At our institution, radiographs and ultrasounds are released within an hour of being finalized while CT, MRI, and PET studies are released approximately 48 h from completion. While reports needed to be embargoed, the team felt that images did not need to be withheld. This decision was like the current state where patients could receive a disk of images prior to the report being created. We also know that while patents would be able to access images without a report, that this workflow would be convoluted, not available for all patients, and unlikely to be stumbled upon (a patient could view his or her unreported images by launching them as a comparison to a study that had already been reported). Finally, the team required the ability to audit patient access to their images.

Implementation

Once the online imaging platform build was complete, the functionality was announced on the main page of the patient portal as well as in the waiting rooms of the radiology department. The number of study views and service ticket requests was recorded to track patient adoption and complaints, respectively.

Results

System Build

To accomplish our predefined system requirements, we needed to design a solution that would allow patient users to have a different experience compared with clinical users. Namely, the patient user had to have a simplified toolset, no access to embargoed reports, and no access to search for or view-imaging studies performed on other patients. We accomplished this by creating a separate user domain

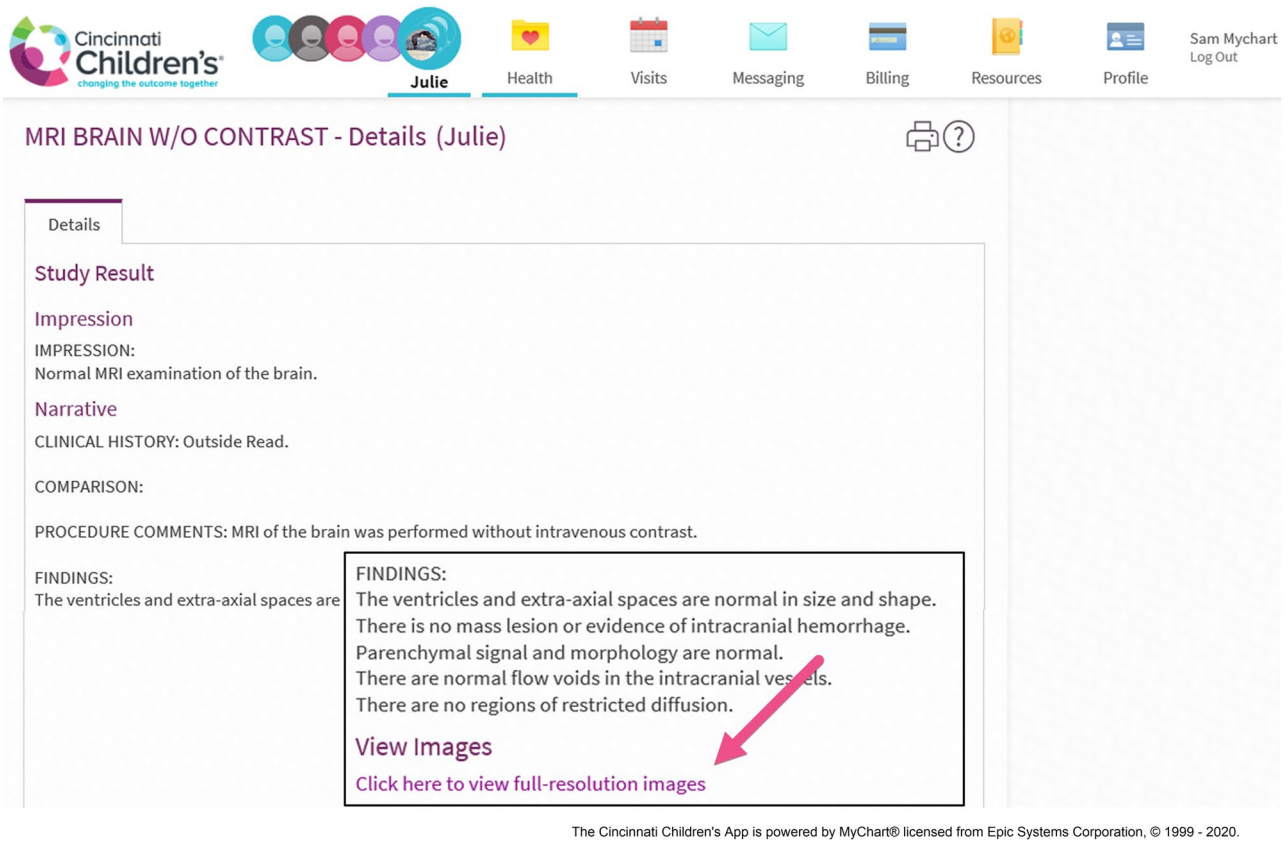

Fig. 1 Screen capture from the electronic health record patient portal. When viewing the radiology report, the patient has the option to click the link (arrow) to view their imaging study. Note that the portion of the report within the box has been enlarged to highlight the detail of the link to the images

specifically for patients within the enterprise viewer. Once this domain was created, we added a single generic patient user to the domain. This allowed us to control the user experience and apply user restrictions at the system level. Additionally, having a single generic patient allowed us to simplify the link structure so that a unique username and password did not need to be passed to the viewer with each link click. Because we created a generic patient login for the viewer, we realized that we would have to rely on the EHR to provide an audit of which patient user clicked the link to view images. This functionality was particularly important to us as most of our patients are minors, and their images are typically viewed by a proxy family member, often either the mother or father. By combining the audit trails of the EHR patient portal and the enterprise viewer (using the time stamps as identifiers), we are able to understand the user who launched the imaging study from the patient portal and determine what actions that user took when viewing the images.

We ensured that all the links from the patient portal to the enterprise viewer were secure by using the triple data encryption algorithm (TDEA or 3DES) for uniform resource locator (URL) encryption. This standard encrypts information such as the usernames, passwords, and other protected health information and prevents them from being readable. Our enterprise viewer was configured so that users outside of the local network could access the system via a proxy server IP address. This virtual IP (VIP) is in front of the web application proxy servers which handle multiple applications throughout the institution. Typically, our hospital requires multifactor authentication for applications that utilize the proxy server. Specifically, clinical users of the enterprise viewer must use multifactor authentication when accessing the viewer from an outside network. While multifactor authentication works well for employees, it does not work for patients. Thus, like other patient-facing applications, the proxy server is configured such that requests for image viewing which are coming directly from the patient portal bypass the need for user multifactor authentication. This allows patient users to authenticate automatically using a common context into the enterprise viewer simply

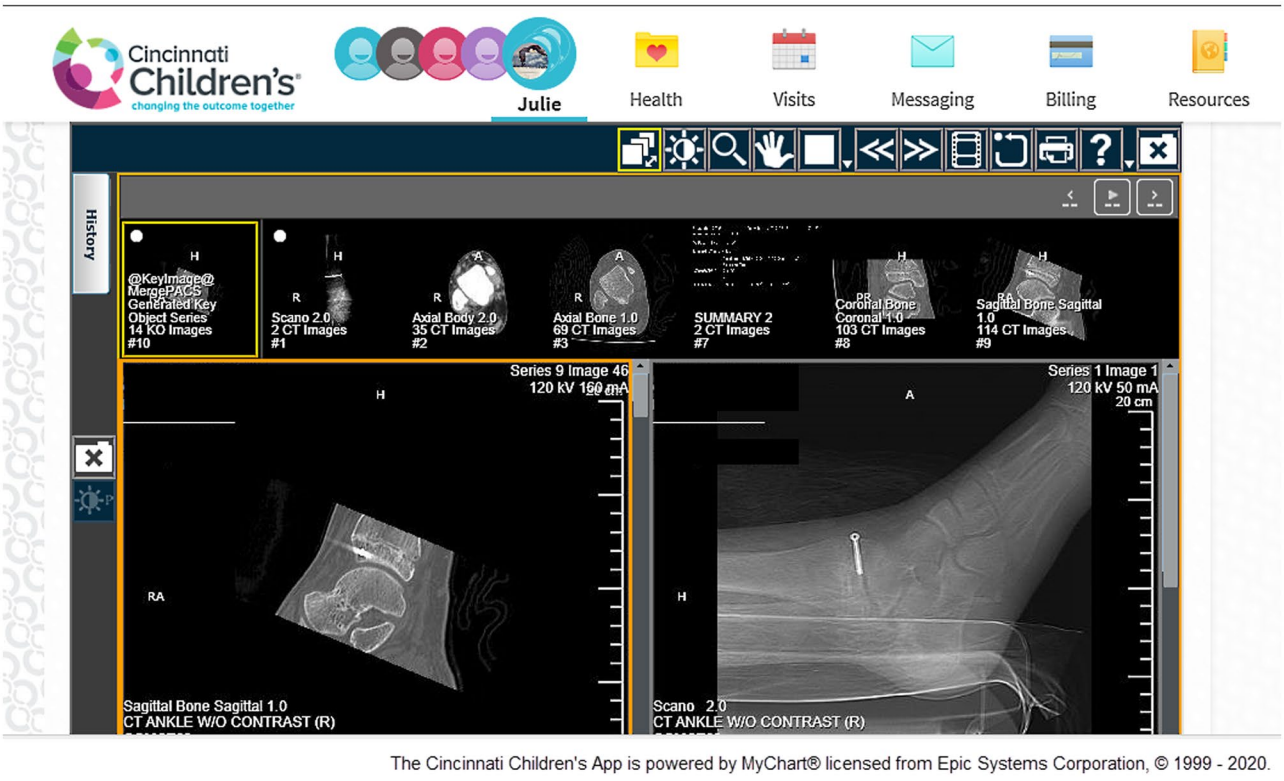

Fig. 2 Screen capture showing the enterprise viewer embedded in the patient portal. The viewer appears after the patient clicks the link within the report

by clicking the link in the patient portal, a system that they have already authenticated into.

Since there is only one patient user due to the common user context, we can easily configure the viewer for patient use. As we designed the patient experience, we simplified the viewer's functionality compared with the general clinical user. Our goal was to only include the basic tools needed to view the images. Thus, the following tools are available for patient use: window/level, image scroll, zoom, pan, next/previous series, and play cine, reset display, print, and help. These 11 tools represent a decrease from the 47 tools available for the default clinical user at our institution.

Having a separate patient domain allowed us to display imaging reports differently for patient users as compared with clinical users. We used this distinction to respect the hospital's rules for embargoing radiology reports. This was accomplished by turning off all report viewing for the patient user in the enterprise viewer and forcing patients to read the reports in the EHR-patient portal. We are then able to rely on the functionality present in the patient portal to respect embargo rules.

System Use

The image-enabled patient portal was launched on August 14, 2019. The number of study views was recorded daily over the first 90 days of use (Fig. 3). During this time, patients viewed 12,257 imaging studies. This represented 22% of the 56,413 imaging studies performed in our department over those 90 days. On average, there were 136 imaging studies viewed/day (range 52–250). The average number of imaging studies viewed by patients was higher on weekdays (160 views/day) than weekends (77 views/day). No support tickets related to image viewing were placed during this period.

Discussion

In the USA, there has been a push to empower patients to have access to their medical information for better healthcare decision-making. This is evidenced by the provisions in the 21st Century Cures Act passed in 2016. Although the main aim of this legislation was to streamline drug and

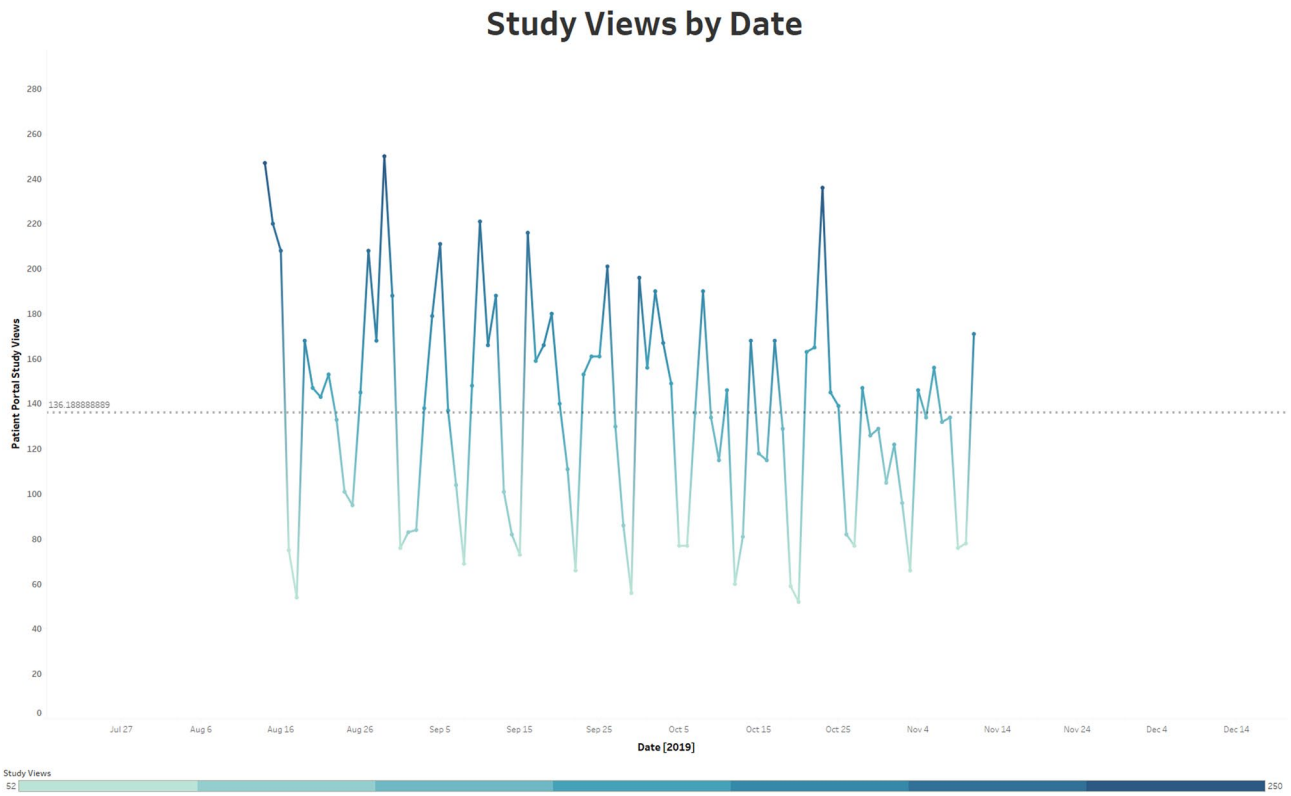

Fig. 3 Graph of study views per day for 90 days. Average line is shown

device approval, a provision was included to address information blocking (defined as any practice that demonstrates anti-competitive behaviors by healthcare organizations to prevent users from sharing information related to EHRs) and the interoperability of electronic records [8].

Over the past decade, radiology as a specialty has made significant strides in improving departmental efficiency and the ordering providers' access to information [9]. However, our specialty has been slow to encourage patient engagement and recognize the patient as our primary consumer. Recently, however, radiology has begun to embrace patient-facing initiatives. The American College of Radiology (ACR) and the Radiological Society of North America (RSNA) through their Imaging 3.0 and Radiology Cares initiatives have led this charge [10, 12]. One example of an effort these organizations have supported to increase patient engagement is the #DitchTheDisk campaign [13]. The #DitchTheDisk campaign uses social media advocacy and other tools to promote providing a patient access to his or her images as well as efforts for electronic image sharing between hospitals.

We have embraced the #DitchTheDisk campaign as an effort to empower our patients. While we believe that providing patients with direct access to their images will decrease the number of disks requested, we did not attempt to measure the change in disks used for this project. We made this decision because we did not think that we would be able to provide an accurate measurement of disk use as this project coincided with a separate effort to expand electronic image-sharing between our department and other hospitals. Importantly, we believe that to truly #DitchTheDisk, the efforts described in this project must be coupled with tools to provide patients with the ability to download their imaging studies, share their imaging studies with other providers, and upload their studies to personal health vaults. We hope that this type of functionality will be available in an easy-to-use interface in a future version of our enterprise viewer software.

While an image-enabled patient portal has been described in the popular press, we believe this description is the first in medical literature [14, 15]. At our hospital, a large percentage of patients quickly adopted the viewing of imaging from the EHR patient portal. We believe that the rapid and sustained use of our image-enabled patient portal demonstrates that patients are eager to see their imaging studies and become more engaged in their health. We believe that radiology can be used to help encourage patients to use the patient portal. As a department, we have implemented other projects to engage patients. Examples of these projects include social media outreach, building real-time status boards for the waiting rooms so that parents know how their child's anesthesia-aided imaging study is progressing, text message reminders to parents describing how to find a

new imaging location, delivering difficult news, the use of video goggles to reduce anesthesia needs, and a tool within the EHR allowing patients to directly communicate with a radiologist [16–19]. We hope to continue to use technology to drive patient engagement.

As we implemented the image-enabled patient portal, we had to address several challenges. While we worked to solve each challenge, we tried to balance the patient experience with the limitations of our underlying systems. For example, we wanted to make sure that patients had a way to view the final radiology report and see their images. Traditionally, the viewer includes the capability to view both the images and the report. However, because clinicians in our hospital use the same viewer, we could not create a solution where reports were embargoed from the viewer. Instead, we created a patient user domain within the viewer. We then were able to disable report viewing for the patient user role within the enterprise viewer. This ensured that the EHR remained the system of reference for the radiology report while at the same time, clinical providers were still able to view the report when using the viewer.

Conclusion

Patients are eager to become more involved in their care. Our historical method of providing physical disc-based media is no longer viable and does not meet the needs of our patients. An image-enabled patient portal has the potential to decrease repeat imaging, reduce cost, and engage patients with their radiologists. An online image-viewing platform is how medical images will be consumed in the coming years as regulations, vendors, and information technology systems continue to grow.

Compliance with Ethical Standards

Conflict of Interest The authors declare that they have no conflict of interest.

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