ORIGINAL ARTICLE

Providers' Access of Imaging Versus Only Reports: A System Log File Analysis

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Abstract

Background: An increasing number of technologies allow providers to access the results of imaging studies. This study examined differences in access of radiology images compared with text-only reports through a health information exchange system by health care professionals.

Methods: The study sample included 157,256 historical sessions from a health information exchange system that enabled 1,670 physicians and non-physicians to access text-based reports and imaging over the period 2013 to 2014. The primary outcome was an indicator of access of an imaging study instead of access of a text-only report. Multilevel mixed-effects regression models were used to estimate the association between provider and session characteristics and access of images compared with text-only reports.

Results: Compared with primary care physicians, specialists had an 18% higher probability of accessing actual images instead of text-only reports ($\beta = 0.18$; $P < .001$). Compared with primary care practice settings, the probability of accessing images was 4% higher for specialty care practices ($P < .05$) and 8% lower for emergency departments ($P < .05$). Radiologists, orthopedists, and neurologists accounted for 79% of all the sessions with actual images accessed. Orthopedists, radiologists, surgeons, and pulmonary disease specialists accessed imaging more often than text-based reports only.

Conclusions: Consideration for differences in the need to access images compared with text-only reports based on the type of provider and setting of care are needed to maximize the benefits of image sharing for patient care.

Key Words: Health information technology, radiology, medical specialty, nursing, radiographic image interpretation, computer-assisted, radiology information systems/classification

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INTRODUCTION

The capability to share the results of imaging studies and the investments made to support such infrastructure are growing dramatically. Through health information technologies such as regional imaging exchange networks, shared PACS, exchange services offered by health information organizations, interoperable electronic health records, and tools for media import, near-real-time access to imaging studies and accompanying interpretations from multiple sources is becoming widespread [1]. Evidence suggests that technologically supported access to previous imaging studies and reports can improve the quality of care and save health care costs from reduced duplicate imaging [2].

As technology continues to enable availability of a patient's information at the point of care, what types of imaging information do providers want to have accessible? The evidence suggests widespread interest in having access to images in addition to, or as a multimedia component enhancement to, text-based reports. In general, health care providers want access to their patients' prior imaging information, including images and reports [3]. In survey and qualitative research, providers have reported the desire to access actual images [4,5]. When PACS become available to clinicians, the viewing of images tends to increase [6]. Furthermore, providers have indicated that the availability of images supports a better understanding of accompanying reports [7]. At

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the same time, however, reports are desired but are not always available [8]. Moreover, differences exist in the use of radiology images and reports, varying by physician specialty. General practitioners seemingly rely on reports more than do other specialists, and some specialists may have a greater interest in viewing actual imaging studies than others [9]. Additionally, these potential differences in preference for images rather than reports do not consider the potential variation that might exist between physicians and non-physician providers, such as nurse practitioners.

With this study, we sought to describe patterns of accessing radiology images by individual health care professionals compared to access of text-based reports only. We extend the existing survey-based and physician-focused literature by using objectively measured, actual usage behaviors of a broad set of health care professionals in multiple organizations. Understanding the difference in the use of images and reports provides greater insights into the role of previous imaging conducted in different settings of care and among different types of providers.

METHODS

Setting and Subjects

This study describes and analyzes the information system behaviors of users of a web-based portal to view community-wide, longitudinal patient records (ie, "portal") offered by the Rochester Regional Health Information Organization (RHIO). The RHIO facilitates the electronic exchange of information for more than 1,000,000 patients at 70+ health care organizations in a 13-county region of upstate New York [10]. The records in the portal are populated with demographics, encounter histories, medications, laboratory results, and diagnosis information from participating primary care, specialty care, emergency, public health, inpatient, and long-term care providers. Additionally, through the portal, users have access to text reports from imaging studies and can request the display of high-resolution imaging studies. If imaging studies are available for a given patient, hyperlinks referencing the available imaging studies are embedded within the patient's record. Following these links initiates a call for information to the imaging exchange system (eHealth Technologies' Connect Image Exchange Henrietta, NY), which in turn displays the images. The study population includes registered users who accessed the portal from January 1, 2013 through December 31, 2014. All database administrators employed by the RHIO, software vendors, and users without identified places of work were excluded.

Data

We combined the system user logs of multiple information systems with user registration information and basic patient demographics. System user logs automatically document a user's activity for security purposes and provide an objective measure of information system usage that is not subject to recall bias [11]. When a user accessed the portal, system logs recorded the user account information, which patient records were accessed, and detailed events within the system, such as following hyperlinks to navigate records or following hyperlinks to display specific patient information. All portal activity includes date and time stamps. These logs (also called clickstream data) [12] provide a comprehensive method of measuring all user activity.

Outcome: Imaging Usage

In conjunction with RHIO staff, we created a binary outcome variable indicating user sessions with access of imaging studies compared with sessions with access of text reports only. All other sessions were excluded from the sample.

Independent Variables

Portal users were grouped as follows: physician (primary care or specialist), nurse practitioner, nurse, other non-physician provider (eg, physician assistant), licensed health professional or case manager, podiatrist, and other staff. For physicians, we identified the most common and potentially relevant specialties. We grouped the users' settings into the following categories: ambulatory primary care, ambulatory specialty practices, emergency departments, imaging centers or departments, and all others. We also noted if the setting was part of a hospital or health system. Gender and age were available for each patient accessed through the portal.

Analysis

The unit of analysis for this study was the portal usage session. We defined a session as all portal-based viewing activity by a given user for a given patient on a given date [13]. We described the portal users and sessions by job type, specialty, and place of work. To account for multiple sessions per user and the nesting of users within practices (and organizations), we modeled the association between session characteristics and access of imaging using multilevel mixed-effects linear probability models. Portal users and organizational identifiers were