Clinical Evaluation of a Lay-Language Radiology Glossary Integrated into an Electronic Health Record System

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Abstract. Radiology reports typically contain complex, technical language that can pose a barrier to patients, especially to those with limited educational attainment or literacy skills. PORTER—the Patient-Oriented Radiology Reporter system—incorporates a lay-language glossary to help patients understand radiology report content. The system displays illustrations and definitions of radiology terms when viewing a report. A large U.S. health system integrated PORTER into the patient portal of its electronic health record (EHR) system and evaluated its use during a 7-month study period. Of 4,664 concepts defined in its glossary, 4,607 (98%) were readable at the 8th-grade level. Of 10,859 patients who completed a single-question survey, 6,947 (64%) found the system to be helpful or very helpful. A system that integrates illustrations and lay-language definitions of medical terms into a patient portal can help patients better understand the reports of their radiology examinations. Such a system has potential to improve communication for patients with limited health literacy.

Keywords. Patient-centered care, patient portals, radiology, patient-clinician communication, health information literacy

1. Introduction

Patient portals offer personalized access to the electronic health record (EHR) to help patients to access their health information online [1-4]. Radiology reports constitute an important source of information for patients: most patients wish to view their radiology report [5] and a majority of those with access to their radiology reports viewed their reports online [6]. Because radiology reports are intended for communication between medical professionals, patients often have difficulty understanding the medical jargon contained in these results [7]. Without a radiologist or referring provider to explain the results, the lack of understanding of radiology reports may cause the patient unnecessary anxiety [8].

Health literacy can pose a major barrier to patients. The average U.S. adult reads at the 8th grade level (approximately age 13), but radiology reports typically are written at a 13th grade reading level. In one sample, only 4% of reports were readable at the 8th

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grade level [9]. PORTER—the Patient-Oriented Radiology Reporter—incorporates a glossary and a web-based application to annotate radiology reports with illustrations and lay-language definitions of radiology terms. PORTER was developed to empower patients to become more engaged in their care, to better consume the knowledge within their radiology reports, and to overcome their limitations in health literacy. This report describes the implementation and clinical evaluation of PORTER in the patient portal of a large health system.

2. Methods

After development of a prototype system as a successful standalone pilot project [10,11], PORTER was implemented within the patient portal of the electronic health record (EHR) system (Epic Systems, Verona, WI, USA) at the University of Pennsylvania Health System (Penn Medicine, Philadelphia, PA, USA). Penn Medicine is a large academic health system that includes eight hospitals and more than 10 multispecialty outpatient clinics in urban, suburban, and rural settings; more than 1.5 million radiology procedures are performed each year.

To understand how PORTER's glossary could address the needs of patients with limited reading ability, we assessed the reading grade level of the definitions in PORTER's glossary. The reading grade level was computed as the arithmetic mean of three widely used readability indices: Flesch-Kincaid Grade Level [12], Gunning Fog index [13], and Simple Measure of Gobbledygook [14]. Because evaluation of the prototype system showed that patients strongly favored the inclusion of illustrations, the number of concepts with associated illustrations was tallied.

During the study period from September 2021 through May 2022, we tallied the number of examinations for which patients accessed PORTER. A single survey question ("Did the pop-up definitions and images make it easier to read your report?") was displayed to the patient along with the annotated report; the patient could respond by selecting a response on a 5-point Likert scale from "not at all" to "a lot." An example screen shot of the system's display is shown in Figure 1.
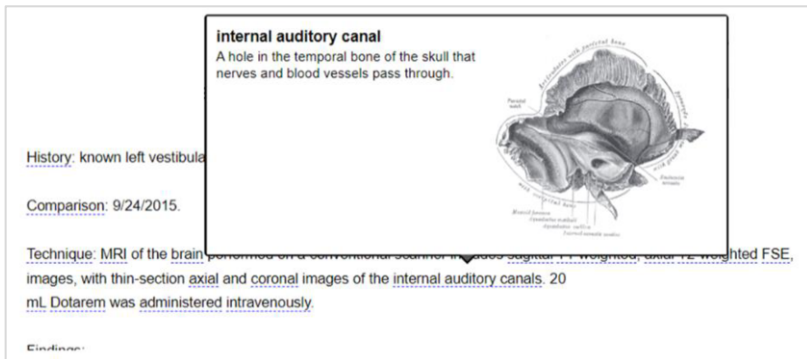

Figure 1. Example screen shot of an annotated radiology report in the patient portal. Terms with definitions are underlined. Here, the patient's mouse hovers over the term "internal auditory canals"; the system displays the corresponding definition and illustration in a pop-up "tool-tip" window.

3. Results

3.1. Glossary

PORTER's glossary contained 4,664 defined concepts, of which 1,377 (30%) included an illustration. There were a total of 14,423 terms, which includes the defined concepts and their lexical variants, such as plural forms, adjectival forms, synonyms, and abbreviations. For example, the concept *femur* had related terms *femurs*, *femora*, and *femoral*; the concept's definition, "The thigh bone," had a reading grade level of 1.5. Almost two-thirds of concepts' definitions were readable at the 5th-grade level, and 98% were readable at the 8th-grade level. The cumulative readability scores of the glossary's concepts and terms are shown in Table 1.

Table 1. Cumulative number (and percentage) of the PORTER glossary's concepts and terms that are readable at the specified grade level.

Grade Level	No. of Concepts (%)	No. of Terms (%)
4	2,408 (52%)	7,342 (51%)
5	2,993 (64%)	9,067 (63%)
6	3,425 (73%)	10,334 (72%)
7	3,839 (82%)	11,656 (81%)
8	4,607 (98%)	14,251 (99%)

3.2. Patient evaluation

During the 7-month study period, 69,494 patients used PORTER, with slight month-over-month growth to end at 9,832 patients in May 2022 (Figure 2). The survey question received 10,859 responses; of those 1,604 (14.8%) were positive and 5,343 (49.2%) were strongly positive. Figure 3 shows the full distribution of scores.
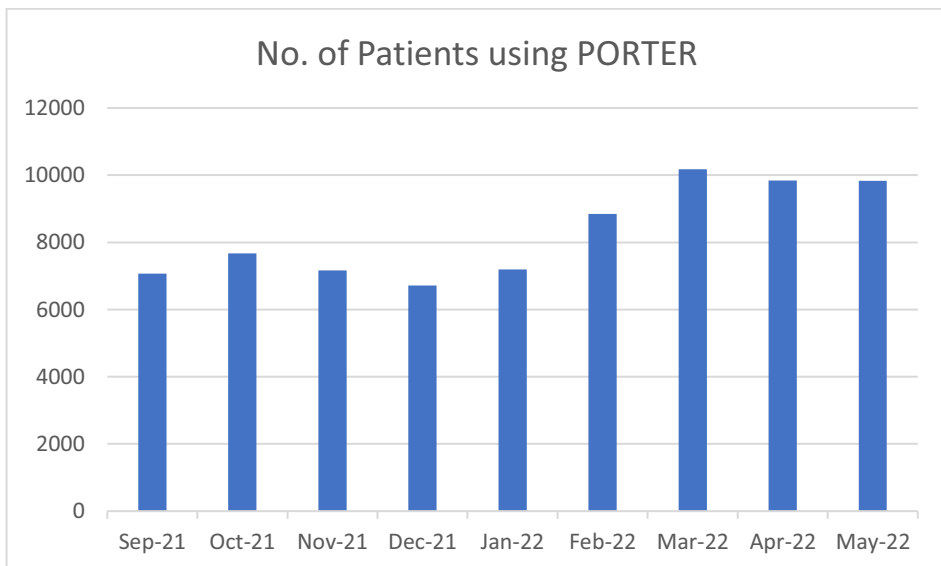

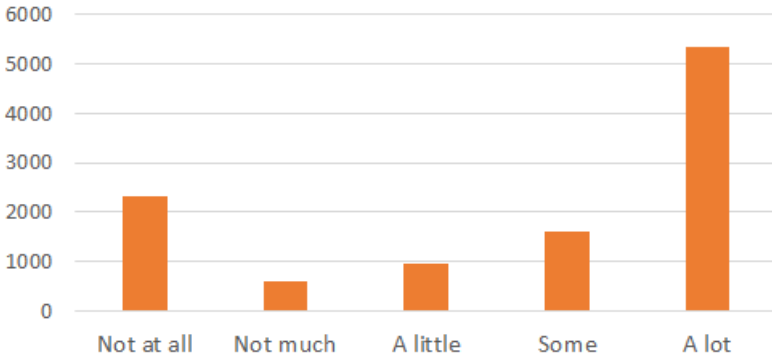**Figure 2.** Number of patients each month who opened PORTER.

Figure 3. Histogram of patient responses to the question, "Did the pop-up definitions and images make it easier to read your report?"

4. Discussion

Health literacy—which includes general reading ability and an understanding of medical terminology—is an important factor to consider to assure that patients receive equitable and effective healthcare. Efforts to make medical care more patient-centered require tools to help bridge the gaps in understanding that can arise between patients and healthcare providers. In particular, the unfamiliar terms and long, complex sentences of radiology reports limit most patients' ability to understand the reported information.

The current study had several limitations. When viewing a radiology report through the web-based patient portal, patients accessed PORTER by clicking a link that read, "Help me understand my report." The link typically appeared below the text of the report itself, and was not highly visible. One consideration to increase utilization of PORTER would be to make it the default for display of radiology reports. PORTER was not accessible through the versions of the patient portal for smartphones or tablet computers. No demographic information was available about the patients who used the system or about those who answered the survey question. Such information would be helpful to better understand the types of radiology procedures for which patients seek information, and the demographic characteristics of patients who seek out additional information.

5. Conclusions

Illustrations and lay-language definitions offer one approach to improve patients' understanding of the content of radiology reports. Systems that provide such information provide a means to overcome barriers of limited health literacy. An important avenue for future study will be to understand the further impact of such information on care delivery and health outcomes.

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