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Short communications and technical notes

Real world challenges in maintaining data integrity in electronic health records in a cancer program

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ABSTRACT

Electronic Health Record (EHR) systems increase clerical workload, promote copy-paste and error propagation. Documentation error rate in cancer diagnosis and treatment was examined in 776 patient records. Fifteen percent of the charts contained an error. Modern EHR systems, patient portals and engagement tools may facilitate the maintenance of accurate information.

Introduction

The integration of Electronic Health Records (EHRs) generally aims to enhance documentation and accessibility of patient records for improved patient care. As of 2017, more than 94 % of hospitals in the United States are utilizing EHRs [1]. Similarly, the adoption of EHRs in Canada has been on the rise, predominantly led by Canadian primary care practices, of which 86 % used EHRs in 2019[2]. However, it has been shown that EHRs can increase the workload of healthcare providers [3,4] and add to the burden of practice inefficiency. The quality of data stored within EHR is affected by design quality, usability, and functionality of the incorporated features [5].

Beyond EHR's aims to enhance the documentation and accessibility of patient records for improved patient care, it has been widely adopted to also save clerical time and institutional costs. However, it has been shown to be capable of increasing the clerical workload of physicians, including additional time spent on documentation [3,12]. To compensate for this added burden, physicians have adapted their documentation habits using note templates, EHR-featured text auto-population, and copy-and-paste functions. While this practice improves efficiency and limits errors from retyping information, existing mistakes can be propagated across multiple visits, potentially leading to unfavourable health outcomes. In a specific experience, for example, it has been documented that approximately 2.6 % of these documentation errors lead to serious medical issues for patients [6]. Moreover, clinical setups may not be conducive to real-time charting previously used in paper documentation, which leads to frequent electronic charting by memory [13,14].

With increasing patient access to their own healthcare records, the accuracy of EHR information is essential to maintain their trust in healthcare institutions. Healthcare data is also increasingly recognized for its potential in advancing medicine through the integration of Big Data projects, multi-centre collaborations, and artificial intelligence. However, the value of such data can only be maximized if they are organized, robust, and reproducible [7]. The University Health Network (UHN) migrated from one EHR system (QuadraMed) to a new EHR system EPIC (Epic Systems) in June 2022. This presented for the unique opportunity to conduct a quality improvement study to examine the baseline rate of EHR documentation error rate and their potential sources. During the EHR migration, UHN interns manually extracted oncology history from the previous EHR system (date of diagnosis, cancer staging, details of treatment planned and received, and any notable developments of the disease) and subsequently inputted the data into the new EPIC EHR system's "Problem list". This manual transfer of key cancer related history complemented the transfer of old patient notes and served to mitigate the propagation of individual patient record errors and allowed for the recording and correction of existing errors.

The purpose of this study was to report on the documentation error

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rate and to suggest potential sources for these errors within transferred patient records in the Genitourinary (GU), Skin and Sarcoma Radiation Oncology Clinics at the Princess Margaret Cancer Centre.

Methods

This was a quality improvement study whereby patient records were retrieved from our institutional Electronic Patient Record (EPR) system (QuadraMed, Texas, USA). A waiver of individual patient consent was granted for this quality improvement study (QI ID 22-0342) by our institution's Research Ethics Board (REB). As mentioned previously, the aim of this quality improvement study was to assess the rate and type of documentation errors within EPR. There was no comparator intervention within the study.

Data transfer from EPR to the newer EPIC EHR (Epic Systems, Wisconsin, USA) occurred at Princess Margaret Cancer Centre from May to September of 2022. Data abstraction consisted of reviewing and extracting patient information from EPR clinic notes, operative and radiotherapy records, and other patient files to populate corresponding fields within EPIC. Data abstractors consisted of undergraduate, graduate, and medical students who were assigned to specific cancer clinics throughout the 4-month duration. Following an introductory orientation on EPR, EPIC and cancer diagnosis and management, the students were assigned to site-specific radiation oncologists for continued supervision and correction. They only handled patient EHR's from the site (s) they were taught in and assigned to. Data abstraction was conducted manually without a copy-and-paste function to prevent the transfer of existing errors and add information that was not previously attached to the record. Transferred data included cancer diagnosis, staging, treatments, allergies, and problem list, which included non-cancer related diseases and comorbidities.

During the data transfer, documentation errors were sampled from patients' records followed at the GU, sarcoma, and skin clinics in the Radiation Medicine Program in July 2022. These clinics were chosen to represent common, rare, and highly diversified cancer sites, respectively, within the Princess Margaret radiation oncology practice, in which the work of 4/20 Full-time equivalent (FTE) of the data abstractors was assessed. The work from the students chosen represented different cancer sites, so that the data could be compared with each other. For the one-month period, the total number of patient charts transferred and any identified documentation errors related to cancer diagnosis, staging, and treatments were tabulated. Cancer staging observed in patients' charts were verified against the cancer staging entered by cancer registrars. The cancer registrars inputs were used as the standard, as there is significantly less room for error when inputting information after patient evaluation. Data from the month of July 2022 was selected for this study as students would have had sufficient time to learn and get accustomed to the EHRs and their assigned cancer sites. Student abstractors worked outside of the stressful clinical environment and were tasked to complete chart abstraction of patients who were to be seen the next day in clinic. Typically, 10–20 min are needed per chart abstraction, depending on the complexity of the patients' history. A documentation error refers to any error, discrepancy, or inconsistency found in a patient's EHR, including inconsistent information among clinic notes and missing information from essential fields such as date of diagnosis, cancer staging, treatment details, and disease history. Documentation errors were logged, described, and resolved under the guidance of supervisor oncologists to ensure that the corrected information was used to populate EPIC.

Once error data from all three clinics were compiled, the errors were examined and classified as either 'major' or 'minor'. If extracted and propagated forward, a major error could have serious effects on patient care, while minor errors would have a lesser effect. The assignment of error types were reviewed by supervising radiation oncologists.

Data was collected within Microsoft Excel (Microsoft, Redmond, Washington US). Descriptive and statistical analyses and graphs were performed using Microsoft Excel.

Results

This quality improvement study sampled 10 % of the data abstraction that occurred over the summer of 2022. A total of 776 cancer patients' charts across all three cancer sites were reviewed and transferred from EPR into EPIC. GU charts consisted of 628 (80.9 %) patients, 99 (12.8 %) charts were from the sarcoma clinic, and 49 (6.3 %) charts were from the skin clinic (Table 1). Of all the abstracted patient charts, 119 (15.3 %) were identified to have at least one documentation error or discrepancy in their EHR (Table 1). One documentation error was found in 111 (93.3 %) of the charts, while 8 (6.7 %) charts had two or more documentation errors.

The overall error rate was 15.3 %. However, the error rate was not consistent across all cancer sites (Fig. 1a). A near identical error rate was identified in both the genitourinary and sarcoma clinics at 14.0 % and 14.1 %, respectively. The skin cancer clinic showed a significantly higher error rate at 34.7 %.

Errors were further classified as either 'major' or 'minor' (Table 1, Fig. 1b). Major errors were defined as those that had the potential to affect a patient's course of care, including discrepancies in cancer diagnosis, clinical or pathological staging, grading, and treatment regimens. For example, a discrepancy in the grade of prostate cancer (using the Gleason classification system) is considered a major error. Naturally, a lower-grade cancer, such as a Gleason 6 adenocarcinoma, will be treated differently than a medium-grade cancer, such as a Gleason 7. Patients with Gleason 6 may be offered the option of expectant management (e.g. monitoring with trending PSAs), whereas Gleason 7 cancers are more often treated with radical prostatectomy or radiotherapy. Therefore, Gleason score needs to be accurately recorded throughout a patient's history, and an error in score can have considerable effects on patient care.

Minor errors were those that did not pose significant consequences for future patient care, such as missing information on medication doses and missing pathology reports. A missing dose of a previously administered drug is considered a more minor error because generally the physician need not rely on that omitted information to guide their subsequent treatment decisions. They have the option to consult guidelines or standard practice to determine the appropriate dose for their patient at present and moving forward.

The majority (85.9 %) of reported chart errors were considered major. The proportion of major versus minor errors varied by cancer site (Fig. 1b). The highest proportion of major errors was identified in the genitourinary group (95.8 %), followed by the skin group (83.3 %). The

Table 1
Patient and Documentation Error Data.

Patients	N = 776
Cancer site:	N (%)
Genitourinary	628 (81 %)
Sarcoma	99 (13 %)
Skin	49 (6 %)
Patients with errors	119 (15 %)
Patients with one error	111 (14 %)
Patients with two or more errors	8 (1 %)
Errors[†]	128 (100 %)
Major errors	110 (86 %)
Genitourinary	92
Sarcoma	3
Skin	15
Minor errors	18 (14 %)
Genitourinary	4
Sarcoma	11
Skin	3

[†] Major and minor error rates are based on absolute number of errors, not number of patients with errors.

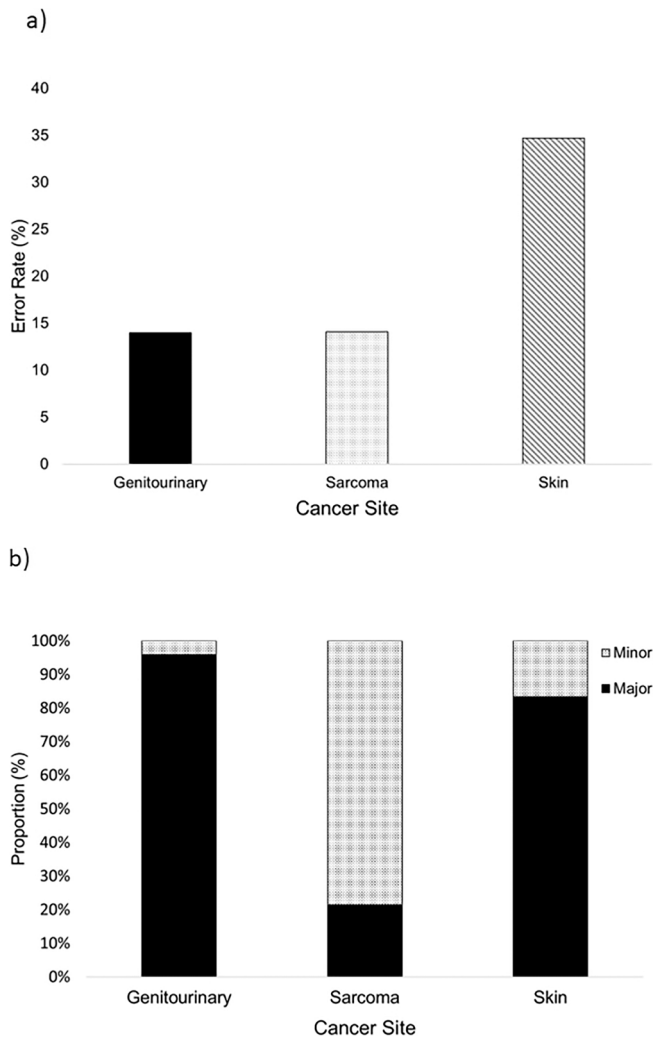

Fig. 1. Proportion of charts with errors per cancer site. 1a: Error rate by cancer site. The rate of documentation errors found in patient charts per disease site. Genitourinary (GU), Sarcoma (SARC) and Skin. 1b Proportion of major vs. minor errors by cancer site. Genitourinary (GU), Sarcoma and Skin.

sarcoma clinic included more minor errors (78.6 %) than major errors (21.4 %).

Regarding the GU EHR, most errors related to prostate cancer were considered major, predominantly related to significant discrepancies in dates of diagnosis, radiation therapy, and hormone therapy, as well as staging and grading, which includes clinical stage, pathological stage, Gleason score, and initial PSA level. Note that differences in actual versus recorded dates of less than one month were not considered major. Discrepancies seem to stem from a lack of consistency in notetaking and formatting among different physicians and disciplines. As patients with prostate adenocarcinomas are followed over a long period of time, changes in a patient's provider occur and new errors are introduced, which are then propagated to subsequent encounters. Error propagation is exacerbated by the ease and efficiency of copy-pasting in electronic systems, which is not available to providers when they are required to chart by hand.

The care of sarcoma cancer is unique at the Princess Margaret Cancer Centre, whereby patient care is shared between two neighboring institutions with different EHR systems. EHR errors in the sarcoma clinic were related to missing or incorrect treatment information, such as missing clinic notes and incorrect medication dosages, which were primarily classified as minor errors. The clinic's EHR errors may potentially arise from the inconvenience or inaccessibility of information from the other EHR for confirmation or documentation.

Concerning the skin cancer clinic, the major EHR discrepancies consisted of inconsistent localization, diagnostic dates and histology of various skin cancers in the same patient. Patients seen at the skin cancer clinic typically have multiple skin cancers. The major EHR discrepancies were amplified when multiple physicians were involved in the care of the same patient, leading to inconsistent interpretations in the patient's history. This is seen with the skin clinic's major error rate of 83.3 %.

Discussion

Of all the abstracted patient records, 119 (15.3 %) patients had at least one documentation error or discrepancy in their electronic medical records. 85.9 % of all errors extracted were major errors, and if propagated further, could have significantly impacted a patient's past disease management. For example, a patient's prognosis may worsen due to delayed or incorrect treatment that stems from lesion-location misinterpretation, inconsistencies with Gleason score or inconsistencies in pathological and clinical staging. This study did not aim to evaluate the impact of the identified errors on cancer patient care and management. The charts abstracted during this study consisted of patient charts on follow-up only, and the errors identified were often secondary to changes in health care providers over a longer period of time. As such, it was unlikely that the observed errors affected cancer care. However, the risk of the errors affecting future care is present, with an increasing number of patients surviving longer, who may need further cancer treatments for delayed toxicities, recurrences, or new cancers.

As modern EHRs incorporate a single source of diagnosis documentation from which physicians can refer and correct over time, the consistency of a patient's oncology history will improve. Visual maps are also available to document the location of various lesions, potentially empowering physicians who care for patients with multiple cancer diagnoses. However, such improvement in patient oncology history can only occur if utilized by all physicians involved in each encounter. As sarcoma patient care is shared by 2 institutions with independent EHRs, additional efforts would be needed to accurately transfer and record reports in the patient's electronic charts. Additionally, patient engagement in their own health record keeping could further ensure the accuracy of the data within EHRs [9]. Institution specific patient portals along with independent person-centered health platforms would allow patients to partner and participate in their own EHR upkeep. This joint EHR access may decrease documentation error rates as team documentation can assist to ensure clinical notes, laboratory results and medical imaging reports are correctly reported. However, the concerns regarding the extent of information sharing and the potential for unauthorized access and prejudice need to be evaluated. Finally, with advances in natural language processing, the use of automated flagging of potential discrepancies across notes could aid physicians and patients in identifying errors or misunderstandings.

Prior reports on the rate of documentation errors in patient charts [8–10] have suggested that approximately 40 % of patient charts contained serious mistakes, of which diagnosis misalignment is the most common mistake category. Using a Natural Language Processing method, Warner et al. observed 83.6 % of cancer patients had discordant cancer stages within their charts [11]. A meta-analysis by Tsou et al. suggested that approximately 2.6 % of EHR major errors lead to subsequent unplanned care. The above studies corroborated our study's results and observations.

In conclusion, although the implementation of EHR was meant to improve documentation and accessibility of patient records for enhanced patient care, it has introduced new challenges in maintaining the accuracy of patient records over time. Whereas the transition from paper chart to EHR was relatively swift, the adoption of EHR has not been well integrated into clinical setup and workflow which largely followed the customs used during paper chart era. In deploying EHRs, institutions augmented their potentials in improving information

accessibility, patient safety and reduced costs, but may have discarded or ignored some of the virtues related to paper chart routines. For example, healthcare providers may not be able to document during their patient encounters at point of care, as they would have done with paper charts. Asynchronous charting had previously been found to be a major source of documentation inaccuracy along with interrupted workspace during charting [15–17]. Furthermore, lack of standardized documentation practices across healthcare workers can generate new errors that are perpetuated through subsequent notes. More recently, Natural Language Processing tools are being explored to help extract oncological history to complement existing EHRs and reduce the workload of physicians [18,19]. Physician could also verify the accuracy and completeness of the patient's EHR information in real-time together with the patient and caregivers [20]. Finally, patient access to EHR records and their active engagement may decrease documentation error rate [9], through their collaboration in reporting disconnects between their understanding and what was described in their own clinical notes.

CRediT authorship contribution statement

Harpriya Khela: Methodology, Formal analysis, Writing – original draft. **Justin Khalil:** Methodology, Formal analysis, Writing – original draft. **Nathan Daxon:** Methodology, Formal analysis, Writing – original draft. **Zdenka Neilson:** Methodology, Formal analysis, Writing – original draft. **Tina Shahrokhi:** Methodology, Formal analysis. **Peter Chung:** Methodology, Formal analysis. **Philip Wong:** Conceptualization, Methodology, Writing – review & editing, Supervision, Project administration.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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