A Patient Portal for Clinical Trials: Towards Increasing Patient Enrollment

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Abstract

Clinical trials face delays due to the inability to enroll the necessary number of patients. A survey performed on cancer clinical trials demonstrated that American adults are willing to participate in clinical trials, however there is often an inability to recruit the required number of participants to a clinical trial study. To address this deficit, we propose an application that mines patient records, to extract diagnoses via ICD 9 codes obtained by natural language processing (NLP), and links patients with clinical trials relevant to their diagnoses. The patient portal searches relevant clinical trials tailored to a user's personal demographics, allows users to save trials from previous searches, provides a medium to initiate contact with a recruiter prior to enrollment with a click of a button, and presents additional information targeted towards patient needs such as options for continued care, cost of participation and required appointments and procedures. We theorize that this application will improve patients understanding of clinical trial information and potentially increase enrollment rates.

Introduction

Failure to recruit the required number of participants to a clinical trial is a significant hurdle impeding clinical trial research[1]. Achieving the required numbers of patients is necessary to ensure statistical power and that results will be applicable to populations outside the clinical trial participants. The failure is not due to a participant's unwillingness to enroll. 32% of American adults surveyed indicated they would be very willing to participate in a cancer clinical trial if asked to do so and an additional 38% of adults are inclined to participate in a clinical trial if asked, but hold some questions or reservations about participating[2]. The primary problem with accrual of patients is due to the lack of awareness of an appropriate clinical trial[3]. Specifically within the domain on cancer, less than 1 percent of cancer patients enroll in clinical trials. In addition, while over a third of the U.S. population identifies as a minority, less than 1% of those enrolled in cancer clinical trials are minorities. In comparison to other types of cancer, lung cancer patients are less likely to enroll in clinical trials than other cancer patients[3]. Although the average age of a person diagnosed with lung cancer is 71[4], patients over the age of 64 are underrepresented in clinical trials. A lack of participants affects research quality. A diverse group of participants is needed to design effective therapies[3,4].

The emergence of the internet has brought new opportunities for patients to be more active in their care. A particular group of patients, cancer patients, have been shown to utilize medical information online. A survey of a group of patients' self-reported Internet use before and after the diagnosis of cancer found that use of the Internet either directly (i.e., patient themselves doing the research) or indirectly (i.e., someone else searching for the patient) increased[5]. Similarly, another survey of cancer survivors, cancer patients, and patients with no history of cancer found that survivors and cancer patients tended to have a more positive view of electronic health records (EHRs) and the potential for access to its contents, as well as Health Information Technology (HIT) in general[6].

Across patient types, patient portals are being implemented[7-10], and are likely to become commonplace. Patient portals allow patients to electronically access health information managed by a healthcare institution. This is in part driven by the paradigm shift from patients as recipients of care to active members of their healthcare team. Portals are documented as having the potential to help patients make care decision[11]. They also contain the potential for patients to make health decisions that benefit others in addition to themselves, such as staying abreast of public health campaigns or enrolling in clinical trials.

Background

Other attempts to increase clinical trial enrollment use more traditional forms of patient outreach, including: using physicians as the contact point and the distribution of public services messages (e.g., T.V. and radio commercials) [12]. Previously, an EHR, the clinical counter-part of a patient portal, had been enhanced to alert physicians when they were treating a patient that fit clinical trial recruitment criteria[1]. The enhanced EHR resulted in a significant increase in the number of clinical trial referrals a physician wrote, and the number of patients who enrolled in a trial.

Similarly, in an intervention where patients were exposed to educational content about clinical trials[12], patients had a more positive attitude regarding enrolling in clinical trials after they watched an educational video.

While other efforts have helped to increase the number of patients enrolled in a trial, they do not provide a platform for disseminating clinical trial information directly to patients across trial types and patients. Using doctors to recruit patients does not enable patients to search for trials on their own. The website ClinicalTrials.gov does allow for patients to search for trials, but does not provide a means to contact the recruiter via the site, or make inclusion criteria explicit. Nor does ClinicialTrials.gov let patients save information about trials, enabling them to review the information later, and compare trials to one another. Using other media to educate patients about clinical trials as seen in Nelson 2013[12] can only provide either general information on the subject of clinical trials, or information about one specific trial. Our application provides specific information about trials, including inclusion criteria, and allows for the user to communicate with recruiters. Our application enables patients to refer back to clinical trial information at a later time and to compare trials. Providing this level of detail and the ability to save and compare trials empowers patients, encouraging patient involvement based on the information they have received.

Proposed Implementation

I. System Architecture

Our proposed system provides a link between the patient's clinical data and relevant trials from ClinicalTrials.gov. The portal is intended to summarize patient information already disclosed to the patient, highlight aspects of this information, and rate its relevancy to current clinical trials. The system architecture is shown in Figure 1. The portal fetches the required patient information. Personal medical record information is automatically searched, and ICD-9 diagnoses codes are annotated from patient reports. The extracted features (age, sex, diagnoses) are stored in a database on the server. These features are submitted to ClinicalTrials.gov and the search results are returned to the portal database. A user can access the patient portal page with the appropriate authentication. Upon logging in, a dynamically generated HTML page will display relevant clinical trials based on the search criteria of extracted features.

II. Components of Patient Portal

The main components of our patient portal are as follows (Figure 2): (1) a panel summarizing diagnoses extracted by the NLP system; (2) a panel displaying a ranked list of relevant clinical trials tailored to the patient based on age, sex, and diagnoses (these filters can also be removed); and (3) a panel summarizing the clinical trials that a patient has flagged as "of interest," each with a requirement checklist provided by the recruiter.

(1) Extracted Diagnosis

NLP modules are used to identify extracted diagnoses. A candidate list of health concerns is automatically extracted from the summary or conclusion section of radiology, pathology, or physician reports using the Mayo Clinical Text Analysis and Knowledge Extraction System (cTAKES) natural language processing (NLP) software in combination with Systemized Nomenclature of Medical Clinical Terms (SnoMED-CT) terminology[13]. Negated health concerns are deleted from the final set using cTAKES integrated negation detector. Examples of extracted diagnoses include tumor, chronic obstructive pulmonary disease (COPD), and smoking status in 5-predetermined categories. The final list of extracted diagnoses is displayed in the My Diagnoses section, and each diagnosis can be clicked on to see its definition. These diagnoses are also used as search terms to retrieve relevant clinical trial results.

(2) Relevant Clinical Trials

The query is performed using the search engine from ClinicalTrials.gov. There are preset filters on the left-hand-side of the webpage to identify clinical trials based on age, location, and conditions. Initial search results will also utilize the diagnoses extracted from the patient's medical record that are listed in the My Diagnoses section. The user can click on trials within the Search Menu's results (Figure 2, Module 2A) to see a trial's details displayed in the Clinical Trial Information Panel (Figure 2, Module 2B). At the top, Clinical Trial Information Panel summarizes general information including the condition, intervention, and primary outcome. In the middle of the panel, a table displays the inclusion and exclusion criteria organized by category and compares each criterion to the user's

characteristics. User characteristics are extracted from defined fields within the EHR. Other characteristics can be manually entered by the physician or the user. At the bottom, the panel summarizes to the user whether the user is eligible for the study based on initial search results.

Within the Clinical Trial Information Panel there is a Contact the Recruiter interactive button (Figure 2). The Contact Recruiter button lets the user send an email to the primary investigator to request more information about the trial. This request message also contains the patient's original search criteria (age, sex, diagnoses), to help the recruiter to determine how eligible the patient is for the trial in question. The recruiter requests more information regarding eligibility from the patient using the Determine Eligibility form (Figure 4) and can then reply with the additional Clinical Trial Requirements form (duration of study, cost of study, compensation, number of visits, etc.) (Figure 5). The Determine Eligibility and Clinical Trial Requirements forms are dynamic, based on the trial criteria. When the patient returns the Determine Eligibility form via the portal, the recruiter has extra information, from which to assess the patient's eligibility. This user and recruiter communication workflow is seen in Figure 3. The Add to My Clinical Trials button takes the current selected trial and adds it to the patient's My List of Clinical Trials (Figure 2 Module 3B). Although the Clinical Trial Requirements form has not been standardized, past research suggests patients are interested in learning about the cost of trials, additional tests, and follow-up care for trials[2]. Our evaluation will assess whether these information interests hold true for patients. The Clinical Trial Information Panel also contains a Request a Brochure interactive button. This button sends a request for a general overview of the study, similar to the hardcopy brochures available on clinical trials currently. Using the Request a Brochure button takes the current selected trial and adds it to the patient's My List of Clinical Trials, which is updated with the brochure content provided by the recruiter.

(3) My List of Clinical Trials and Menu Bar

This panel displays all trials selected by the user. After a trial is added using the panel above, the trial is indexed in the Clinical Trial Menu Bar (Figure 2, Module 3A). The Clinical Trial Viewer (Figure 2, Module 3B) is populated with additional information provided by the recruiter in the Clinical Trial Requirements form, such as cost of participation and any compensation; and requirements of the trial, including intervention, follow-up requirements, and options for continued care. The purpose of this panel is to track the details of each clinical trial study prior to the initial meeting with the recruiter.

Within the Clinical Trial Menu Bar, a user can check the status of each trial and perform actions if necessary. Each tile contains a customized name given by the user, and the title of the trial. The status is displayed in green (i.e., Complete Form), demonstrating that action is necessary; or red (i.e., Awaiting Recruiter Response), demonstrating that no action is necessary. A user can scroll through the tiles and click on one to populate the Clinical Trial Information Panel (Figure 2, Module 2B) and the Clinical Trial Viewer. Before enrollment, the Clinical Trial Viewer displays the checklist of steps required. After enrollment, a distinction is made between steps completed, such as initial visit completed, and steps remaining, such as follow-up appointment (not shown). The user can also export the list, print it out, and show it to their physician for more input.

Proposed Evaluation

We designed a patient portal to improve understanding, perform queries more easily, and facilitate communication. To determine if users report improved understanding, we will conduct usability testing of the portal. During this usability test, patients will compare the search results of the portal to the status quo, ClinicalTrials.gov. This usability testing will be a two arm cross over test. Patients will be randomly divided into two groups: Group A and Group B. Group A will first use our designed portal and then the website ClinicalTrials.gov. Group B will use the website ClinicalTrials.gov and then the portal. Both groups will complete a questionnaire (Table 1) after each step, based on the survey by Wu 2013[14], to determine which format they found better improved their understanding of what clinical trials were applicable to them, and which format they found easier to use.

In addition to a usability study, patients will also be followed for one year via email to determine rates of participants' enrollment in clinical trials. To do this, patients will be sent an email twice, once six months after completing the usability study, and the second time, twelve months after, to ask if they have enrolled or attempted to enroll in a clinical trial. They will be asked if they have enrolled or attempted to enroll, as some patients may try to enroll but find themselves disqualified.

Perceived Usefulness	
1	Using this portal/website can make me accomplish clinical trial information tasks quickly.
2	This portal/website is useful to manage my clinical trial information.
3	Using this portal/website can increase my productivity in managing my clinical trial information.
4	Using this portal/website can enhance my effectiveness in clinical trial information management.
Perceived Ease of Use	
5	This portal/website is easy to learn how to use.
6	This portal/website is easy to operate.
7	It should be easy to become skillful at using this portal/website.
8	This portal/website is not difficult to use.
Patient-Researcher Communication	
12	Using this portal/website can assist my communication with clinical trial researchers.
13	Using a portal/website can assist the communication between patients and clinical trial researchers in general.
Health Information Understandability	
14	Using this portal/website can improve my understanding of what clinical trials are relevant to me.
15	Using this portal/website can improve my understanding of a trial's inclusion and exclusion criteria.

Table 1. Usability Test Survey

Discussion

This portal allows for patients to search for clinical trials that match their demographics (age and sex) as well as diagnoses found in their medical records. While this portal can be used to directly provide patients with clinical trial information, future work can include integration with a tool like the enhanced EHR in Embi et al. 2005[1]. The enhanced EHR interface could add the function of letting a physician send a message to a patient regarding a trial that matches their criteria. Patients could then access these messages via this portal, with each message linked to the trial information provided in the Relevant Clinical Trials list.

Limitations of this work include the reliance on NLP to extract all diagnoses from the patient's medical records, the assumption that patients want these types of information on clinical trials, that recruiters will spend time filling out additional forms to provide patients with more information, that there is the potential to increase primary care physicians workflow should patients need help filling out the Eligibility Criteria form, and the difficulty in mapping ICD9 codes to eligibility criteria. While cTAKES has been used to extract findings from patient records[9], it may not prove as accurate in this domain. In the event that NLP does not capture all of a patient's diagnoses, manual entry and review by a physician will be necessary. This process can be streamlined, with the physician reviewing the annotations made by the system, to determine their correctness. The portal provides additional information to the patient to assist with making a better informed decision. However, a usability study is needed to better assess the types of information patients want. Results from the study will be used to refine the information visualized in the portal, to better reflect patient information needs and preferences. The portal clearly matches eligibility criteria with a patient's characteristics. However, there is no definitive mapping between ICD9 codes and eligibility criteria. A translation is needed between EHR vocabularies and their corresponding eligibility criteria.

A considerable contribution of this portal is it provides additional screening to find more patients with a higher chance of eligibility. However, additional tasks added to the recruiter workflow are a considerable effort to make. While there is a startup cost, these additional tasks can save time in the end. Creating these forms one time can help to save time later in the recruitment process, allowing for some of the patient-trial matching to occur asynchronously. Similarly, while some patients may need the help of their physician to fill out the Determine Eligibility form, this request could also be accomplished online, with an additional feature added to the portal to forward the form to the patient's physician.

Future directions for this work include: the usability study mentioned above, integrating this portal with an EHR system, and providing a dictionary within the portal to define difficult terms for patients. Integrating this portal with an EHR would have the benefits previously mentioned of allowing practitioners to flag relevant trials for patients,

and allowing patients to request help filling out the Additional Criteria form. A dictionary of clinical trial terminology with patient friendly definitions could be used to provide scroll over definitions within the portal.

Conclusion

The presented patient portal provides a solution to assist patients with finding an appropriate clinical trial. The portal automatically populates a search function with a patient's criteria and formats the results in tabular format alongside the patient's characteristics. Compared with the visualization for ClinicalTrials.gov, the presented patient portal's visualization filters information to present only what is relevant to user's diagnoses. It also provides information on care, financial, and scheduling, to assist patients deciding what trials fit their needs. In addition, a user can initiate and track communication with numerous recruiters to find the best clinical trial for them. Provision of this information can increase awareness and understanding of the clinical trial enrollment process, increase communication between recruiters and patients, and potentially increase rates of enrollment.

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