Assessing the Use of Data Analytics in Detecting Adverse Drug Events from Medical Records:

(Review Artical)

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Abstract

Background: Electronic health records (HER) use has increased in recent years, but there is a lack of detailedresearch on identifying asymptomatic diseases (ADEs) in ambulatory settings. This study aims to address this gap by examining methods of ADE identification in the ambulatory setting, as patients often have less contact with their physicians and maintain less thorough records. This will ensure accurate measurement of ADEs and reproducibility in future research.

Aim of Study: The objectives of our study was to analyze the techniques used and establish the functions of electronic health records (EHRs) in the identification and evaluation of adverse drug events (ADEs) in the ambulatory environment.

Methods: Our research included doing a systematic literature review by searching PubMed and Google Scholar for papers published before June 2017. These studies focused on adverse drug events (ADEs) that were discovered in the ambulatory environment and used the use of electronic health records (EHRs). We collected information on the features of the studies included in our analysis about the procedures used to identify adverse drug events (ADEs).

Results: Researchers used the Electronic Health Record (EHR) as a data source and utilized it to produce patient safety reports, which were then employed in the identification of Adverse Drug Events (ADEs). The identification methods used included manual record review conducted by skilled nurses, pharmacists, and/or doctors, prescription review, computer monitors, electronic triggers, International Classification of Diseases codes, natural language analysis of clinical notes, and patient phone calls and surveys. Seven investigations included instances of search keywords, laboratory results, and criteria used to detect adverse drug events (ADEs).

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Conclusion: Overall, most of the studies analyzed used Electronic Health Records (EHRs) as the primary data source for detecting Adverse Drug Events (ADEs). This retrospective methodology is suitable for quantifying the occurrence rates of Adverse Drug Events (ADEs), but it is insufficient for identifying preventive ADEs before damage is inflicted upon the patient. Researchers will be able to detect and address avoidable adverse drug events (ADEs) using advanced techniques that use computer monitors and electrical triggers.

Key Words: *Electronic Health Records – Review – Drug-Related Side Effects – Adverse Drug Reaction Reporting Systems – Medication Errors – Computerized – Ambulatory Care.*

Introduction

ADVERSE drug events (ADEs) refer to expected and unexpected negative consequences that occur as a result of taking certain prescriptions [1]. These events may happen in both hospital and non-hospital settings, and often result in harm or even death to the patient. Nevertheless, prior studies have mostly focused on instances of Adverse Drug Events (ADEs) inside the confines of a hospital environment. Recent studies have shown that the rates in the ambulatory context may range from 3% to 38% [2-6].

The reporting of incidence rates has advanced due to the use of electronic health records (EHRs) and the incorporation of computerized provider order entry (CPOE) with clinical decision support [7]. The effectiveness of CPOE in reducing ADEs has been proven in the hospital setting.

Previous methods for detecting ADEs relied on manual chart review by physicians and other trained

health professionals, who would examine medical notes, laboratory results, and prescription changes [8]. Executing this technique on a wide scale requires a significant amount of time and money. Several adverse drug events (ADEs) that happen outside of a hospital or clinic environment need additional methods of identification, particularly if patients do not actively seek medical attention for their symptoms. Measuring adverse drug events (ADEs) in outpatient settings can be done using patient surveys. Recent studies have developed tools like electronic triggers and automated computer monitors to help detect ADEs. These methods either use electronic health records (EHR) as a source of data or have integrated these tools into their functionality. Over 4 billion prescriptions are dispensed annually in the outpatient environment. Consequently, it is necessary to investigate the outpatient sector, where adverse drug events (ADEs) are sometimes challenging to identify owing to underreporting and inadequate management [9-11].

Aim of work:

Prior evaluations have examined the general frequency of ADEs, but none have conducted a thorough analysis of the various techniques used to identify them, particularly in recent times when electronic health records (EHRs) may have influenced the detection of ADEs. The objective of this research was to analyze the techniques used and ascertain the functions of electronic health records (EHRs) in identifying and evaluating adverse drug events (ADEs) in outpatient care. This was achieved by a comprehensive evaluation of existing literature.

Methods

We conducted a comprehensive search of the PubMed database and Google Scholar to identify papers published prior to June 2017 that investigated adverse drug events (ADEs) observed in outpatient settings with some use of an electronic health record (EHR). In addition, we used cited references as a supplementary method for selecting relevant research. The terms searched in PubMed were medication errors, adverse drug reaction reporting systems, drug therapy adverse effects, drug-related side effects and adverse reactions, iatrogenic disease drug therapy, emergency medical services, primary health care, patient admission, hospitalization, outpatients, ambulatory care, ambulatory care facilities, physicians family, family practice, medical records systems computerized, medication systems, software, ambulatory care information systems, drug therapy computer-assisted, medical order entry systems, decision support systems clinical. The search terms used in Google Scholar were (adverse drug event OR medication error) AND (ambulatory OR outpatient OR primary care) AND (electronic health record OR electronic medical record). We restricted the Google Scholar search to the top 100 results.

We considered peer-reviewed publications published in English from any nation, provided that the research attempted to quantify the occurrence of Adverse Drug Events (ADEs) in an outpatient environment and used an Electronic Health Record (EHR). Studies were eliminated if they did not assess adverse drug events (ADEs) in a non-hospital context, assessed ADEs without using an electronic health record (EHR), were systematic reviews or meta-analyses, lacked comprehensive data and conclusions, or were not available in full text. We manually retrieved the following information from the full-text articles: research setting, study design, sample size, followup time, ADE detection techniques, EHR role, ADE definitions, ADE prevalence, and restrictions.

Results

All the studies included in the analysis used a variety of techniques to detect and describe adverse drug events (ADEs) in the outpatient environment. The methods used included manual chart review conducted by qualified nurses, pharmacists, and/or doctors, prescription review, computer monitors, electronic triggers, International Classification of Diseases (ICD) codes, natural language analysis of clinical notes, and patient phone calls and surveys [13]. Two studies use the occurrence of a repeat visit to the emergency department (ED) or admission from the ED within 24 hours as their adverse drug event (ADE) trigger [14,15]. However, none of these researches offered a full list of search keywords, laboratory values, or logic rules. Five studies used the Naranjo algorithm to ascertain the probability that an adverse drug event (ADE) was caused by a specific medication rather than other contributing factors [13,16,17,18,19]. Two studies applied the Beers Criteria in research involving persons who were 65 years of age or older [20,21].

The primary function of the EHR was to serve as a data repository that researchers used to discover Adverse Drug Events (ADEs). EHRs assumed a passive role in 27 trials that were included. Instead than doing a manual examination of paper charts, researchers used electronic charts to identify signs of an Adverse Drug Event (ADE). The process of reviewing the charts was carried out by a team consisting of skilled abstractors, research nurses, doctors, pharmacists, and toxicologists. In a particular study, senior ED nurses examined the case file. If the nurses did not reject the file, it was then reviewed by emergency physicians [15]. In a French study, a committee consisting of clinical pharmacologists, internists, and general practitioners conducted the case review [22]. In all cases, chart review was considered the most reliable method for identifying ADEs, even in studies where a computer monitor or electronic trigger was utilized [16].

The studies included several methodologies for querying the electronic health records (EHR) to identify indications of an adverse drug event (ADE). Commonly used were laboratory data, clinical notes, and ICD codes. Cantor et al., conducted a search in free-text notes to identify trigger phrases that indicate adverse drug events (ADEs) [23]. On the other hand, Brenner et al., identified six specific laboratory values that were used to determine the stage at which the ADE occurred [9]. These laboratory values include international normalized ratio >5, serum creatinine >2.5, blood urea nitrogen >60, alanine aminotransferase >84, aspartate aminotransferase >80, and undetectable thyroid-stimulating hormone while on levothyroxine.

These values were adapted from a more comprehensive tool developed by Singh et al., [10]. Only the laboratory values were used because they have a high positive predictive value, and the researchers were able to extract the associated data [24]. Gandhi and his colleagues [3] created advanced methods to search and analyze laboratory data and prescription lists. They also used logical criteria to determine the presence of a probable adverse drug event (ADE). This study developed a search monitor that utilized a predefined set of rules to search the free-text electronic notes for symptom words that could indicate an adverse drug event (ADE). Honigman et al., [16] also developed a similar search tool that examined ICD-9 codes, allergy rules, computer event monitoring rules, and an automated chart review that used text searching of the electronic health record (EHR).

EHR use was found to be more innovative in three studies [13,[20,25]. Two of these studies demonstrated that CPOE provided decision support through alerts and pop-up notifications [20,25]. In the Terrell et al study, clinical decision support was implemented through a randomized controlled trial involving nine medications, which were identified as representing 80% of potentially inappropriate medications prescribed to seniors in the ED. The control group had a proportion of 3.9% of ED discharges resulting in potentially inappropriate medication, while the intervention group had a proportion of 2.6% [20]. In the second study, researchers focused on physicians' responses to dose-range alerts in the EHR system, but did not measure the occurrence of ADEs due to prescription errors [25]. The third study by Genco et al used an EHR system to generate data-based reports on patient safety, which were then used to identify ADEs during the review process [13].

The limitations often mentioned in various research were mostly associated with the reliance on Electronic Health Records (EHRs) as a reliable source of information. The lack of standardized documentation practices among physicians and across practices may not accurately reflect the rate of adverse drug event (ADE) occurrences. This is because missing relevant information in patient charts could lead to misclassification, and errors that are not documented in the electronic health record (EHR) may go unnoticed, resulting in an underreporting of ADEs [23,26-29]. In a study by Brenner et al, it was unclear from EHR documentation whether errors occurred due to a lack of monitoring or as a result of following recommended medication monitoring protocols [9].

Furthermore, many study designs primarily focus on identifying prescribing errors and may overlook preventable ADEs, such as those caused by medication errors in the wrong patients, incorrect diagnoses leading to inappropriate prescriptions, or drug interactions with other medications taken at home [17,30,31].

Research has also recognized that bias might have been present in situations when researchers and evaluating doctors were aware of the study's objective, therefore potentially influencing the results. Researchers could have exercised greater caution in their evaluations or excluded patients at high risk from the study, while providers could have been more cautious when prescribing medications [25,31,32]. Furthermore, Abramson et al., [17,18] observed that adverse drug events (ADEs) were most accurately assessed through a combination of chart review, patient interviews, or surveys, a methodology that was not employed in several of the studies included.

Discussion

We have discovered 30 papers that fulfill the criteria set for the review. We included studies that used Electronic Health Records (EHRs) in their research techniques to detect Adverse Drug Events (ADEs) in the outpatient environment. The majority of studies analyzed used computerized Health Records (EHRs) as data sources for conducting chart reviews. This included substituting the conventional method of paper chart review with computerized retrieval of laboratory results and visit notes. Several studies demonstrate the development of automated monitors and search tools that effectively analyze electronic patient data to detect adverse drug events (ADEs).

The utilization of electronic health records (EHRs) has grown in recent years due to advancements in health information technology and the implementation of Meaningful Use directives. Extensive research on adverse drug events (ADEs) has been conducted over several decades [33]. Although previous studies have investigated ADEs in outpatient settings, none have provided a comprehensive account of the specific techniques used to identify ADEs in outpatient settings, particularly with an emphasis on EHRs. In 2007, Thomsen et al., [34]

performed a systematic study on the occurrences of adverse drug events (ADEs) in ambulatory care. Although the previous review used similar search criteria, it focused on the characteristics of ADEs rather than the methods of identification, which is the focus of this study.

Our review specifically looks at the challenge of identifying ADEs in an outpatient setting, which is different from previous studies that focused on inpatient settings. Patients lack direct interaction with their doctors, in contrast to the hospital environment where physicians often evaluate patients [35]. In the ambulatory setting, individuals are accountable for acquiring and managing their own medications. However, they do not maintain as comprehensive records as hospitals do, which hampers the effectiveness of retrospective chart review. Therefore, it is imperative to investigate methods of identifying adverse drug events (ADEs) to ensure that researchers obtain the most accurate assessment of ADEs in the ambulatory setting. Additionally, these methods should be reproducible for future research purposes.

Conclusion:

Our analysis revealed that electronic health records (EHRs) were mostly used as data sources for the identification of adverse drug events (ADEs). Most of the studies examined used a retrospective methodology, which was effective in assessing the occurrence rates of adverse drug events (ADEs), but not in identifying preventive ADEs. Research that developed electronic tools with the ability to search the electronic health record (EHR) for certain words or laboratory results indicates potential for reducing the need on human chart review to identify adverse drug events (ADEs). Performing manual record review restricts researchers and clinicians to identifying Adverse Drug Events (ADEs) only after they have already occurred. By using computer monitors and electronic triggers to search the electronic health record (EHR) in real time, healthcare practitioners have the potential to promptly detect avoidable adverse drug events (ADEs) and implement necessary measures to prevent damage to patients.

Further investigation is required to assess the uniformity of record-keeping in different ambulatory environments, ranging from expansive outpatient clinics to compact primary care institutions. If there is a significant discrepancy in the documentation of patient data, the research findings will not accurately reflect the actual extent of ambulatory adverse drug events (ADEs).

This systematic review is subject to several limitations. We conducted a search on the publicly accessible databases PubMed and Google Scholar, which means that material published in other sources may have been excluded. The presence of inherent publication bias limited the quantity of publications accessible for examination. There was a scarcity of investigations on adverse drug events (ADEs) in the ambulatory environment in the published literature. Our focus was only on research that used Electronic Health Records (EHRs), which restricted our analysis to more recent studies as the usage of EHRs became more widespread. Given the high expenses associated with Electronic Health Records (EHRs), it is probable that the research were carried out in institutions that had the financial means to acquire an EHR. Consequently, the findings may not be applicable to a broader population.

In addition to the constraints of this review, electronic health records (EHRs) are further restricted by the data that is inputted into them. Insufficient standardized documentation standards might result in inadequate medical charts, which in turn impede the identification and monitoring of adverse drug events (ADEs). Medication reconciliation is a crucial task that must be carried out during patient visits to ensure that the medication list is accurately updated in the system. In conjunction with physician adherence, improved research instruments that are compatible with electronic health records (EHRs) will empower researchers to more effectively quantify, describe, and identify adverse drug events (ADEs) in outpatient care.

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تقييم استخدام تحليلات البيانات
فى كشف أحداث الدواء الضارة من السجلات الطبية:
مراجعة

الخلفية: استخدام سجلات الصحة الإلكترونية (EHR) قد زاد فى السنوات الأخيرة، ولكن هناك نقص فى الأبحاث التفصيلية حول تحديد الأمراض اللاعرضية (ADEs) فى بيئات الرعاية الطبية الخارجية. تهدف هذه الدراسة إلى مهالجة هذه الفجوة من خلال دراسة طرق تحديد ADE فى بيئة العيادات، حيث يكون للمرضى عادة اتصال أقل بأطبائهم ويحتفظون بسجلات أقل دقة. وسيضمن ذلك قياساً دقيقاً لـ ADEs وإعادة إنتاجية فى الأبحاث المستقبلية.

هدف العمل: كانت أهداف دراستنا تحليل التقنيات المستخدمة وتحديد وظائف سجلات الصحة الإلكترونية (EHRs) فى تحديد وتقييم أحداث الدواء الضارة (ADEs) فى بيئة العيادات.

الطرق: شمل بحثنا إجراء استعراض نظامى للأدبيات من خلال البحث فى PubMed و Goolge Scholar عن الأوراق المنشورة قبل يونيو ٢٠١٧. كانت هذه الدراسات تركز على الأحداث الدوائية الضارة (ADEs) التى تم اكتشافها فى بيئة العيادات واستخدام سجلات الصحة الإلكترونية. (EHRs) جمعنا معلومات عن ميزات الدراسات المدرجة فى تحليلنا حول الإجراءات المستخدمة لتحديد أحداث الدواء الضارة (ADEs).

النتائج: استخدم الباحثون سجل الصحة الإلكترونى (EHR) كمصدر بيانات واستخدموه لإنتاج تقارير سلامة المرضى، التى تم استخدامها بعد ذلك فى تحديد أحداث الدواء الضارة. (ADEs) كانت طرق التحديد المستخدمة تشمل استعراض السجل اليدوى الذى أجراه ممرضون، صيادلة، و/أو أطباء ماهرون، استعراض الوصفات الطبية، شاشات الكمبيوتر، المشغلات الإلكترونية، رموز التصنيف الدولى للأمراض، تحليل اللغة الطبيعية للملاحظات السريرية، واتصالات المرضى واستطلاعات الرأى. شملت سبعة تحقيقات حالات بحث عن كلمات مفتاحية، نتائج المختبر، ومعايير استخدمت لاكتشاف أحداث الدواء الضارة (ADEs).

الختام: بشكل عام، استخدمت معظم الدراسات المحللة سجلات الصحة الإلكترونية (EHRs) كمصدر بيانات أساسى لاكتشاف أحداث الدواء الضارة (ADEs). هذه الطريقة التأريضية مناسبة لقياس معدلات حدوث أحداث الدواء الضارة (ADEs)، ولكنها غير كافية لتحديد ADEs الوقائية قبل أن يتسبب الضرر فى المريض. ستمكن الباحثون من اكتشاف ومعالجة أحداث الدواء الضارة (ADEs) القابلة للتجنب باستخدام تقنيات متقدمة تستخدم شاشات الكمبيوتر والمشغلات الإلكترونية.