Review

The Impact of Patient Access to Their Electronic Health Record on Medication Management Safety: A Narrative Review

Ghadah Assiri *

Department of Clinical Pharmacy, College of Pharmacy, King Saud University, Riyadh, Saudi Arabia
Prince Abdullah Bin Khalid Celiac Disease Research Chair, College of Medicine, King Saud University, Riyadh, Saudi Arabia

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ABSTRACT

Introduction: As the American's Federal Health Insurance Portability and Accountability Act (HIPAA) stated that patients should be allowed to review their medical records, and as information technology is ever more widely used by healthcare professionals and patients, providing patients with online access to their own medical records through a patient portal is becoming increasingly popular. Previous research has been done regarding the impact on the quality and safety of patients' care, rather than explicitly on medication safety, when providing those patients with access to their electronic health records (EHRs).
Aim: This narrative review aims to summarise the results from previous studies on the impact on medication management safety concepts of adult patients accessing information contained in their own EHRs.
Result: A total of 24 studies were included in this review. The most two commonly studied measures of safety in medication management were: (a) medication adherence and (b) patient-reported experience. Other measures, such as: discrepancies, medication errors, appropriateness and Adverse Drug Events (ADEs) were the least studied.
Conclusion: The results suggest that providing patients with access to their EHRs can improve medication management safety. Patients pointed out improvements to the safety of their medications and perceived stronger medication control. The data from these studies lay the foundation for future research.

Contents

1. Introduction

The American's Federal Health Insurance Portability and Accountability Act of 1996 (HIPAA) stated that "patients must be able to see and get copies of their records, and request amendments" ("Federal Register," 2000). Before the arrival of Electronic Health Records (EHRs), there was only one single copy of the patient's medical record. If requested by the patient, he or she could see it, as well as obtaining a copy (Tucker, 1978).

In the last decade, providing patients with online access to their own medical records through a patient portal (as an information technology platform) or mobile application, in addition to improving the quality of their engagement with their healthcare providers is becoming both easier and more popular (Delbanco, 2010; Mador et al., 2008; Tang et al., 2006; Vest, 2012).

Patients can now: (a) view their records, (b) download information that is in them, (c) share clinical data (including lab results, clinical summaries, and medication lists), (d) communicate with their healthcare providers and (e) browse educational resources (Tang et al., 2006). On the other hand, ethical, security and privacy arguments have been made against patients accessing their records (Rogerson and Fairweather, 2001). Healthcare providers have concerns about routinely giving patients access to data that are not intended for public or that are inappropriate for disclosure (Rogerson and Fairweather, 2001).

Improving the flow of information among patients and healthcare professionals would help in enhancing the quality of care and reducing errors, as suggested in the report "Crossing the Quality Chasm" issued by the American's Institute of Medicine ("Institute of Medicine," 2001). In addition, patients can benefit from that access to: (a) improve their health, (b) manage their diseases and (c) improve communication with their healthcare providers (Tang et al., 2006). Some reviews were published on the impact on quality and safety of care of providing patients access to EHRs. No reviews focused explicitly on the potential impact on medication management safety (Mold et al., 2015; Neves et al., 2020).

The narrative review presented here aims to summarise the results from epidemiological research studies on the impact upon the medication management safety of adult patients having access to information in their own EHRs.

2. Methods

This narrative review method does not attempt to adopt a systematic approach to identify, select and assess the quality of studies, like in systematic review (Greenhalgh et al., 2018). Rather, the focus of this narrative review is to qualitatively interpret the selected body of literature, summarise and describe results, provide a synthesis of what is known and identify research gaps on the effect of patient access to electronic records on safety of medication management.

Studies were identified using PubMed. Also, Google Scholar was searched for grey literature. Biographies of identified studies were checked for potentially eligible studies. The searches were limited to English-language publications during the last 20 years, from January 2000 to December 2020 (time of emerging studies on the patient access to EHRs) (Neves et al., 2020). The search terms "electronic medical record, "electronic health record", "patient participation", "medication management", as well as the keyword combination ("patient" and "access") used Mesh terms which were combined with Boolean (AND/OR). The search strategy was reviewed with an informatics librarian to maximise search sensitivity.

Epidemiological research studies included: *interventional* studies [experimental; randomised controlled trial (RCT) and non-RCT quasi-experimental trial] and *non-interventional* studies [descriptive (no control); case series and case report and analytical studies (control); cross-sectional, case-control and cross-sectional].

In addition, patient access to their own records through EHRs portals or mobile applications will be included. Patients' worries about the issue of privacy is beyond my topic.

After removing duplicated studies, all the results were imported to a Covidence review software to manage the studies selection. Titles and abstracts were screened for relevance. Then, a full-text review took place to select the included studies (see Table 1).

Excluded studies are: (a) studies related to others' (e.g., relatives and parents) access to the patient's medical record because this review aims to find the impact of access to a patient's own

Table 1
Number of included studies in the narrative review.

	Number of excluded studies
Studies imported from PubMed and Google Scholar for screening (257)	1 duplicate removed.
Studies screened against title and abstract (256)	210 studies excluded.
Studies assessed for full-text eligibility: 30 studies included from PubMed and 16 from other sources (Google Scholar and bibliographies of the identified publications) = (46)	22 studies excluded: • 13 Studies not related to medication management • 4 Prescription renewal or refill outcome only • 2 Non-English • 1 Wrong study design • 1 Paper record, not electronic record • 1 Medication management outcome-related to physician and not patient.
Studies included = 24	–

records, (b) studies on the effect of patient access on outcomes not related to medication management, (c) prescription renewal or refill outcome only, (d) paper records not electronic records, (e) non-English studies and (f) ongoing studies.

The results of this review were divided according to Health System–Oriented and Patient-Oriented Medication Safety Measurement Concepts; an approach which was developed to improve medication management (Lee et al., 2018).

A. Health system-oriented medication safety measures have six types: medication discrepancies, drug-drug interactions, medication errors (commission and omission), appropriateness, adverse drug events (ADE) and adherence.

B. Patient-centred medication safety measures also have five types: quality of communication regarding medication management process, engagement, medication safety-related quality of life, patient concerns about safety and patient-reported experience (Lee et al., 2018).

3. Results

A total of 24 studies were included in this narrative review (see Table 1). For the selected interventional studies, there were four RCTs (Chrischilles et al., 2014; Quinn et al., 2008; Ross et al., 2004; Schnipper et al., 2012), and three non-RCT, quasi-experimental trial (Delbanco et al., 2012; Oster et al., 2015; Wright et al., 2015). For the non-interventional studies, there were thirteen descriptive studies (Alshoumr et al., 2021; Bhavnani et al., 2011; DesRoches et al., 2019; Haggstrom et al., 2011; Jackson et al., 2018; Lehnbom et al., 2012; Nazi et al., 2015; Ronda et al., 2015; Staroselsky et al., 2008; Turvey et al., 2014; Van der Vaart et al., 2014; Walker et al., 2011; Wolff et al., 2016), and three analytical studies (control) (Pell et al., 2015; Weingart et al., 2008; White et al., 2016). One study used mixed qualitative and quantitative methods (Esch et al., 2016).

Eighteen studies were done in the United States of America (USA) (Chrischilles et al., 2014; Delbanco et al., 2012; DesRoches et al., 2019; Esch et al., 2016; Haggstrom et al., 2011; Jackson et al., 2018; Nazi et al., 2015; Oster et al., 2015; Pell et al., 2015; Quinn et al., 2008; Ross et al., 2004; Schnipper et al., 2012; Staroselsky et al., 2008; Turvey et al., 2014; Walker et al., 2011; Weingart et al., 2008; Wolff et al., 2016; Wright et al., 2015). Four studies were done in Europe (two in Netherlands and two in the United Kingdom (UK)) (Bhavnani et al., 2011; Ronda et al., 2015; Van der Vaart et al., 2014; White et al., 2016). One study was done in Australia (Lehnbom et al., 2012). In addition, one study was done in Asia (Saudi Arabia) (Alshoumr et al., 2021).

Details about the methods used in each study are available in Table 2.

Only measures covered in the included studies will be mentioned in this narrative review-details in Table 3. Table 2 gives details of the included studies in the narrative review.

3.1. Health system-oriented medication safety measures

3.1.1. Medication discrepancies

In a cluster randomised trial, patients in the intervention arm (n = 267) were invited to complete medication eJournals before their upcoming primary care physician's (PCP) visit. They were compared with a matched sample of 274 patients in control practices that received a different Personal Health Record (PHR)-linked intervention. Medication eJournals allowed the patients to review and indicate updates to their medication lists and allergies (Schnipper et al., 2012).

Unexplained discrepancies were found, including differences between documented and reported medication regimens: (a) missing medications (i.e., reported to be taken by the patient but not in the Longitudinal Medical Record (LMR), in 36% of patients, (b) differences in dose and frequency (46%) and (c) additional medications (i.e., reported to not being taken by patients but documented in the LMR) (68%) (Schnipper et al., 2012). The proportion unexplained discrepancies per patient was significantly lower (42%) in the intervention group compared to the control group (51%) (adjusted Odds Ratio (OR) 0.71, 95% Confidence Interval (CI) 0.54–0.94, p = 0.01). The number of unexplained discrepancies per patient, with the potential for severe harm, was lower in the intervention group (0.03) than in the control group (0.08) (adjusted Relative Risk (RR) 0.31, 95% CI 0.10–0.92, p = 0.04) (Schnipper et al., 2012).

3.1.2. Medication errors (commission and omission)

In a RCT, diabetic patients were using the WellDoc mobile System (WDS). Patients using a cell phone-based diabetes management software system in conjunction with web-based data analytics and therapy optimisation tools, were much more likely to: (a) have physicians intensify their diabetes medications (medication changed or titration) (84.6% vs 23.25, P = 0.002) and (b) have medication errors identified by the WDS, e.g., inaccurate patient use (53.4% vs 0%, P = 0.002), than were patients in the control group (Quinn et al., 2008).

3.1.3. Appropriateness

One RCT examined the impact of PHR use on inappropriate medications based on the Assessing Care Of Vulnerable Elders project (ACOVE-3) to assess medication appropriateness among the elderly (aged 65 and over) (Chrischilles et al., 2014). There was no difference between older adults using inappropriate medications randomised to PHRs (high users), compared to low/non-users (Chrischilles et al., 2014). At follow-up, older adults randomised to PHR users were significantly less likely to be taking two or more NSAIDs, including aspirin (one of the ACOVE-3 quality indicators) (14.1% vs 19.4%, p = 0.036) (Chrischilles et al., 2014).

3.1.4. Adverse drug events (ADEs)

ADE is "an injury resulting from medical intervention related to a drug" (Bates et al., 1995). A retrospective cohort study aimed to learn whether electronic medication safety messages directed to primary care patients through MedCheck (a medication safety application) can improve communication about medications and identify potential ADE situations (Weingart et al., 2008). Patients experienced 21 total ADEs; they reported 17 ADEs electronically (Weingart et al., 2008). Seventeen of the 21 ADEs were reported by 128 patients who responded to the MedCheck message, and four ADEs were reported by 139 non-responders at an office visit (p = 0.01, Fisher's exact test). The remaining events were all judged to be significant ADEs (the lowest level of severity); examples included nausea and bloating on metformin, dyspepsia and diarrhoea on selective serotonin reuptake inhibitors, dizziness with atenolol, and constipation on narcotics (Weingart et al., 2008). There was one serious preventable ADE, in which a patient stopped taking prescribed phosphate supplements and had a seriously low serum phosphate level (Weingart et al., 2008).

3.1.5. Adherence

Four studies used OpenNotes (Delbanco et al., 2012; DesRoches et al., 2019; Oster et al., 2015; Walker et al., 2011). OpenNotes, is a rapidly expanding movement in the USA that encourages clinicians to offer patients ready access to their encounter notes.

Through OpenNotes, a higher proportion of patients from the Human Immunodeficiency Virus/ Acquired Immunodeficiency Syndrome (HIV/AIDS) clinic (intervention) reported that because of online access to their doctor's notes, they would be more likely

Table 2
Details of studies included in the narrative review.

	Author, year	Study design/type	Population of interest. (Country)	Control (if any)	Electronic system	Electronic system delivery method	Methods of assessment	Outcome of interest
1	Ross et al. (2004)	Interventional, Randomised controlled trial (RCT).	107 Heart failure patients. (54 intervention and 53 controls) (United States of America (USA)	Patients continued to receive standard care in the practice were in the control group N = 53	System Providing Access to Records Online (SPARO)	Periodic messages were sent by the research staff.	Questionnaire	Adherence
2	Staroselsky et al. (2008)	Observational: descriptive	163 ambulatory care patients. Compared the medication list accuracy of 84 patients using Patient Gateway (PG) with that of 79 patients who were not. (USA)	Not using PG. n = 79	A secure web-based patient portal called PG	A paper-based survey, pre-populated with current medication information from their electronic health records (EHRs)	Paper based survey	Medication list accuracy
3	Weingart et al. (2008)	Observational: analytical	267 primary care practice patients. (USA)	None	MedCheck, a medication safety application	MedCheck sent patients a secure electronic message 10 days after they received a new or changed prescription	Retrospectively reviewer medical records for three months following their first MedCheck message	Adverse drug events
4	Quinn et al. (2008)	Interventional, RCT	30 diabetic patients from 3 community physician practice. Intervention group received a Bluetooth®-enabled One Touch Ultra BG meter, for the duration of the trial, and a Nokia cell phone equipped with WellDoc's proprietary Diabetes Manager software. (USA)	Patients randomized to the control group received One Touch Ultra™ BG meters and adequate BG testing strips and lancets.	WellDoc's proprietary Diabetes Manager software	The system sent computer-generated logbooks (with suggested treatment plans) to intervention patients' healthcare providers	Diabetes Self-Care Activities questionnaire	Medication errors.
5	Bhavnani et al. (2011)	Observational: descriptive, quantitative	231 patients from general practice surgeries. (United Kingdom (UK))	None	Patient Access to Electronic Records System (PAERS) record access system.	A questionnaire was sent by post to patient registered to use the PAERS system	Self-administered postal questionnaire	Patient-reported experience
6	Walker et al. (2011)	Observational: descriptive	37,856 patients of primary care practice (USA)	None	OpenNote	Surveys were conducted online to all participating and nonparticipating primary care physician (PCPs) and to their patients	Survey	Adherence
7	Haggstrom et al. (2011)	Observational: descriptive	24 VA medical centre patient. (USA)	None	Web-based Personal health records (PHR) called MyHealtheVet.	Four PHR scenarios (prescription refill, registration and log-in, tracking health and searching for information related to health)	Qualitative study. Observational videos and efficiency measures were collected among users performing the four PHR scenarios	Patient-reported experience
8	Schnipper et al. (2012)	Interventional, Cluster-randomized trial	267 patients (medications eJournals) compared with a matched sample of 274 patients in control from primary care practice. (USA)	Control practices that received a different PHR-linked intervention. n = 274 patients	PHR-linked medications module	Phone call three weeks after an eligible visit of patients who submitted medications eJournals	eJournal by phone call	Discrepancy
9	Delbanco et al. (2012)	Interventional, Quasi-experimental trial	105 PCPs and 13 564 of their patients. (USA)	None	OpenNote	Participating doctors and patients received invitations electronically through email	Survey	Adherence
10	Lehnbom et al. (2012)	Observational: descriptive	26 consumers. (Australia)	None	Personally controlled electronic health record	N/A	Qualitative study, consumer were interviewed using a semi-structured interview guide	Patient-reported experience
11	Chrischilles et al. (2014)	Interventional, RCT	Older patient aged ≥ 65 were randomized 3:1 to be given access to a PHR (n = 802). (USA)	A standard care control group (n = 273)	PHR	For baseline, computer-use screening questionnaire was mailed to adults age ≥ 65. For follow-up, questionnaire was sent by email	Baseline and follow-up questionnaire	Adherence, appropriateness

Table 2 (continued)

	Author, year	Study design/type	Population of interest. (Country)	Control (if any)	Electronic system	Electronic system delivery method	Methods of assessment	Outcome of interest
12	Turvey et al. (2014)	Observational: descriptive	5995 patients were current users, in Department of Veterans Affairs' (VA). (USA)	Had never used Blue Button (non-users) (n = 11 671)	Blue Button feature in the department of Veterans Affairs' (VA) PHR portal, My HealtheVet (MHV)	A voluntary online survey of MHV site visitors	Survey	Patient-reported experience
13	Van der Vaart et al. (2014)	Observational: descriptive	194 patients from the patient database of the Arthritis Centre Twente in Enschede, the Netherlands. (Europe)	None	Web portal	Patients were sent a personal invitation letter and a paper-and-pencil questionnaire on T0 (the month before the web portal went online).	Survey in the month before the web portal went online (T0), and five months after (T1)	Adherence
14	Ronda et al. (2015)	Observational: descriptive	1500 patients with type 1 and type 2 diabetes from primary care practice. Patients who used it at least two times ('persistent users'). (Europe)	Compared patients who requested a login but never used it or once ('early quitters')	Web portal called 'Digitaal Logboek'	A survey among patients with type 1 and type 2 diabetes with a login to a patient portal	Survey	Adherence
15	Nazi et al. (2015)	Observational: descriptive	6861 Veterans Affairs' (VA) notes user. (USA)	None	Blue Button feature of the MyHealtheVet portal.	A nationwide web-based survey was offered to a 4% of website visitors who had navigated four or more web pages on MyHealtheVet	Survey	Adherence
16	Pell et al. (2015)	Observational: analytical	50 inpatients (USA)	None	Electronic tablet to access parts of their EHR	A study-provided electronic tablet to access parts of their EHR.	Surveys before and after the intervention	Medication list error
17	Oster et al. (2015)	Interventional, pre- and postintervention surveys	99 doctors and 3819 patients. (USA)	Patients primary care clinics using OpenNote	Patients at the Human Immunodeficiency Virus (HIV) clinic using OpenNote	NA	Pre- and postintervention surveys.	Adherence
18	Wright et al. (2015)	Interventional: non-RCT, quasi-experimental study	2147 patients taking at least one antihypertensive or antihyperlipidemic agent (756 intervention participants; 1391 controls). (USA)	Control patients also had Web portal access throughout, but their PCPs' notes were not available from primary care practice.	OpenNote. Intervention patients were offered access to their PCP notes via the MyGeisinger Web portal	Following signature of a note by a PCP documenting an encounter, patients received an email message sent to their personal email address notifying them of a portal message	Retrospective quasi-experimental study. Surveys, interviews, and focus groups,	Adherence
19	White et al. (2016)	Observational: analytical, quantitative	201 patients from outpatient and in-patient settings. (UK)	None	Personalised access to the secondary care EHR.	If patients attended routine outpatient clinic or ended their in-patient care, a specialist research nurse invited participants to take part in the study	Self-complete survey	Patient-reported experience
20	Esch et al. (2016)	Mixed methods qualitative and quantitative study	576 free text answers and 13 interviews. Patients cared for by PCPs. (USA)	None	OpenNote	Online survey	Analyses of survey data	Patient-reported experience
21	Wolff et al. (2016)	Observational: descriptive	323 patients and 389 care partners. (USA)	None	OpenNote. Geisinger Health System	Participants were invited electronically to view doctors' visit notes through MyGeisinger	Survey	Patient-reported experience
22	Jackson et al. (2018)	Observational: descriptive	2921 patients with diabetes mellitus. (USA)	Patients without diabetes	OpenNote	Patients were invited to complete a web-based survey a	Survey	Adherence
23	DesRoches et al. (2019)	Observational: descriptive	19,411 respondents. (USA)	None	OpenNote	The survey sent online to all potential participants	Survey	Adherence and patient-related experience and Medication list
24	Alshoumr et al. (2021)	Observational: descriptive. Case study	146 eligible hospitalised cancer patients. (Asia)	None	Inpatient portal to hospitalised patients	Once admitted, a patient was given access to the portal	Interviews with hospitalised patients in one Centre	Patient-reported experience

Table 3

Narrative review results categorised according to Health System–Oriented and Patient-Oriented Medication Safety Measurement Concepts.(()). Adopted from Lee et al., 2018

Measures	Definitions	Narrative review included studies reference number
A. Health system-oriented medication safety measures		
A.1 Medication discrepancies	Discrepancy is defined as "*differences between a Longitudinal Medical Record (LMR) list and what patients thought they should be taking (e.g., differences in dose, missing medications)*" (Schnipper et al., 2012). "*Medication discrepancies are generally assessed through review of medication lists at transitions between settings (e.g., hospital discharge and primary care) or comparing such lists to what patients report they are taking*" (Lee et al., 2018).	(Schnipper et al., 2012)
A.2 Medication errors (commission and omission)	"*Errors of omission (not being prescribed a medication that is indicated by guidelines or not taking a medication that was appropriately prescribed) or commission (being prescribed or taking the wrong medication or dose)*" (Lee et al., 2018).	(Quinn et al., 2008)
A.3 Appropriateness	"*Appropriateness of prescribing (e.g., the Beers Criteria for the elderly), polypharmacy, complexity, or potential or actual medication interactions*" (Lee et al., 2018).	(Chrischilles et al., 2014)
A.4 Adverse drug events (ADE)	Bates et al. define ADE as "an injury resulting from medical intervention related to a drug" (Bates et al., 1995) Some ADEs are caused by underlying medication errors and therefore they are preventable (Bates et al., 1995).	(Weingart et al., 2008)
A.5 Adherence	"*The degree to which the person's behaviour corresponds with the agreed recommendations from a health care provider.*" ("World Health Organization" 2003)	(Chrischilles et al., 2014; Delbanco et al., 2012; DesRoches et al., 2019; Jackson et al., 2018; Nazi et al., 2015; Oster et al., 2015; Ronda et al., 2015; Ross et al., 2004; Van der Vaart et al., 2014; Walker et al., 2011; Wright et al., 2015)
A.6 Other		Medication list. (DesRoches et al., 2019; Pell et al., 2015; Staroselsky et al., 2008)
B. Patient-centred medication safety measures		
B.1 Patient-reported experience	"*Patient experience in areas such as patient burden, patient-reported adverse effects, and concerns about adverse effects (including long-term effects); satisfaction with medication-related processes and outcomes*" (Lee et al., 2018).	(Alshoumr et al., 2021; Bhavnani et al., 2011; Chrischilles et al., 2014; DesRoches et al., 2019; Esch et al., 2016; Haggstrom et al., 2011; Lehnbom et al., 2012; Turvey et al., 2014; White et al., 2016; Wolff et al., 2016)

to take their antiretroviral medications as prescribed compared to those patients in a primary care setting (control) (75% versus 67%) (Oster et al., 2015).

In a quasi-experimental trial, online access to OpenNotes was also found to increase reported medication adherence as 60–78% of patients taking medications (Delbanco et al., 2012). Patients were offered online access to ambulatory notes written by the PCP who volunteered to participate in OpenNotes. Patients opinion about OpenNotes is that they were more likely to take their medications as prescribed (Walker et al., 2011).

Among patients who had read their notes (via OpenNotes) and reported having taken or been prescribed medications in the last year, 14% from practices reported that reading their notes made them more likely to take their medications as prescribed (86% reported no change) (DesRoches et al., 2019).

Three studies used the Morisky survey to measure adherence (Chrischilles et al., 2014; Ross et al., 2004; Van der Vaart et al., 2014). The first study is a RCT that investigated how patient access to 'System Providing Access to Records Online' (SPARO) can affect patients' satisfaction, their adherence to taking medication and their health status (Ross et al., 2004). Fifty-four patients were in the intervention group and 53 patients in the control group. Adherence to medications was assessed using the Morisky validated survey, which contains four items (scored from 0 to 4) (Morisky et al., 1986). Adherence to medications show improvement in the patient access to the SPPARO group but was not significant (Ross et al., 2004).

The second study investigated the impact of rheumatoid arthritis patient access to the web portal on medication adherence (assessed by the Morisky Medication Adherence scale). The web portal is a hospital-based patient portal which provides rheumatoid arthritis patients with home access to their EHR. A score of 7 on medication adherence (range from 1 lacking adherence – 8 perfect adherence) was reported in 56% of the respondents (Van der Vaart et al., 2014).

In the third study, there was no difference in self-reported adherence between older adults randomised to PHR (high users) compared to low/non-users (Chrischilles et al., 2014).

On the other hand, the majority of Blue Button (an online portal of MyHealtheVet (MHV) of Veterans Affairs (VA) PHRs) users agreed that accessing their notes will help them to do a better job of taking their medications, as prescribed (80.1%) (Nazi et al., 2015).

In a retrospective comparative analysis quasi-experimental trial, participants were adult patients with electronic portal access, taking at least one antihypertensive or antihyperlipidemic agent (Wright et al., 2015). Intervention and control groups had Web portal access. Intervention patients were invited and reminded to read their PCPs' notes, in contrast to control patients where their PCPs' notes were not available. The proportion of days covered (PDC) was used to assess the adherence; patients with a PDC $\geq$ 80 were considered to be 'adherent'. Patients invited to review notes were more adherent to antihypertensive medications; an adherence rate of 79.7% for intervention versus 75.3% for the control group (adjusted risk ratio 1.06, 95% CI 1.00–1.12). On the other hand, for patient groups taking antihyperlipidemic agents, adherence was similar; an adherence rate of 77.6% for intervention versus 77.3% for the control group (adjusted risk ratio 1.01, 95% CI 0.95–1.07) (Wright et al., 2015).

In addition, two studies were done with diabetic patients (Jackson et al., 2018; Ronda et al., 2015). More patients believed that the portal will help with medication adherence in the persistent users of diabetes patient web portal group; patients who used the portal at least two times were significantly (21%) better at medicinal adherence compared to an early quitters group (patients who requested a login but never used it or used it only once (15.7%)) (Ronda et al., 2015). The responses of the patients with diabetes, when compared to the patients without diabetes, were statistically significantly different (p < 0.001) for being more likely to believe that having access to and reading their notes via an elec-

tronic patient information portal would help them to improve their medication-taking performance: "*I would be more likely to take my medications as prescribed*" (82% vs 77%, respectively)] (Jackson et al., 2018). In logistic regression analyses, adjusted for characteristics, patients with diabetes perceived that reading their doctor's notes would help them to take their medications as required by their physicians (OR 1.16, 95% CI 1.04, 1.29) (Jackson et al., 2018).

3.1.6. Other: Medication list
3.1.6.1. Accuracy and errors.
Among patients who had read notes (OpenNotes) and reported having taken or been prescribed medications, 18% of respondents reported that the medication list was not accurate and 85% wanted to submit corrections to their medication list online (DesRoches et al., 2019).

On the other hand, a hospital-based prospective cohort study found that patient access to their medication lists (intervention) would help them find errors (preintervention survey: 22 of 50 [44%]) and this error rate decreased significantly across the intervention (postintervention survey: 3 of 50 [−38%; P < 0.001]).(Pell et al., 2015)

One uncontrolled observational study evaluated the influence of a secure web-based patient portal called Patient Gateway (PG) on the accuracy of medication lists in the EHR; 84 patients were using PG and 79 who were not and found no significant differences between the two groups in terms of medication errors.(Staroselsky et al., 2008) A lower percentage of PG users' drug regimens were reported to be correct than for the PG non-user group (54% versus 61%, p = 0.07). However, PG users took significantly more medications than their non-user counterparts (5.0 versus 3.1 medications, p = 0.0001) (Staroselsky et al., 2008). In this study, accessing a patient portal alone was not associated with more accurate medication list information in a patient's HER (Staroselsky et al., 2008).

3.2. Patient-centred medication safety measures

3.2.1. Patient-reported experience
All the studies measuring patient-reported experience were descriptive qualitative studies except one RCT study (Chrischilles et al., 2014), two quantitative studies (Bhavnani et al., 2011; White et al., 2016), and one mixed-method study (Esch et al., 2016).

Older adults randomised to PHRs. High users were significantly more likely to report having a side effect in the past three months compared to low/non-users (Chrischilles et al., 2014).

Three studies used OpenNotes. A mixed-method qualitative and quantitative analysis was done to characterise patient experience with OpenNotes (Esch et al., 2016). Possibly improving adherence to, and compliance with, medications was often mentioned by the patients. In addition, nearly all interviewed patients mentioned that reading notes led them to correct their drug regimen, with most changes focusing on medication intake (Esch et al., 2016). As a result of reading their notes, patients reported correcting wrong dosages or times of medication administration. As examples: "*I discovered that the doctor has misunderstood something I said.*", "*It … sometimes clarifies my need and use of medications.*", "*I was [online] and happened to see that I was taking the wrong amount of prescription.*", "*The biggest benefit I see is being able to … double-check*" (Esch et al., 2016).

Patients reported many benefits of OpenNotes, including more often taking medications as prescribed (71.4%).(Wolff et al., 2016) Among patients who had read OpenNotes and reported having taken or been prescribed medications in the last year, most patients reported that note reading: (a) helped them understand why a medication was prescribed (64%), (b) made them feel more comfortable with and in control of their medications(61% and 62%), (c) answered their questions (57%) and (d) helped them under-

stand possible adverse effects (45%) (DesRoches et al., 2019). Very few reported that notes made them feel worried or confused about their medication (2–4%) (DesRoches et al., 2019).

Another qualitative study recruited 24 users of web-based PHRs called MHV; more users liked seeing prescription numbers than seeing prescription names (Haggstrom et al., 2011). Twenty-six Australian consumers of personally controlled EHRs were interviewed. The most frequently mentioned benefit was that they would take a more holistic approach with more information regarding up-to-date medication lists and known allergies (Lehnbom et al., 2012). The information that users of the Blue Button feature of online patient portal (Veterans Affairs' (VA) PHRs) were most interested in accessing was the current medication list (57.8%); the most frequently endorsed type of information shared with care providers was the medication list (54.4%) (Turvey et al., 2014).

Medication teaching was one of the most used features in the inpatient portal in a qualitative case study in cancer patients (Alshoumr et al., 2021). Patients accessed their oral medication lists via the "See My Medicines" icon and learned more about these medicines through the "Learn about My Medicines" icon. Thirteen out of 22 participants (59%) reported that they learned about their medicines through viewing the medication icons. They accessed this icon to: (a) view the oral medication list, (b) learn about medication side-effects, (c) read instructions for using particular medicines, (d) request taking oral drugs instead of other forms, (e) know the medication time or (f) view the treatment plan (Alshoumr et al., 2021).

A quantitative study explored the impact of patient access to electronic records system (PAERS) on their health behaviour. Forty-two percent of patients (95% CI: 34–51%) reported that access to record had made a difference to their medicine taking. Of those, approximately 25% (n = 17) felt that access to record made them more likely to take their medication. In addition most (83%, n = 56) thought that the access helped them understand why they needed to take their medication (Bhavnani et al., 2011).

The patients' views on the functionality for personalised access to their EHR was studied. Quantitative analysis of a cross-sectional self-complete survey from secondary care patients attending the cystic fibrosis unit was done (White et al., 2016). The highest rating for the area that patients most wanted to access included changes of medications (82%) and the list of their current medications (83%). Giving feedback on a drug or a treatment was also important to the patients (White et al., 2016).

4. Discussion

The emerging use of the EHRs by healthcare professionals in the world's more developed healthcare systems, combined with the emerging use by patients of information technology through portals or mobile applications, means that patients can now benefit from that access, so resulting in enhancing the quality of patient care and reducing the incidence of medication errors ("Institute of Medicine," 2001).

In addition, results from other studies found that patient access to their records resulted in (a) improvement of timely patient-centred management, (b) improvement of self-reported levels of participation, knowledge, or activation related to self-management, (c) improvement of participation in care and caregiver-provider communication, (d) health improvements, (e) improvement of recovery scores, and (f) reduce hospital admissions (Tang et al., 2006; Tapuria et al., 2021).

In regards to the negative impacts of patients access to their EHRs, results from other studies found that (1) the content of an electronic medical record, which often includes frightening diag-

nostic possibilities, confidential or sensitive information, can add anxiety and stress to patients (Tapuria et al., 2021), (2) some patients had difficulties in understanding medical terms and abbreviations (Wass et al., 2019), and (3) the risk of malpractice and liability threats if data security is compromised (Beard et al., 2012; Tapuria et al., 2021).

Some reviews were published on the impact of providing patients access to EHRs on safety and quality of care, but none was explicitly focused on the impact on medication management safety (Neves et al., 2020; Mold et al., 2015). However, ethical and privacy concerns are beyond my review brief. This narrative review aims to study the effect of adult patient access to their own EHR relative to the safety of the patients' medication management, provide a synthesis of what is known regarding the topic and identify research gaps.

Most of the studies cited in this review (75%) have been done, to some extent, in the USA. The most two studied measures of safety in medication management were: (a) medication adherence and (b) patient-reported experience. Five interventional studies addressed the adherence measure, one RCT shows improvement but was not significant (Ross et al., 2004) and the other RCT shows no difference (Chrischilles et al., 2014). In addition, three non-RCTs showed improvement in adherence (Delbanco et al., 2012; Oster et al., 2015; Wright et al., 2015).

Studies that addressed patient-reported experience were all non-interventional studies (Alshoumr et al., 2021; Bhavnani et al., 2011; DesRoches et al., 2019; Esch et al., 2016; Haggstrom et al., 2011; Lehnbom et al., 2012; Turvey et al., 2014; White et al., 2016; Wolff et al., 2016), except for one study that was a RCT (Chrischilles et al., 2014). Through accessing electronic records, patients were more likely to: (a) take their medications as prescribed, (b) better understand why they needed to take their medications, (c) correct their medication regimen, (d) report if they were having side effects and (e) learn more about their medications.

The other measures that were less studied were: (a) discrepancies, (b) medication errors, (c) appropriateness of prescribing and (d) ADEs. Studies that addressed discrepancies, medication errors, and appropriateness measures were RCTs (Chrischilles et al., 2014; Quinn et al., 2008; Schnipper et al., 2012). The ADE study was a non-interventional analytical study. Many patients are willing to participate in ensuring the accuracy of their medication lists (Jackson et al., 2018; Pell et al., 2015). In another study, merely accessing a patient portal was not associated with more accurate medication list information in a patient's HER (Staroselsky et al., 2008).

Results from this narrative review showed that providing patients with access to their EHRs resulted in many benefits. Patients with access to the EHRs group were able to find (a) lower unexplained discrepancies (Schnipper et al., 2012), (b) higher medication errors and ADEs (Quinn et al., 2008; Weingart et al., 2008), (c) lower inappropriate medications (Chrischilles et al., 2014), compared to the control group. In addition, improvement in medications adherence and medications safety as reported by patients were found in several studies.

In addition, providing patients access to EHRs or summary records can optimise medication safety at transitions of care to ensure medication list completeness and accuracy (World Health Organization, 2019). Furthermore, one study that used a mixed-method to identify how carrying medication lists by patients or carers (including both paper or electronic) can improve medication safety (Garfield et al., 2020). Medication safety improvement included (a) improving medication list accuracy, (b) allowing potential drug interactions identification, (c) facilitating communi-

cation regarding medications, (d) acting as a reminder to patients during visits, (e) allowing patients to check their medications for errors and (f) reminding patients to take and refill their medications (Garfield et al., 2020).

Even though patients have asked for more widespread of access to the medical records (Esch et al., 2016), few patients felt worried or confused about their medications and that was found as one of the drawbacks (DesRoches et al., 2019; Delbanco et al., 2012). A further drawback that should be pointed out is that the actual number of medications in the medication list used by the patients is unknown and it is predicted to be higher because other medications can be bought as self-medication or over-the-counter (OTC) medication from community pharmacies or online from the internet. That can result in drug-drug interactions resulting in decreased effectiveness and/or increased toxicity (Staroselsky et al., 2008; Fincham, 2021).

A systematic review by Mold et al., (2015) assessed the impact on the provision, quality and safety of patients' health care of providing patients with access to their EHRs. This initiative was confined to primary care and only two studies on the medication-related outcomes were included under the 'patient safety and prevention' outcomes. It was found that safety improvements were patient-led by identifying medication errors, identifying discrepancies in their medication list (Schnipper et al., 2012) and an increased level of adherence to medications (Delbanco et al., 2012).

A recent systematic review was published on the impact of sharing EHRs with patients on six domains of quality of care, one of which was safety outcomes related to medications; a theme found in a total of four studies included in this narrative review (Neves et al., 2020). The researchers found that a significant beneficial effect was observed in medication safety outcomes (Quinn et al., 2008; Schnipper et al., 2012), yet was and non-significant relative to the medication adherence outcome (Chrischilles et al., 2014; Ross et al., 2004). All four studies (Chrischilles et al., 2014; Quinn et al., 2008; Ross et al., 2004; Schnipper et al., 2012), having outcomes or measures related to medication safety in this systematic review was as a result of this narrative review.

This narrative review is not a comprehensive review of all the medication safety measures. Instead, it is focused on the different types of medication management safety measures available and the most commonly studied in different settings.

4.1. Limitations of the studies in this narrative review

First, 17 out of 24 of the included studies (71%) were non-interventional; the quality and strength of their evidence are less than the interventional studies. Studies using more robust methods are necessary to increase the strength of any conclusions drawn. Second, the methods for assessment of medication safety measures were heterogeneous across the included studies, making comparisons across studies difficult. Third, these studies were also unable to address drug-drug interactions in the health system-oriented medication safety measures. The reason for this shortfall may be due to not considering "drug-drug interaction" as a keyword. Fourth, 75% of the review results were studies conducted in the USA, other countries from Europe have also implemented patients access to EHRs and have not appeared in the search results such as Denmark, Estonia, Finland, France, New Zealand, Norway, and Sweden (Essén et al., 2018). That could be due to restricting the search terms to medication management. Moreover, this review is limited to researchers conducting studies in the English language. Many measures have been translated and validated in several languages, yet this review does not include them. Measures not addressed regarding patient-centred medication safety

are: (a) quality of communication regarding medication management process, (b) engagement, (c) medication safety-related quality of life and (d) patients' concerns about safety.

4.2. Strengths in this narrative review

This narrative review is the first to draw a direct line between (i) the effect of patients accessing their electronic records and (ii) the safety of medication management in different health settings. The Health System–Oriented and Patient-Oriented Medication Safety Measurement Concepts (Lee et al., 2018), was used to facilitate and inform the framing and categorising of the findings presented in this narrative review.

The data from these studies lay the foundation for future research in this area. This study draws some information on investigating different medication-related safety measures, medication safety measures assessment methods (i.e., survey, questionnaire, interview, phone call and medical records review), examples of electronic portals and mobile applications used for patients access (i.e., SPARO, OpenNote and MedChek) and methods of electronic records system delivery (i.e., by phone messages, nurse invitation, email or letters) (Table 2).

More randomised research needs to be conducted on the impact of patient access to health records on the outcomes which were less or not covered in this narrative review, e.g., medications discrepancies, medication errors, appropriateness of prescribing, ADEs, quality of communication, engagement, medication safety-related quality of life and patients' concerns about safety.

To avoid the risks related to difficulties in understanding medical terms and abbreviations by the patient or anxiety related to frightening diagnosis, physicians should be aware of how to choose and simplify medical terms and they could change the way they present potentially sensitive information (Delbanco et al., 2012; Tapuria et al., 2021). In regards to insuring accurate up-to-date medication list, physicians should ask their patients about other prescription and/or OTC medications and document them in the HER in order to avoid potential drug-drug interactions (Staroselsky et al., 2008). The role of the patient's self-care must not be ignored. Patients could identify medication errors and notify the physician through an amendment request in the system (Hanauer et al., 2014).

National medication authorities and pharmacovigilance or patient safety centres can support provision of patients access to electronic records to understand and use medication effectively and safely (World Health Organization, 2019). When implementing patient access to EHRs, it's essential to focus on interventions that is able to measure outcomes related to medication management and enhance rigorous adoption and the interventions needs to be addressed by policymakers.

In general, patient access to EHRs is challenging. The risk of patients access to EHRs should be weighed against existing benefits (Tapuria et al., 2021). Even if patients have some worries or confusion when reading their notes, offering patients access to their medications list appeared to be a valuable addition to safe medication management.

5. Conclusion

Although patient access to health records means a substantial change in their medication and disease self-management, the practice of inviting patients to review physicians' notes online is spreading. The results of this development suggest that providing patients with access to their EHRs can improve medication management safety, including helping patients manage and adhere to their medications. Patients pointed out how access to their records

improved the safety of their medications and resulted in stronger medication control.

For EHRs with patient access to be frequently used by those patients, it is essential to focus on interventions that enhance adoption and measure outcomes related to medication management.

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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