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Systematic review of electronic health records to manage chronic conditions among displaced populations

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ABSTRACT

Objectives The objective of this study was to assess the impact of electronic health records (EHRs) on health outcomes and care of displaced people with chronic health conditions and determine barriers and facilitators to EHR implementation in displaced populations.

Design A systematic review protocol was developed according to the Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Systematic Reviews.

Data sources MEDLINE, Embase, PsycINFO, CINAHL, Health Technology Assessment, Epub Ahead of Print, In-Process and Other Non-Indexed Citations, Cochrane Central Register of Controlled Trials and Cochrane Database of Systematic Reviews was searched from inception to 12 April 2021.

Eligibility criteria for selected studies Inclusion criteria were original research articles, case reports and descriptions of EHR implementation in populations of displaced people, refugees or asylum seekers with related chronic diseases. Grey literature, reviews and research articles unrelated to chronic diseases or the care of refugees or asylum populations were excluded. Studies were assessed for risk of bias using a modified Cochrane, Newcastle-Ottawa and Joanna Briggs Institute tools.

Data extraction and synthesis Two reviewers independently extracted data from each study using Covidence. Due to heterogeneity across study design and specific outcomes, a meta-analysis was not possible. An inductive thematic analysis was conducted using NVivo V.12 (QSR International, Melbourne, Australia). An inductive analysis was used in order to uncover patterns and themes in the experiences, general outcomes and perceptions of EHR implementation.

Results A total of 32 studies across nine countries were included: 14 in refugee camps/settlements and 18 in asylum countries. Our analysis suggested that EHRs improve health outcomes for chronic diseases by increasing provider adherence to guidelines or treatment algorithms, monitoring of disease indicators, patient counselling and patient adherence. In asylum countries, EHRs resource allocation to direct clinical care and public health services, as well as screening efforts. EHR implementation was facilitated by their adaptability and ability to integrate into management systems. However, barriers to EHR development, deployment and data analysis were identified in refugee settings.

Conclusion Our results suggest that well-designed and integrated EHRs can be a powerful tool to improve healthcare systems and chronic disease outcomes in refugee settings. However, attention should be paid to the common barriers and facilitating actions that we have identified such as utilising a user-centred design. By implementing adaptable EHR solutions, health systems can be strengthened, providers better supported and the health of refugees improved.

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ Our study is the first systematic review assessing the implementation of electronic health records (EHR) for displaced populations and how they impact chronic disease outcomes.
⇒ The heterogeneity of outcomes data reported across studies led to analysing and synthesising the findings in a qualitative, narrative approach rather than conducting a quantitative meta-analysis.
⇒ Our study was limited by using only a qualitative analysis and future work is needed to quantitatively assess the effectiveness of EHRs in this setting.
⇒ While we could not assess effectiveness, our qualitative approach allows for an important description of the barriers and facilitators of implementing EHRs for displaced populations in future studies.

INTRODUCTION

The United Nations High Commissioner for Refugees estimated that there were over 80 million displaced people worldwide in 2019.[1] This number is increasing globally, and is exacerbated by significant barriers that make returning home increasingly burdensome for refugees.[1] Forced displacement has doubled since 2010, and with the rise of extreme weather events and conflict, it is predicted that this trend will continue over the next decade.[1 2] Displaced populations are uniquely vulnerable to threats to their health including

violence, food insecurity, infectious diseases and exacerbation of underlying chronic conditions.[2–4] Chronic diseases such as diabetes, hypertension and depression are highly prevalent in refugee populations, which may lead to severe morbidity and mortality especially when there is limited access to healthcare.[5–7]

Delivering care to displaced populations poses unique challenges. Healthcare for refugees has relied on refugee camp-based care and limited services sponsored by host country governments.[8 9] Uncertain living situations, continued displacement and inconsistent access to medical services present barriers to longitudinal care, particularly for chronic diseases.[4 9] Additionally, refugee clinics often operate without formal systems for recording patient information, further amplifying the challenges of irregular care.[7] These disjointed systems limit continuity of care for people with chronic diseases, overall increasing patient burden and perpetuating poor health outcomes.[10] When refugees are able to reach new host countries, they face barriers to accessing care that meets their needs, including prohibited cost, language barriers and the inability to reliably access longitudinal health records.[11 12]

A previous systematic review of health records for refugees showed that the general use of medical records improved health outcomes in the refugee population.[8] However, no such consensus has been reached on the use of electronic health records (EHR) in refugee care settings and their impact on health indicators. Moreover, to the best of our knowledge, no study has outlined the barriers and facilitators to implementing EHRs in refugee care settings. The aim of this systematic review is to (1) evaluate the impact of EHRs in the care of displaced people with chronic health conditions, and (2) identify the barriers and facilitators to successful implementation of an EHR system for refugees.

METHODS

Search strategy

A systematic review protocol was developed according to the Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Systematic Reviews (PRISMA) checklist (online supplemental appendix 1). A comprehensive search query (online supplemental appendix 2) was conducted in English and run on nine databases (MEDLINE, Embase, PsycINFO, CINAHL, Health Technology Assessment, Epub Ahead of Print, In-Process and Other Non-Indexed Citations, Cochrane Central Register of Controlled Trials and Cochrane Database of Systematic Reviews) from inception to 12 April 2021.

Selection of studies

The search results were uploaded to Covidence, an online reference distilling programme (Covidence, Veritas Health Information, Melbourne, Australia) to allow for collaborative screening by multiple reviewers. Articles were independently screened by title and abstract based on a list of inclusion and exclusion criteria to judge the eligibility of the identified studies. Eligible studies included a patient population that was internally or externally displaced and must have evaluated an EHR or described implementation of EHR solutions, to track or treat chronic communicable and non-communicable diseases. We also included studies that were randomised control trials, observational studies or qualitative studies. Exclusion criteria included diagnosis of non chronic or non-communicable diseases such as acute physical trauma or acute infections such as upper respiratory tract infections. These were excluded because we were interested in seeing how EHRs improved the care of displaced and migratory populations over time. We also excluded grey literature, and non-original research designs. The same blinded reviewers then screened articles by full text for potential eligibility. Any conflicts in inclusion were resolved by an independent arbiter. All included studies were assessed by two reviewers for methodological quality and risk of bias.

Critical appraisal

We used a modified Cochrane risk of bias assessment tool for the randomised control trials,[13] the Newcastle-Ottawa tool for observational and non-randomised control trials[14] and The Joanna Briggs Institute assessment for qualitative studies (online supplemental appendix 3). Any discrepancies in the assessments were reconciled by consensus.

Data extraction

Two reviewers (AB and FE) independently extracted data from each study using the Covidence data extraction form. The following data were extracted: study year; study type/method and setting; population; sample size and method; study objectives.

Synthesis of results

Due to heterogeneity across study design and specific outcomes, a meta-analysis was not possible. An inductive thematic analysis was conducted using NVivo V.12 (QSR International, Melbourne, Australia). An inductive analysis was used in order to uncover patterns and themes in the experiences, general outcomes and perceptions of EHR implementation.[15] Two independent reviewers (AB and FE) developed an initial codebook with a sample of 10 articles. After comparing and consolidating a final codebook, the two reviewers both independently coded the remaining studies with an inter-rater reliability kappa score of 0.82. Studies were grouped by population as refugees, internally displaced persons or asylum seekers. Broad categories were developed from the extracted data related to evidence on effectiveness of EHRs and experiences with EHRs. Experiences were categorised into barriers and facilitators of implementing EHRs.

Patient and public involvement

This research did not involve patients or the public in the design, conduct, reporting or dissemination plans.

Ethical review

This research did not require an institutional board review approval as the data were collected from existing online data bases and publicly available. This research did not involve any human subjects.

RESULTS

Description of included studies

Of the 225 identified studies, 32 were included in the final analysis (PRISMA chart).[16] Included studies are summarised in table 1. The 32 included studies were conducted in nine countries. An important differentiating factor between the studies was the setting in which they were conducted: refugee camps or settlements (n=14) or asylum countries (n=18). As the implications of EHRs in these two settings are markedly different, they are presented and discussed separately below. Most of the included studies were cohort studies (n=20), followed by cross-sectional studies (n=8) and descriptive studies on implementation (n=4). The most commonly studied populations were Palestinian (n=11) and Syrian (n=6) refugees. The most commonly studied health conditions were diabetes (n=12), hypertension (n=8) and psychiatric illnesses such as post-traumatic stress disorder (PTSD) (n=3). Fourteen studies assessed the impact of EHRs on health outcomes within refugee camps or settlements for displaced people.[4 10 17–26] Nineteen studies assessed the impact of EHRs on health outcomes in populations after arriving in an asylum country.[27–45]

Quality assessment of included studies

According to the critical appraisal tools described in the methods section, 20 articles were of medium–high quality, nine were of medium quality and three were low-quality. The qualitative studies demonstrated acceptable methodological quality but did not report on the influence of the researcher. The cross-sectional studies and cohort studies were of medium quality in part due to suboptimal measurements of the exposure and outcomes and a lack of clarity around the identification of confounding variables. The one randomised control study was of a medium–high quality due to an overall low response rate.

Impact of EHRs on chronic disease outcomes in displaced populations

All 32 studies discussed the impact that EHRs had on chronic disease outcomes. They suggested that EHRs improved both objective measures, such as markers of disease severity (blood pressure and aemoglobin A1c, HbA1c), and subjective measures such as continuity of care. The explanation behind these improvements was not because EHRs are solutions on their own, but because they were a tool for improving communication, documentation, adherence to guidelines and delivery mechanisms.[4 10 17–23 25 26 42]

Impact in refugee camps or settlements

Three landmark studies made up most of the literature on EHRs implemented in refugee camps. Two of these were cohort studies represented by multiple publications: one conducted among Palestinian refugees living in Jordan and one conducted in Lebanon for Syrian refugees across 10 health facilities. The third study was a randomised controlled trial (RCT) conducted across 16 primary healthcare sites in refugee camps and rural areas of Lebanon.[25] These three studies collectively showed that a well-established EHR could have significant impacts on improving hypertension and diabetes management.[4 10 17–23 25] These studies also discussed how EHRs improved health outcomes, citing increased provider adherence to guidelines or treatment algorithms, monitoring of clinical indicators, patient counselling and patient adherence.[4 10 17 19 20 22]

Khader *et al* demonstrated that EHRs decreased the morbidity and mortality of hypertension and diabetes after 1 year by increasing screening and adherence to treatment guidelines.[22 23 46–48] The EHR improved physicians' abilities to track a patient's hypertension over time and adjust medications appropriately through a standardised algorithm.[19 46] In many parts of the world, diabetes management is based on poorly documented data that is collected at irregular intervals. This hinders a provider's understanding of both short-term and long-term blood glucose trends required for optimal management. Notably, Khader *et al* found that EHR implementation increased the continuity of data on postprandial blood sugars for diabetes patients.[46 47] This allowed clinicians to better titrate medications and dietary counselling.[46 47] It was also noted that EHRs allowed for better tracking of patients and improved follow-up on missed appointments or missed prescription refills.[23] Khader *et al* implemented an EHR-driven system to flag patients which enabled providers 'to encourage patients to attend (their appointment) the next quarter so that continuity of care and uninterrupted drug intake are maintained'[46]

Doocy *et al* showed that metrics for both hypertension and diabetes improved when utilising an EHR and patients reported increased satisfaction with clinical care.[4 10 17] The authors cited three potential reasons for the improvement in health outcomes: (1) increased rate of history-taking and data collection, (2) more frequent and accurate recording of chronic disease metrics and (3) more frequent lifestyle counselling compared with paper records.[10 17] Regarding history taking, Doocy *et al* noted, 'the proportion of patients reporting that the provider took a medical history during the enrolment phase (72/101 patients, 71.3%) increased by 16.6% to 87.9% (160/182)'.[17] Likewise, physicians were more likely to record blood pressure, body mass index and blood sugar levels with EHRs compared with paper records ($p<0.001$).[10] They were also more likely to discuss dietary modification ($p<0.001$) and smoking cessation ($p=0.06$).[10]

Table 1 Summary of included studies

Authors (year of publication)	Electronic medical record (EMR) used	Location	Study type	Number of participants	Patient population	Health conditions
Berkowitz *et al* (2016)[27]	EMR through partners health	Massachusetts, USA	Retrospective longitudinal cohort study	3174	Refugees, Spanish-speaking non-refugee immigrants	Diabetes
Darwish and Muldoon (2020)[44]	EMR Nightingale on demand	Ottowa, Canada	Cross-sectional retrospective study	338	Syrian refugees receiving care at temporary triage clinics	General characterisation of population and chronic diseases
Doocy *et al* (2017)[17]	Sana mHealth, clinic-based medical records	South, Bekaa, Beirut Lebanon	Longitudinal cohort study	1020	Syrian and Lebanese refugees	Hypertension or type II diabetes
Doocy *et al* (2018)[18]	Magpi mobile data	South, Bekaa, Beirut, Mount Lebanon	Longitudinal cohort study	793	Syrian and Lebanese refugees	Hypertension or type II diabetes
Doocy *et al* (2017)[17]	Magpi mobile data	Lebanon	Longitudinal cohort study	1020	Syrian and Lebanese refugees	Hypertension or diabetes
Goodman *et al* (2018)[36]	Turbomed	Dresden, Germany	Retrospective cohort study	2753	Refugee patients (Syrian, Afghani, Iraqi and other)	General characterisation of population and chronic diseases
Goosen *et al* (2015)[35]	MOA EMR database	The Netherlands	Retrospective cohort study	4854	Pregnant asylum seekers	HIV, pregnancy
Hanna *et al* (2015)[37]	Epic	Pittsburg, PA, USA	Retrospective cross-sectional study	74	Bhutanese, Iraqi and Sudanese refugees	General characterisation of population
Higgins *et al* (2019)[38]	EMR through International Family Medicine Clinic at University of Virginia	Charlottesville, VA, USA	Retrospective cohort study	80	Refugee patients from 60 countries including Iraq, Afghanistan, Bhutan	Diabetes
Hoffman, *et al* (2021)[39]	In-house EMR	Minneapolis/ St. Paul, USA	Retrospective cohort study	143	Karen refugees resettled between May 2011 and May 2013	General characterisation of population and chronic diseases
Khader *et al* (2012)[19]	eHealth through United Nations Relief and Works Agency (UNWRA)	Amman, Jordan	Retrospective descriptive cohort study	4130	Palestinian refugees	Hypertension
Khader *et al* (2012)[19]	eHealth through UNWRA	Amman, Jordan	Retrospective descriptive cohort study	2851	Palestinian refugees	Diabetes
Khader, Ballout *et al* (2014)[23]	eHealth through UNWRA	Jordan	Descriptive cohort study	288	Palestinian refugees	Diabetes and complications
Khader *et al* (2014)[21]	eHealth through UNWRA	Nuzha, Taybeh, Marka, S. Baqaa, Baqaa and Suf Jordan	Retrospective cohort study	18 881	Palestinian refugees	Hypertension
Khader, Ballout *et al* (2014)[22]	eHealth through UNWRA	Amman, Jordan	Retrospective cohort study	119	Palestinian refugees	Diabetes and complications
Khader, Ballout *et al* (2014)[23]	eHealth through UNWRA	Amman, Jordan	Retrospective cohort study	2974	Palestinian refugees	Diabetes
Lagos-Gallego *et al* (2017)[24]	National health records system	Colombia	Retrospective cohort study	240 000	Colombian IDPs	PTSD
Maher (2012)[40]	E-health	N/A	Descriptive editorial review		Patients with NCDs and chronic infectious diseases	Hypertension, diabetes, HIV, tuberculosis

Continued

Table 1 Continued

Authors (year of publication)	Electronic medical record (EMR) used	Location	Study type	Number of participants	Patient population	Health conditions
Njeru *et al* (2017)[34]	EMR from clinics	Minneapolis and Rochester, MN, USA	Retrospective cohort study	13 456	Adult patients receiving primary care in internal medicine or family medicine	Type II diabetes
Oltrogge *et al* (2020)[43]	In-house EMR	Hamburg, Germany	Retrospective longitudinal observational study	1467	Patients at a refugee camp	General characterisation of population and chronic diseases
Olson *et al* (2017)[33]	Epi Info 7.1.5.	Syracuse, NY, USA	Longitudinal cohort study	1067	Refugee children seen in university-based refugee health programme	Obesity
Pohl *et al* (2017)[41]	Hospital EMR	Basel, Switzerland	Retrospective cohort study	93	Paediatric refugees and asylum seekers seen	Multiple chronic diseases
Rossi *et al* (2009)[45]	In-house interfacility EMR	Lebanon	Description of EMR implementation	N/A	Palestinian refugees	Multiple chronic diseases
Santoro *et al* (2016)[50]	UNWRA eHealth System	Jordan	Description of EMR implementation	N/A	Palestinian refugees seen in UNWRA clinics	Hypertension of diabetes
Saleh *et al* (2018)[25]	mHealth	Lebanon	Randomised control trial	3481	Palestinian refugees	Hypertension of diabetes
Shapiro *et al* (2016)[32]	EMR through hospitals	Philadelphia, PA, USA	Retrospective longitudinal cohort study	129	Resettled refugee children visiting paediatric clinics	Obesity
Sengoren *et al* (2020)[42]	In-house EMR	Bursa, Turkey	Retrospective descriptive cross-sectional study	378 487	Syrian refugees and Turkish citizens	Chronic diseases pertinent to the chest
Skogberg *et al* (2019)[49]	National health records system	Oulu, Helsinki, Joutseno, Turku Finland	Cross-sectional study	1000	First-time asylum seekers	General characterisation of population and chronic diseases
Storck *et al* (2018)[31]	Mobile patient survey	Muenster, Germany	Cross-sectional study	96	Paediatric refugees	General characterisation of population, PTSD
Wagner *et al* (2014)[30]	Khmer health advocates EMR database	Connecticut, USA	Prospective cohort study	301	Cambodian refugees	Hypertension, obesity, PTSD
Waldorf *et al* (2014)[29]	EMR through Boston Medical Center	Boston, MA, USA	Retrospective cohort study	100	Patients going through the refugee and immigrant health programme	Provider adherence to chronic disease screening
Walters and Sullivan (2016)[28]	EMR through country refugee medical assistance	Multnomah County, Oregon, USA	Prospective cohort study	2087	Refugees	Hepatitis B

IDPs, internally displaced persons; N/A, not applicable; NCDs, non-communicable diseases; PTSD, post-traumatic stress disorder.

The RCT conducted by Saleh *et al* showed that centres randomised to use a mobile EHR had significant improvements in blood pressure control (p=0.03) and mean decreases in HbA1c (p<0.01).[25] This study also integrated text messages into their EHR to remind patients about appointments and how to manage chronic conditions.[25] Other included studies demonstrated that EHRs improved error detection and staff productivity,[26] identification of PTSD among internally displaced persons in Columbia via one-on-one screening[24] and patient management following the internal development of an EHR in a hospital in Lebanon.[45]

Impact in asylum countries

Nineteen studies assessed the impact of EHRs on chronic disease health outcomes for asylum seekers.[27–45] The uses of EHRs in these studies ranged from screening measures to characterising the chronic diseases in a population to improving guidelines and reducing the health disparities in asylum populations compared with the general population.[27–45]

Several studies commented on the utility of EHRs as screening tools for asylum populations. Higgins *et al* showed that using a pharmacist to systematically review patients flagged by EHRs for possible chronic diseases led to better pharmaceutical recommendations to optimise medical management.[38] Similarly, a study in primary care demonstrated that EHRs within hospitals could improve screening by flagging patients and creating reminders for care teams.[29] Another study conducted in the USA showed that the use of these same principles, specifically in screening for Hepatitis B, led to notable improvements in the proportion of patients linked to care and receiving treatment.[28]

One advantage of EHRs cited throughout the literature was their ability to provide an avenue for better characterisation of diseases in asylum populations to inform public health interventions and clinical guidelines.[31 35–37 41 49] A notable example of this was a study in Finland that used EHRs and survey data to develop a protocol to screen all asylum seekers entering the country.[49] This example provides a very powerful illustration of how national EHRs can support asylum seekers as they immigrate; a finding that was echoed in additional studies.[32 33] Other studies in tertiary hospitals and regional care areas developed general guidelines for the care of asylum seekers.[35 37] Further research sought to understand the prevalence of diseases such as obesity, diabetes and trauma-related mental health disorders.[31 32 36] Overall, the literature reviewed found that screening and characterising populations allowed healthcare systems to address health disparities in asylum-seeking communities.[29 49]

Barriers to implementing EHRs in displaced populations

There were 11 studies that discussed barriers to EHR implementation.[10 17 19 20 22 26 27 31 45 48 49] This review revealed that key barriers exist across three phases of implementation: development, deployment and data evaluation.

Barriers to development

Our review identified system and software barriers to successful EHR development in settings focused on refugee populations. The rate-limiting-step for system development of EHR systems was the burden of required resources including money, personnel and training. Participating programmes needed a large budget for computers, software, education materials and training, particularly in the startup stage.[17 45] The technological barriers to EHR deployment, which required on-demand expert technical support, were also particularly salient at the implementation stages of the new information system.[17 45] These issues ranged from infrastructure to software problems including: internet connectivity, software bugs or crashes, integration with other facility systems and required software updates due to unplanned data collection requirements.[10 17 27 45] Successfully addressing these barriers required organisational level support, including staff dedicated to implementation.[17 46] Operation staff also required advanced training in software design and data analysis.[45]

The main software issues included patient literacy and language translation. To utilise EHRs, many patients required language translation by multilingual clinicians or professional interpreters.[10 17 31 49] Storck *et al*'s 2018 study described language translation as 'one of the most difficult and time-consuming 'aspects of EHR use.[31] Moreover, facilities serving Chinese or Arabic refugees required systems that supported character encoding for Chinese or Arabic speaking scripts and faced the added complication of using right-to-left writing languages in applications designed for languages that write left-to-right.[31]

Barriers to deployment

Inherent challenges in caring for refugee populations also contributed to difficulties in deploying EHR systems. These challenges included substantial loss to follow-up[17 22] and provider burnout leading to poor uptake of EHRs.[10 17 19 20 22 48] Lack of patient follow-up was a significant challenge for facilities implementing EHR in refugee communities, as refugee patients had shorter follow-up time periods than immigrants and controls, perhaps in part due to residential instability.[17 21 22 27] Incomplete follow-up was often caused by expired or changed phone numbers.[17] In many cases, however, the reason for lack of patient follow-up was unknown, and requires more research.[22 23]

Poor provider uptake presented significant difficulties in implementing and developing mobile health interventions.[10 17 19 20 22 48] Low uptake was most frequently attributed to provider attitudes towards the use of a new technology, citing redundant reporting and technological difficulties.[17 23 45] Additionally, providers expressed frustration towards increased time demands when using a new EHR with a high volume of complex patients.[10 17 23 45] While negative provider perception was a barrier to EHR uptake, some studies also documented a more nuanced perception of mobile health record implementation.

EHRs were regarded as more beneficial in healthcare facilities previously lacking electronic records. In such settings, providers noted that the EHRs facilitated improved patient education and satisfaction.[10]

Barriers to data evaluation

Effective evaluation of data is key to attaining the full advantage of EHRs. Barriers to analysing EHR data included incomplete data entry[20–23] and problems with the time-frames for patient integration and evaluation.[10 17 19 46] The multifaceted challenges of EHR implementation impeded baseline data recording in several studies.[20–23] In early stages, providers and staff struggled to consistently implement EHR systems and appropriately record data, resulting in compromised baseline recordings that limited the interpretation of data.[20–23] It was found that in asylum-seeking host countries, many studies were unable to extract socioeconomic variables, preventing rigorous analysis of EHR implementation and population-level clinical trends.[32 34] Previous studies on EHRs often noted that short evaluation periods failed to allow patients enough time for follow-up.[10 17 23] Studies also reported issues evaluating the overall chronicity of events, due to EHRs that did not separate laboratory data across different patient visits.[17] Moreover, cumulative outcome reports were limited in studies with wide time ranges for patient integration and monitoring.[15 21]

Facilitators of EHR implementation in displaced populations

In total, nine studies discussed facilitators of successful EHR implementation. The most common facilitators were data accuracy, adaptability and ability to interlink with systems management.[4 10 19 21 22 31 40 45 50] EHRs were noted to improve both efficiency and accuracy of analysing data compared with paper records. Storck *et al* discussed how an EHR approach reduced errors when transferring data from pen and paper questionnaires, especially when multiple languages were being used.[31] Additionally, reviewing paper records was time-consuming and took staff away from patients.[19]

EHRs were noted to be adaptable to different clinical settings and improve provider satisfaction in the long run.[19] Adapting an EHR for a clinical setting does take considerable time and resources. An example of adaptability was the in-house EHR designed for a health facility in Jordan.[50] While adapting an EHR led to a unique EHR designed specifically for its providers and clinical setting, it also requires a considerable amount of time and energy to create. The advantage of adapting an EHR is that healthcare providers were a part of the design process, and were satisfied with the final product. Others noted that customisation of the apps for specific settings will optimise EHR design and increase uptake.[10] Specifically, consulting with providers ahead of time before implementation is likely to achieve the best design and uptake outcomes.[17]

Interlinking with other clinic management systems facilitated improved uptake and overall success of EHRs. EHRs helped increase the accuracy and efficiency of data collection, which led to improved tracking and forecasting and ultimately strategic planning and cost reduction.[4 17 22 50] Khader *et al* noted how this integration then allowed for improved 'public health services planning and management, such as rational forecasting for drugs and other consumables and all the logistics necessary for providing quality care such as blood pressure machines, treatment cards, etc.'[19] Integrating EHRs with associated analysis led to cost reductions.[22 40 45 50] As refugee camps are often underfunded in low-resource settings, the reduction in cost and resource waste has the potential for far-reaching impacts.

DISCUSSION

This systematic review examined the literature to assess the impact of EHRs on chronic disease outcomes for displaced populations. It also evaluated the associated barriers and facilitators of implementing EHRs in refugee settings. Our analysis revealed that EHRs improved chronic disease outcomes such as diabetes and hypertension in refugee camp-based clinics. This was achieved through increased provider adherence to guidelines or treatment algorithms, monitoring of clinical indicators such as disease metrics, patient counselling and patient adherence through integrated messaging services.[4 10 17 19 20 22 25] Results from asylum countries also showed that EHRs helped to develop focused screening guidelines and increase adherence to those guidelines.[27–45] This in turn can lead to a reduction in health disparities between asylum seeking patients and the general population.[27–45] This review identified a number of barriers to successful implementation of EHRs across development, deployment and data analysis.[10 17 19 20 22 26 27 31 45 48 49] This review also found improved usability in EHR systems that were easily adaptable or able to interlink with systems management.[4 10 19 21 22 26 31 40 45 50]

We found numerous barriers to EHR implementation, which are expected, given the technical complexities of EHR systems. These include software design, maintenance and internet connectivity. Substantial start-up costs may also hinder implementation. As EHRs become prevalent in low-resource settings such as refugee clinics, it is imperative that EHR design accounts for the unique constraints in these settings and is user-centred.[51] Considering how provider attitude was a key barrier to EHR uptake, engaging providers in development of EHRs is likely to increase their overall interest and eventual uptake of the EHR system.[10 17 19 20 22 48 52] This concept is also supported by rich bodies of research around community engagement and user-centred design.[51] Future projects may benefit by incorporating reciprocal and respectful community engagement practices in designing and implementing their interventions.[53–55] Future projects should use key principles such as collaboration, shared purpose and transparency of community engagement in designing their interventions.

A major finding from this review was that EHRs have a positive impact on chronic disease outcomes.[10 17 19 21 22 46 47]

Notably, this finding is in contention with literature that questions the effectiveness of EHRs in improving outcomes in higher resource settings.[56 57] Therefore, it is important to understand what elements of EHRs contribute to the observed improvements in chronic disease outcomes in refugee settings compared with higher resource settings. Studies in this review proposed a number of plausible hypotheses such as more frequent provider history taking, counselling and adherence to treatment guidelines.[15 17 18] Other plausible explanations include increased patient satisfaction and improved adherence through messaging services.[21 22] Important confounding factors to consider include increased scrutiny on clinical practice during implementation or an influx of resources associated with EHR implementation. While these confounders cannot be ruled out, strong evidence across locations suggests that the observed improvements are due to the EHRs.[10 17 19 21 22 46 47]

Limitations

This review was limited by the narrow field of work it describes. After removing duplicate records, there were only 225 studies left to screen. There was also significant heterogeneity in the types of data collected by studies and therefore what could be extracted. By capturing a wide range of experiences, we included studies with diverse interventions and outcomes. Additionally, studies included were limited by short follow-up periods, impacting the quality of data presented. Additionally, very few papers discussed technical factors in deploying their EHRs such as hardware used to operate the EHR. In the future, there needs to be further research on designing EHRs for these specific settings and conducting effectiveness trials to identify how EHRs can truly improve health outcomes for refugee populations.

Conclusion

Given the number of displaced persons worldwide doubling in the last decade, and with this trend forecasted to continue, solutions to manage this vulnerable population's health are urgently needed.[1 2] The findings in this review suggest that, when meticulously implemented, EHRs can improve chronic disease outcomes and enhance healthcare systems in refugee settings. As organisations set out to use EHRs, their barriers to implementation outlined here should be considered and addressed. Additionally, using human-centred design principles and community engagement practices are likely to create successful, sustainable and context-based solutions.[51] By acting now to create adaptable EHR solutions, health systems can be strengthened, providers can be better supported and the health of refugees can be improved.

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