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The Impact of Electronic Health Records on Nursing Burnout in a Hospital Setting in Saudi Arabia: Mixed-Methods Study

Fatimah Alobayli

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ABSTRACT

Background: There is growing evidence suggesting that electronic health records (EHRs) can be associated with clinicians' burnout, which may hamper the effective use of EHRs and introduce risks to patient safety and quality of care. Nursing research in this area is minimal in comparison with studies conducted on burnout among physicians. In addition, although the majority of research on the impact of EHR use on nursing burnout was conducted in Western contexts, this study fills the gap by exploring this prevalent issue within the context of Saudi Arabia.

Aim: The research aim was to examine the association between nursing burnout and EHR use and to explore the contributing factors to nursing burnout related to EHR use in a hospital setting in Saudi Arabia.

Methods: The study used a mixed-methods approach with an explanatory sequential design: a quantitative study followed by a qualitative study. The study was conducted in a hospital that was adopting an advanced EHR system, in Riyadh, Saudi Arabia. Using a purposive sampling method, registered nurses working in inpatient units using an EHR system on a daily basis were included in the study. Two validated instruments were used in the online survey, the Mini-Z and EHR perceptions, to examine the association between nursing burnout and EHR-related factors. Qualitative interviews, undertaken both online and in-person, were used to gain an in-depth understanding of factors associated with nursing burnout and hospital EHR use. Survey data were analysed using regression analysis. Thematic analysis was utilised for the interview data. The study was informed by a

sociotechnical approach to understanding the relationship between the social system (nurses) and the technical system (EHR use) in a given context (a hospital in Saudi Arabia).

Results: A total of 282 completed survey responses were included in the study, and a total of 21 nurses participated in the interviews. Participants were predominantly female and worked in acute and critical care units. Most survey respondents were from the Philippines (53%), Malaysia (21%), and Saudi Arabia (11.7%), with South African and European nurses accounting for about 5% each. Interviewees were primarily from the Philippines and Saudi Arabia (33% each), and 24% from Malaysia. The findings indicated that despite the overall acceptance of the EHR among the nurse participants being relatively high, negative perceptions of the EHR and stress related to EHR use were found. There was a slight inconsistency between the quantitative and qualitative results regarding the perceived burnout outcome. The survey statistics showed that the minority of nurses who reported negative perceptions about the EHR were likely to be burnt out while the interviews showed that all participants who reported stress related to the EHR did not think that EHR-related stress would lead to burnout. This inconsistency suggests there is a weak link between EHR use and burnout may exist, possibly indicating the mitigating role of resilience identified in the qualitative study. In this qualitative study, I identified specific perceived organisational stressors associated with EHR use, such as high EHR documentation workload creating a conflict between organisational requirements and direct patient care. Technological stressors were also identified, including usability issues causing disruption to nurses' workflow, and concerns about data privacy through unauthorised access by healthcare workers at the hospital. Despite these stressors, resilience was demonstrated at both individual and organisational levels, which emerged as a protective factor from EHR-related burnout. Factors like computer literacy, perceived usefulness of the EHR, and nurses' adaptability to

change were key contributors to individual resilience that aided nurses in navigating EHR stressors and adjusting to the EHR system. At the organisational level, health information infrastructure facilitated smoother interaction with the EHR system, reducing potential stressors while supportive organisational culture fostered teamwork, work–life balance, continuous learning, and iterative improvement, thereby bolstering resilience among nurses.

Conclusion: EHR did not significantly contribute to nursing burnout in a specific Saudi Arabian hospital context. The resilience mechanisms in place at both individual and organisational levels mitigated the potential impact of EHR-related stress on nurses' burnout. The unique contribution of this research is the introduction of a novel conceptual model elucidating the impact of EHR on nursing burnout. This renewed perspective emphasises the role of resilience at both individual and organisational levels and their collective influence on mitigating EHR-related burnout among nurses. This model has the potential for further development and application both locally and globally. This study signals a need for healthcare organisations to foster resilience-building strategies in their EHR implementation processes and usability that should be tailored to the specific needs and circumstances of each organisation, to effectively manage EHR-related stress and prevent potential burnout. These include encouraging self-care practices among nurses, promoting work–life balance, fostering supportive workplace culture, improving health information infrastructure, providing training and continuous learning, and improving EHR usability through regular feedback sessions from EHR users. Additional research is needed to corroborate this finding with different types of clinicians in the same hospital, and in other hospital settings within Saudi Arabia.

LAY SUMMARY

What do we already know about the topic?

It is widely recognised that electronic health records (EHRs) have the potential to significantly improve the efficiency of healthcare organisations. However, the implementation of EHRs has also been associated with increased stress among healthcare professionals, including nurses, often contributing to burnout.

What do we not know and what was the study aim?

Existing research on EHR-related burnout is mostly focused on physicians, thus there is limited understanding of how these issues affect nurses, who constitute the largest proportion of the healthcare workforce. This leaves a gap in the literature about the specific experiences, challenges, and needs of nurses in relation to EHR use. Furthermore, most of this research used the survey method, limiting our understanding of the nuanced experiences and perceptions of healthcare professionals regarding EHR use. Moreover, research conducted in Western contexts dominates the literature, leaving questions about the generality and variability of these phenomena across different cultural and healthcare contexts. Given these gaps, the aim of this study was to examine the association between nursing burnout and EHR and to explore the contributing factors to nursing burnout related to EHR use in a hospital setting in Saudi Arabia.

What did I do?

I conducted a study in a hospital in Saudi Arabia, collecting data from nurses through a survey and interviews. In the survey study, I identified workplace factors that contribute to burnout among nurses and measured the associations between EHR-related stressors and nursing burnout. Following the survey, I conducted interviews to gain a rich understanding of nurses' experiences with EHR use, the stressors they encountered, and the strategies they

used to manage these stressors. Nurses were also asked to define burnout from their understanding, and whether EHR use contributed to nurses' stress or burnout. This comprehensive approach allowed for a nuanced exploration of the complex interactions between EHR use, stress, burnout, and coping mechanisms (resilience) in a Saudi Arabian context.

What did I find?

My study revealed several key findings. First, I found that although EHR use contributed to stress among nurses, it did not appear to directly cause burnout in the specific context of the studied hospital in Saudi Arabia. Second, I identified specific organisational and technological stressors associated with EHR use, such as EHR documentation demands, usability issues, and concerns about data privacy. Furthermore, I found resilience to be a significant factor in mitigating the adverse effects of these EHR-related stressors, with individual coping mechanisms and organisational culture playing critical roles in fostering this resilience. This indicates that resilience is not just an individual capacity but can also be cultivated at an organisational level.

What does this mean for future studies and our understanding?

In this study, I extend the general understanding of EHR-related stress and burnout by revealing context-specific stressors and coping mechanisms in a Saudi Arabian hospital. The findings highlight the importance of supportive organisational practices to reduce EHR-related stressors, such as engaging nurses in the EHR implementation to understand their challenges and needs, providing appropriate training and continuous learning, fostering teamwork, promoting work–life balance, and supporting nurses' wellbeing.

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GLOSSARY OF ACRONYMS

ADC: Automated dispensing cabinet
ANM: Assistant nurse manager
CCU: Cardiac care unit
CLMA: Closed loop medication administration
CN: Charge nurse
COPE: Computerised physician order entry
CRN: Clinical resource nurse
DP: Depersonalisation
EE: Emotional exhaustion
EHR: Electronic health records
EMR: Electronic medical record
EMRAM: Electronic medical records adoption model
ER resus: Emergency room resuscitation
ER: Emergency Room
HDU: High dependency unit
HIMSS: Healthcare Information and Management Systems Society
HIT: Health information technology
ICU: Intensive care unit
ISD: Information system department
IT: Information technology
KFSHRC: King Faisal Specialist Hospital and Research Centre
MBI: Maslach Burnout Inventory
Mini-Z: A brief burnout scale and the 'Z' stands for zero burnout
MOC: Model of Care
MOH: Ministry of Health
MS: Medical and surgical
NGHA: National Guard Health Affairs
NICU: Neonatal intensive care unit
NM: Nurse manager
NPHIES: National platform for health and insurance exchange services
NTP: National transformation plan
PA: Personal accomplishment
PCCU: Paediatrics cardiac care unit
PEDS: Paediatrics
PICU: Paediatrics intensive care unit
SIB: Single-item burnout measure
SN: Staff nurse
SRIS: Stress related to information system
STS: Sociotechnical system
SUS: System usability scale
TAM: Technology acceptance model
TICU: Trauma intensive care unit
UTAUT: Unified theory of acceptance and use of technology

DEFINITION OF TERMS

Burnout is defined as a prolonged stress response characterised by emotional exhaustion, depersonalisation, and a lack of sense of personal accomplishment (Maslach and Jackson, 1981).

EHR usability refers to the degree to which the system enables tasks to be accomplished in an efficient, effective, and satisfying manner (Bevan, 2001).

Electronic health records are digital versions of patient medical charts. They serve as up-to-date, patient-centred records that securely provide authorised individuals with instant access to vital information (HealthIT.gov, 2019).

Organisational resilience is the ability of the organisation to anticipate, prepare for, respond to, and adapt to change and sudden disruptions to survive and thrive (Barasa et al., 2018).

Perceived usefulness is the degree to which an individual believes that using a certain technology would enhance their work performance (Davis, 1989).

Resilience is the individual ability to bounce back from adversity (Southwick et al., 2014).

Sociotechnical refers to the interaction between people and technology within a social context (Ammenwerth et al., 2003).

CHAPTER 1: BACKGROUND

1.1: Introduction

This chapter provides a comprehensive overview of the critical concepts and context that inform this study. It begins with a detailed exploration of occupational burnout, examining its prevalence, causes and impact it has within the healthcare sector. Second, I will provide a synopsis of the history of EHRs, highlighting their potential benefits and the challenges associated with their implementation in healthcare. Following this, I will provide an overview of the healthcare system in Saudi Arabia, including a review of the current system, an introduction to the new Model of Care, and an examination of the digitalisation process that is currently underway within the country's healthcare sector.

Following this, an overview of the EHR system at the National Guard Health Affairs (NGHA), the participating hospital for this study, is presented, including pictures of the hospital's EHR system and its integrated medical devices that were taken during my hospital visit. Next, I articulate the problem statement that motivated this study and discuss the significance of this research, within the Saudi Arabian context and specifically the nursing profession.

1.2: Occupational burnout

Burnout is defined in the Oxford Dictionary as "physical or mental collapse caused by overwork or stress" (Oxford, 2019). The term *burnout* originated from the clinical psychologist Freudenberger (1974) who discussed physical and behavioural indicators and associated cognitive, judgemental and emotional consequences of excessive stress at work. Freudenberger (1974) defined burnout as "to fail, wear-out, or become exhausted by making excessive demands on energy, strength, or resources" (Freudenberger, 1974), characterising it

by way of a set of symptoms including a feeling of exhaustion, fatigue, frustration, cynicism, and inefficacy. Burnout reduces productivity and drains energy in the workplace. Building on Freudenberger's work, burnout is also defined as the final stage of severe stress that occurs among employees, characterised by emotional exhaustion (EE), depersonalisation (DP), and a lack of sense of personal accomplishment (PA) (Maslach and Jackson, 1981). WHO's definition is based on Maslach's (1982) three dimensions of burnout. Burnout is a syndrome that arises from enduring unmanaged occupational stress. It is defined by three main aspects: (1) feelings of energy depletion or exhaustion, (2) increased mental detachment or negative attitude towards one's job, and (3) diminished professional efficacy (WHO, 2019a). The WHO classified it as an occupational phenomenon, but not a medical condition or mental disorder. However, it encouraged the development of evidence-based guidelines on mental wellbeing in the workplace (WHO, 2019a).

According to the literature, EE is the most prominent symptom of burnout. It is closely associated with overwork and a stressful work environment, causing the individual to feel emotionally drained (Maslach et al., 1997, Edelwich and Brodsky, 1980). A lack of empathy is an affective-symptomatic manifestation of depersonalisation, which is characterised by an impaired and distorted sense of oneself, others, and one's surroundings. Dissatisfaction with one's work is the third symptom of burnout. This feeling typically comes when individuals feel that their work is not benefiting society and their clients, and when they lose their sense of purpose. This feeling of inadequacy leads to a lack of motivation to improve the status quo and a decline in morale. Eventually, all these negative emotions will result in low institutional efficacy and instability (Maslach et al., 1997). Occupational burnout can be manifested in any or all of these mentioned indicators, and it has devastating consequences on the performance of an individual. The stability of any entire institute is at risk when enough individuals in it suffer from burnout (Hogan and McKnight, 2007).

1.2.1: Prevalence of burnout in healthcare

The prevalence of burnout varies across healthcare professions and geographic regions. Rotenstein et al. (2018) conducted a systematic review to measure the prevalence of burnout in the healthcare profession covering 182 studies across 45 countries. The review revealed significant variations in burnout prevalence in the healthcare profession, with overall burnout ranging from 0% to 80.5%. However, the review identified considerable inconsistency in how burnout was defined and assessed across various studies, thus making it challenging to reliably determine a definitive prevalence (Rotenstein et al., 2018). Likewise, burnout among intensive care unit healthcare professionals, as reported in a systematic literature review, varied significantly with prevalence rates ranging from 0 to 70.1%, partly due to the influence of the use of differing definitions and assessment tools (Van Mol et al., 2015). The author of the review showed that although high-risk burnout was reported in some studies as 25.0% to 51.9% based on an EE subscale, the true prevalence remained unclear and warrants further exploration (Van Mol et al., 2015). Another systematic review explored the relationship between work-related stress, burnout, job satisfaction, and general health among nurses. The review did not directly mention specific prevalence rates of burnout in nursing, but it emphasised that high levels of work-related stress, burnout, and job dissatisfaction were common in the nursing profession (Khamisa et al., 2013).

The outbreak of the novel Coronavirus (COVID-19) pandemic has escalated the workload of healthcare professionals, exposing them to extreme physical and psychological stress, contributing to the development of burnout (Soares et al., 2022). In a cross-sectional survey conducted at six university-linked hospitals, high burnout levels were reported by 53.0% of the healthcare workers engaged in the care of COVID-19 patients (Jalili et al., 2021). The results of a review study indicated that there was a substantial burnout rate among healthcare workers in intensive care units (ICUs) and emergency departments (EDs) during

the COVID-19 pandemic (Gualano et al., 2021). However, it was uncertain whether this represented an increase from the high burnout rates observed in these settings before the pandemic (Gualano et al., 2021). The authors of a study examining the impact of the COVID-19 pandemic on healthcare workers in Saudi Arabia found high burnout levels (38.5% for EE, 31.2% for DP, and 33.6% for PA). This was largely attributed to direct contact with infected patients and alterations in work patterns during the pandemic (Alanazi et al., 2021). A systematic review showed that approximately half (52%) of healthcare workers during the COVID-19 pandemic, both frontliners and non-frontliners, experienced burnout, (EE 51%, DP 52%, and PA 28%), with higher rates observed in wealthier countries than low to middle-income countries (Ghahramani et al., 2021).

1.2.2: Causes of burnout in healthcare

The internal makeup of healthcare workers can contribute to or prevent burnout occurrences such as their upbringing, stress tolerance, expectations, resilience, and values. These internal factors can keep healthcare providers enthused about their abilities to perform their duties and assist others (Fred and Scheid, 2018). However, there are numerous external factors that can significantly contribute to burnout, which are often outside the individual's immediate control. These factors include the challenge of balancing life and work, the prevalence of favouritism and injustice in the workplace, and the misalignment between pay and effort (Murtaza, 2017). Another reason that can contribute to dissatisfaction in the workplace and eventually burnout is a clash of values between individuals, management, and the organisation as a whole (West et al., 2018). Consistently high workload has grown in recent years without enough oversight to prevent employee burnout (West et al., 2018). A study conducted by NHS (National Health Service in the United Kingdom) shows that most of the issues related to workload in nursing were linked to duplications, data collection and audits, non-essential bureaucratic tasks, dwindling administrative support and issues with the

usability of information technology (Cunningham et al., 2012). These factors not only burden the nursing staff but also diminish the perceived value of their roles as qualified professionals (Cunningham et al., 2012).

There is a significant difference between what healthcare providers learn during their academic training and what is expected of them when they transition into professional life (Dyrbye et al., 2014a). In academic settings, they are taught to prioritise patient needs, tailoring their work and practice to individual patient requirements. In contrast, the professional healthcare environment requires physicians to navigate the complex business aspects of healthcare systems, adhering to governmental regulations and insurance policies, which is the case in the U.S. (Dyrbye et al., 2014b). For instance, loss of autonomy is a factor that can lead to feelings of dissatisfaction among healthcare providers (National Academies of Sciences and Medicine, 2019b). This occurs when they perceive that their ability to make patient-centred decisions is compromised due to stringent rules and standard operating protocols (Fred and Scheid, 2018). Additionally, the necessity to consult with health insurance officers regarding patient treatment and medication, who do not possess the same level of training as healthcare providers, adds to this frustration (Fred and Scheid, 2018). The perceived inability to make independent decisions regarding patient care can lead to feelings of helplessness among some healthcare providers. This, in turn, can contribute to EE and depression, potentially resulting in burnout for some individuals within this profession (Ariely and Lanier, 2015).

A sense of powerlessness is another factor that can lead to burnout. Health professionals at the beginning of their careers often expect that they will be able to help alleviate the medical problems of their patients if cures and treatments exist (Eisenstein, 2018), but the reality is a little different, especially for patients from a low socioeconomic class. Physicians who work particularly with this population are disillusioned in their belief

that they will be able to cater to the needs of individuals from any social or economic class (Cervantes et al., 2018, Eisenstein, 2018). This disillusionment about their power in shaping and improving the lives of their patients can result in job dissatisfaction leading up to professional burnout (Eisenstein, 2018). This may lead some to find their role in life and medical science to be meaningless and the whole exercise to be a futile effort at improving the quality of life (Eisenstein, 2018). Statistical data reveals that nearly 50% of healthcare providers especially young doctors have left medical care because of suffering from symptoms of burnout (Dyrbye et al., 2014b).

Although any profession can suffer from burnout, evidence suggests that the healthcare system is the one within which it is most common to find the occurrence of professional burnout (Murthy, 2022). Healthcare personnel tend to frequently experience burnout because of the high demand placed on them to provide intensive care on many different levels, from physical to psychological and emotional (Murthy, 2022). The profession of nursing is one of the most vulnerable to burnout within the healthcare system (Cañadas-De la Fuente et al., 2015). Due to the demanding nature of the work of the nursing profession, which includes long working hours and consistent personal and emotional contact with patients, nurses particularly can be susceptible to burnout (Khamisa et al., 2013). In every region of the world, nurses make up the greatest proportion of the workforce in the healthcare industry (Organization, 2016). The demand placed on nurses as the frontline workforce has increased in conjunction with the growing workloads of healthcare systems, which has had a negative impact on the working environment for nurses (Khamisa et al., 2013). Burnout in nurses has been linked to demanding workloads as well as factors of the working environment, such as inadequate staffing ratios, a lack of communication between physicians and nurses, and a lack of organisational leadership within working environments for nurses (Shah et al., 2021).

1.2.3: Impact of burnout on healthcare

One of the most common results of burnout among healthcare providers can be leaving the healthcare profession when they become unable to cope with the job demands and requirements (Verghese, 2018). Around 50% of U.S. healthcare providers are suffering from the symptoms of burnout, which leads to lower productivity, impaired memory, decreased attention and most important of all viewing their patients as objects rather than people whose emotional and physical healthcare is the responsibility of the physician and nurses (Verghese, 2018). Almulhem et al. (Almulhem et al., 2021) noted in their study that healthcare professionals have highlighted burnout as the leading factor compelling them to leave their job as well as reduce their levels of productivity which would ultimately have a significant fallout in the form of disrupting healthcare services. The high prevalence of burnout among physicians in the United States implies that external factors, such as demanding workloads, EHR-related billing tasks, lack of control over work conditions, inadequate resources, and poor social support in the workplace, have a more significant influence on professional burnout than internal factors such as personal traits or stress management abilities (Verghese, 2018, Colicchio et al., 2019). The authors of a review study revealed that burnout among physicians and nurses was associated with work–life imbalance, reduced job satisfaction, and compromised quality of patient care (National Academies of Sciences and Medicine, 2019a). The personal life of healthcare providers can also be affected by continuing to practice medicine even when they have lost their passion and enthusiasm for the profession (Shanafelt et al., 2015). Alcohol abuse, stressed personal relationships, and thoughts of suicide have all been linked to the despair and burnout of health providers in the workplace (Shanafelt et al., 2012, Dzau et al., 2018). The deterioration of the mental health of clinicians can adversely affect the quality of patient care delivered (National Academies of Sciences and Medicine, 2019a).

1.3: Electronic health record (EHR)

EHR is a digital version of a patient's paper chart. The goal of EHRs is to provide real-time, patient-centred records that make information available instantly and securely to authorised users (HealthIT.gov, 2019). EHR is designed to encompass more than the typical clinical data of a patient's medical history and treatment details collected in a healthcare practice (HealthIT.gov, 2019). It is intended to provide a comprehensive perspective on a patient's care journey (Menachemi and Collum, 2011). There has been significant development in health information technology, primarily aiming to streamline the operations of healthcare organisations (Menachemi and Collum, 2011). EHR, as part of HIT, has significantly evolved and was designed to provide immediate access to patient information for clinicians, freeing them from repetitive work, and enabling them to spend with their patients (Nelson and Staggers, 2016). However, the operational effectiveness of EHR systems can fluctuate, depending on numerous aspects such as the implementation process, the system's usability, user training, and information management and protection (Keshavjee et al., 2006). Therefore, the practical experience with EHRs can vary considerably based on these and other potential factors (Keshavjee et al., 2006).

Around 1900 to the 1920s, Europeans began documenting their patients' medical histories, but these records were often sparse and only included the most basic information on patients' irregular health problems (Koren and Prasad, 2022). Both the nature and organisation of health records have changed significantly throughout time. The introduction of EHRs in the 1960s brought with it the potential to improve the diagnostic process for both patients and healthcare providers (Evans, 2016). EHR was initially used for the documentation of academic inpatient and outpatient medical data (Weed, 1971), but not all the data was reported on charts and even today most EHR are a combination of electronically recorded data and physical charts (Clayton, 1994). Some EHRs that were developed around

the 1970s also included billing information (Octo Barnett, 1989). EHRs that were developed in the early years were basic and lacked physician entry and prescription with data entry focusing on medication and laboratory reviews (Clayton, 1994). EHRs were not commonly used until the 1990s as hardware became more affordable and compact (Octo Barnett, 1989). The availability of personal computers and high-speed internet facilitated the development of web-based, enabling easier access to medical information (Octo Barnett, 1989). The invention of the portable computer further eased access to EHRs. Around 2000, it was increasingly recognised by healthcare organisations and government agencies that EHRs could potentially play a significant role in enhancing patient care and identifying patterns to improve healthcare services overall (Dolin, 1997). Currently, it appears that a majority of EHRs may operate using a web-based or client-server model, utilising relational databases for data storage, and potentially offering user-friendly data access and entry interfaces (Dolin, 1997). Although integrated EHRs have brought revolutionary changes to the healthcare system and offered numerous benefits, there are also drawbacks hindering their effective implementation in healthcare institutes (Menachemi and Collum, 2011). These challenges include concerns about privacy and security, high implementation costs, the potential for increased workload for healthcare providers, the need for extensive training, and issues related to interoperability and standardisation (Videha Sharma et al., 2021, Keshavjee et al., 2006).

1.3.1: Potential of EHR

The potential of EHRs can be vast and multifaceted. EHRs can have the potential to improve healthcare delivery and patient outcomes by enhancing care coordination, facilitating information sharing among healthcare providers, supporting clinical decision-making, and streamlining administrative tasks (Evans, 2016). They can also contribute to research, population health management, and the advancement of data-driven healthcare

initiatives (Adler-Milstein and Jha, 2014). However, although EHRs hold considerable potential for addressing various challenges in healthcare, their implementation and use involve complex considerations and processes (Cresswell et al., 2013b). For instance, these can include, but are not exclusive to, the necessity of careful planning, provision of adequate training, ensuring interoperability, designing user-friendly interfaces, implementing robust data security measures, maintaining ongoing system improvement and maintenance, as well as fostering a supportive organisational culture (Keshavjee et al., 2006, Poissant et al., 2005, Cresswell et al., 2013b, Vest et al., 2019). Given these complexities, much research effort has been dedicated to evaluating the efficiency, and usability of EHRs to understand their effectiveness (Keshavjee et al., 2006, Poissant et al., 2005).

EHR decision support tools and process automation may offer the potential to improve adherence to evidence-based clinical guidelines, patient safety, and the quality of care (Main et al., 2010). EHR-integrated decision support tools, represented as clinical decision rules or algorithms, can be used to leverage patient-specific data to provide clinicians and healthcare professionals with evidence-based information and recommendations (Rothman et al., 2012). This contributes to clinical decision-making by offering alerts, reminders, clinical guidelines, and relevant insights based on specific conditions in a patient's record according to a systematic review and meta-analysis (Moja et al., 2014). EHR-based computerised reminders have been shown to improve various aspects of patient care for hospitalised individuals (Dexter et al., 2001, Ledwich et al., 2009), though the specifics can vary depending on the reminder type and context (Moja et al., 2014). For instance, reminders may aid in reducing medication errors by flagging potential drug interactions or allergies (Menachemi and Collum, 2011). Furthermore, these tools may support preventive care efforts, such as reminding clinicians to conduct routine screenings or administer vaccinations at the appropriate times (Dexheimer et al., 2008). This process can

help improve the quality of care by promoting consistency and ensuring that the latest evidence-based practices are followed (Main et al., 2010). It is important to note that EHR-integrated tools should be seen as a part of a comprehensive approach to improving healthcare outcomes (Mosadeghrad, 2014). The quality of healthcare delivery depends on a wide range of factors, including but not limited to the quality of medical care, health behaviours, social and economic factors, and environmental factors (Mosadeghrad, 2014).

The global spread of COVID-19 may have potentially contributed to the accelerated adoption of technology to support patient care (Golinelli et al., 2020). The authors of a systematic review showed that using technological tools, including EHR, significantly supported patient care during the pandemic crisis (Golinelli et al., 2020). These tools facilitated early detection of suspected individuals infected with the virus by generating big data analytics, and artificial intelligence, providing virtual care to patients and reporting real-time data (Golinelli et al., 2020). Additionally, EHR use during the crisis was leveraged for the rapid identification and tracking of COVID-19 cases, supporting remote patient monitoring, and facilitating data sharing among healthcare providers and public health agencies (Holmgren et al., 2020, Reeves et al., 2020). These functionalities proved to be essential for effective pandemic management (Holmgren et al., 2020, Reeves et al., 2020). However, the real-world application of EHRs during the pandemic significantly varied due to factors like system capabilities, poor interoperability, and data privacy concerns (Holmgren et al., 2020, Dagliati et al., 2021). Thus, although EHRs likely have the potential to enhance healthcare response during such public health emergencies, their actual effectiveness and impact should be explored further (Holmgren et al., 2020).

1.3.2: Challenges in EHR implementation

EHR implementation can face significant challenges, resulting in failures and obstacles to adoption (Kruse et al., 2016). Some EHR implementation challenges identified

include user resistance due to concerns about the impact on patient relationships, inadequate network bandwidth affecting system performance, lack of user feedback leading to unworkable situations, and insufficient tracking of system performance and decision support (Cresswell et al., 2016). Healthcare providers may exhibit resistance towards EHR use due to a lack of knowledge and technical skills, as well as concerns regarding the reliability and ease of managing the technical aspects of EHRs when compared to traditional paper-based approaches (Drigas et al., 2020).

Another challenge facing the successful implementation and adoption of EHR in the healthcare system can be privacy and data security associated with the use of EHR systems (Sulmasy et al., 2017, Huang et al., 2020). The concern lies in the potential for unauthorised access, breaches of privacy, and misuse of sensitive data because all clinical and nonclinical personnel have the capacity to access patient information from anywhere via integrated systems connected to the EHR (Sulmasy et al., 2017, Huang et al., 2020).

Additionally, the integration of an EHR system in a healthcare institute can incur significant expenses due to the various steps involved, such as hardware setup, software configuration, training of healthcare providers and technical staff, and ongoing maintenance and network fees (Mosrie, 2018, Huang et al., 2020). Interoperability, where achieving seamless data exchange and interpretation across different EHR systems and vendors, can be challenging due to variations in data standards and formats, which can lead to gaps in patient information and care (Huang et al., 2020). The process of moving data from old systems to new ones can be complex and time-consuming, posing a risk of data loss or errors during this process (Huang et al., 2020).

Evidence has also suggested that EHR use may increase clinicians' workload, potentially disrupting care coordination workflows, and might negatively impact patient safety, quality of care, or patient satisfaction (Meigs and Solomon, 2016, Cunningham et al.,

2012). A study showed that physicians in the United States spent nearly two additional hours on EHR-related tasks for every hour of direct clinical face time with patients, and devoted an additional one to two hours of personal time each night to computer and clerical work (Sinsky et al., 2016). Similarly, a study on primary care physicians in the United States showed that 44.2% of their time was spent on EHR (including both patient and non-patient care tasks) (Overhage et al., 2001). Concerning nurses, the results of one study from the United States and another from Australia, which were both conducted in inpatient units, revealed that nurses spent the majority of their time charting and reviewing information in the EHR (Westbrook et al., 2011, Yen et al., 2018). Furthermore, the implementation of the EHR system has the potential to have negative impacts and increased stress for certain nursing groups who express concerns about their competence, hold negative attitudes, and anticipate changes in their professional role and nurse–patient relationships, as shown in a mixed-methods study conducted in Australia (Jedwab et al., 2021).

Organisational factors that can influence clinicians' adoption and the effectiveness of EHRs include such aspects as the prevailing work culture (Jedwab et al., 2021, Osajiuba et al., 2021), the quality and approach of organisational leadership (Osajiuba et al., 2021) and specific system attributes, like the scope and type of the system (Nguyen et al., 2021a). Challenges of EHR implementation can also be influenced by the different policy approaches taken by governments. Sheikh et al. (2014) discussed one of the issues of the EHR adoption in the United Kingdom, which was that the United Kingdom opted for a top-down approach, involving significant contracts between the central government and a limited number of EHR vendors, contrasting with the United States bottom-up strategy that granted hospitals and healthcare professionals the freedom to select their preferred EHR systems and offering incentives for that (Sheikh et al., 2014). These challenges highlight the importance of careful

planning, stakeholder engagement, training, and ongoing evaluation to ensure successful EHR implementation and realisation of the expected benefits (Cresswell et al., 2013b).

1.4: Healthcare in Saudi Arabia

1.4.1: Overview of the current healthcare system in Saudi

There are increasing demands on healthcare services in Saudi Arabia (see Table 1) with a growing population, which exceeds 34 million residents and with a current growth rate of 2.38% annually (Sajjad and Qureshi, 2018). The provision of healthcare services in Saudi Arabia originates from three main sectors: the Ministry of Health (MOH), other governmental institutions and private sectors (Figure 1). The MOH is the main government agency responsible for the regulation, management, financing, development and follow-up of all health-related activities curried by public and private sectors (Sajjad and Qureshi, 2018, Alharbi, 2018). In addition, the MOH provides public healthcare services and medications free of charge for all citizens and their families, and other categories of residents such as expatriates working in public sectors, household workers, pilgrims, legal refugees, emergencies and others (Walston et al., 2008, Almalki et al., 2011). The MOH provides all levels of care. Out of 497 total hospitals in KSA, the MOH has 287 hospitals with a total 45,330-bed capacity and 2,121 primary healthcare centres (MOH, 2021). The MOH primary healthcare services provide preventive care, maternal and childcare, immunisations, basic services like first aid care, treatment of non-urgent cases, mobile clinics and screening campaigns, remote rural areas and a referral system to outpatient clinics (Alharbi, 2018). Secondary care services are referral centres for patients who require more advanced healthcare. Tertiary hospitals provide more complex levels of medical treatment or specialised care (Alharbi, 2018).

Table 1: Total health activities in KSA in 2021 (MOH, 2021)	
HCCs & OPD Visits (in million)	146.6
Inpatients (in Million)	3.1
Surgical Interventions (in million)	1.8
Lab. Investigations (in Million)	384
Radiology Investigations (patients in Million)	23.6
Average No. of Visits/Person/Year	4.3
Average No. of Admissions/100 People/Year	9.1

KSA = Kingdom of Saudi Arabia, OPD = Outpatient department, HCCs = Healthcare centres

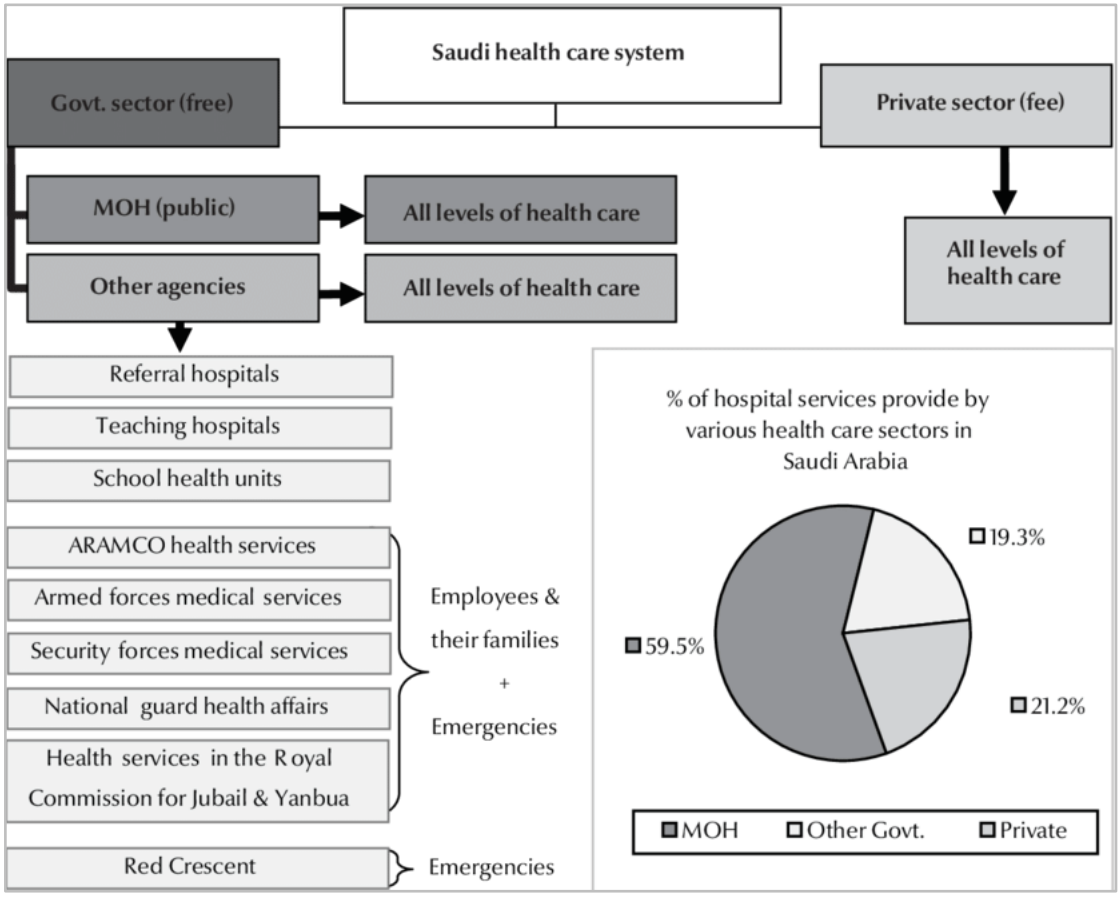


Figure 1: The current structure of the healthcare system in Saudi Arabia (Almalki et al., 2011)

There are other governmental agencies that also provide free healthcare services (outside the MOH budget) to specific groups of employees and their relatives, with a total of 51 hospitals and 14,005 beds (Table 2). They are generally perceived by patients and health

professionals as being of higher quality than MOH facilities (Walston et al., 2008). These healthcare providers are Armed Forces Medical Services, NGHA, King Faisal Specialist Hospital and Research Centre (KFSHRC), University Teaching Hospitals, ARAMCO, Royal Commission for Jubail and Yanbu health services and others (Walston et al., 2008, Sajjad and Qureshi, 2018, Aljuaid et al., 2016). For instance, the Ministry of Defence and Aviation governs and funds Armed Forces Medical Services (23 hospitals) around the country (Ministry of Defence and Aviation, 2015), Security Forces hospitals are under the Ministry of Interior, university hospitals are under the Ministry of Education, and others are directly governed and funded from their respective ministry budgets. Saudi Red Crescent Authority is also a governmental agency that provides free ambulatory medical services for emergencies, first aid, and transferring patients to the nearest hospital, and it plays an important role during Hajj (annual pilgrimage) and catastrophes (Saudi Red Crescent Authority, n.d.).

The private sector provides healthcare services to the population at all levels; primary, secondary, and tertiary care. Noticeably, the private sector has grown rapidly over the past several years and expanded its services, especially in large cities (Walston et al., 2008). The private sector primarily serves non-citizens who are ineligible for public healthcare services. Nevertheless, it has served Saudi citizens considerably, offering opportunities for those looking for a better quality of care than that provided at the MOH facilities, and whoever wants to avoid the waiting list in the public hospitals (Walston et al., 2008).

The existing old model of the healthcare system in Saudi Arabia was based on a mixed; public (MOH), private and other governmental sectors. The MOH plays the role of the chief governmental health provider and regulator, and it is funded by the total government budget, which primarily is derived from oil revenue (Al-Hanawi et al., 2018). The MOH is also responsible for allocating the budgets for each hospital through each regional health directorate (Walston et al., 2008).

Table 2: Health Indicators for 2021 (MOH, 2021)	
Total Hospital in KSA	497
Total Beds (KSA)	77,224
MOH Hospitals	287
CBAHI Accredited MOH Hospitals	65
Other Governmental Hospitals	51
Private Hospitals	159
CBAHI Accredited Private Hospitals	115
MOH Hospital Beds	45,330
Other Governmental Hospital Beds	14,005
Private Hospital Beds	17,889
No. of PHCCs (MOH)	2,121
No. of Private Polyclinics	3,732

CBAHI = Central Board for Accreditation of Healthcare Institutions (National)
PHCCs = Primary healthcare centres

However, unlike some countries worldwide where a single healthcare organisation has the whole authority over all health sectors, the MOH lacks authority over the two important governmental health sectors: the university teaching hospitals and the military hospitals (Walston et al., 2008). The MOH also lacks direct control over the expansion of the private sector. Because of this variety of regulatory bodies in the healthcare system in Saudi and the variations of budget allocations, the MOH has the most financial burden covering 60% of the total health services. This means that other governmental sectors that are directly funded by their respective ministries compete with the budget allocations of the MOH to its public health services (Walston et al., 2008). For instance, Arab News (2012) revealed that the revenues and expenditures solely for KFSHRC in Riyadh and Jeddah with a total 1,549-bed capacity were SR 5,713,000,000 (KFSH&RC, 2015). Whereas, in 2017 the total budget of the MOH was SR 76,758,793,000 (MOH, 2017). Although there has been an increase in the MOH budget from 5% in 2005 to 7.6% in 2017 from the total government budget mainly due to the rapidly growing population, the gap between the MOH budget and other

governmental sectors is growing. This year 2023, the MOH received an allocation of 80, 751, 614, 477 Saudi Riyals, which represents 7% of the total state budget (MOH, 2023).

Understanding the disparity of the healthcare budget allocation provides insight into the resources available for public health services. A lack of sufficient funding can lead to limited resources and hinder technological advancements, potentially resulting in the provisions of low-quality services. For instance, the financial resources designated for each bed are markedly more substantial in non-MOH hospitals. Additionally, physicians and nurses employed by the NGHA hospital could receive salaries that are double or triple those of their counterparts in MOH facilities. Al-Hanawi et al. (2018) linked the decreased funding for the MOH facilities to decreased quality of healthcare delivery. This perspective emerges from the current state of the MOH public healthcare services in Saudi Arabia, which are marked by longer waiting times for medical care, overutilisation of emergency departments, shortage of healthcare personnel, and duplication of the treatment processes due to insufficient technological development (Al-Hanawi et al., 2018). These factors created a public belief that non-MOH hospitals offer superior service quality, easier access, and more advanced technology (Walston et al., 2008). Therefore, the existing model of the healthcare system in Saudi Arabia has failed to bear fruit regarding improved patient outcomes, due to fragmentation of provision of care, lack of coordination and lack of clear communication channels among the multiplicity of healthcare providers, which has led to duplication of effort, overuse and waste of resources (Alharbi, 2018).

1.4.2: The new model of care in Saudi Arabia

The Saudi government has approved a strategic plan for the healthcare system, in an attempt to make a radical change in the structure and function of the Saudi healthcare system to improve the quality of care and service delivery (Alharbi, 2018). In 2016, the Kingdom of Saudi Arabia unveiled an ambitious transformational plan called Vision 2030, to shift the

country's economy and multiplicity of income sources away from its dependence on oil (Sajjad and Qureshi, 2018). As a part of Vision 2030, the National Transformational Programme (NTP) of the healthcare system has been initiated, and the new Model of Care (MOC) is one of the initiatives of the NTP (Figure 2). One of the key initiatives of NTP is a conversion of health organisations from state-owned to private-owned, encouraging both local and international investments in healthcare, which is called a privatisation programme (Jadwa Investment, 2018, Saudi Vision 2030, 2019b). The aim of this programme is to bring major economic benefits and create a competitive quality of health services, efficiency and productivity among all providers and stakeholders (Saudi Vision 2030, 2019a).

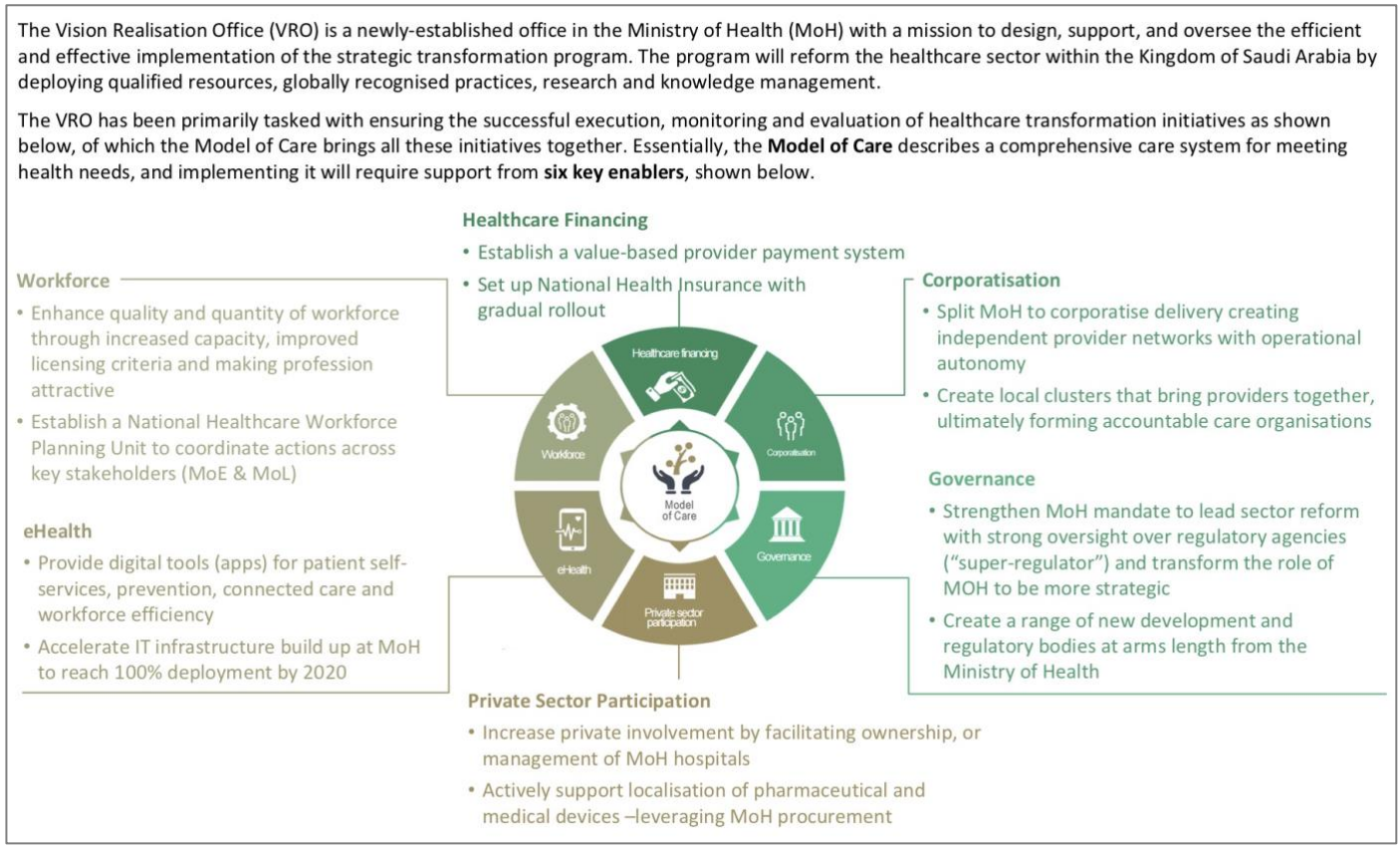


Figure 2: VRO and six key enablers of the MOC (King Saud Medical City, 2017)

Within this new MOC, there is a change of focus from curative care to preventive care, aiming for the systems of care to operate less in hospitals and more in people's homes and communities (King Saud Medical City, 2017). These systems of care are preventive care, planned/elective care, women and childcare, urgent care, chronic care and palliative care, and

there are different patient pathways for each system that are being piloted and modified according to specific needs. The role of the MOH has changed from a service provider to a regulator, and healthcare facilities have been separated from the MOH and transferred to accountable care organisations referred to as corporatisation (Figure 2). This means the MOH will establish a national holding company, and the holding company will set up subsidiaries in different regions of the Kingdom (i.e., the central, eastern, western, northern, and southern regions), each company will operate a cluster of hospitals and healthcare centres. This initiative has been initiated, and healthcare facilities across the country have been divided into clusters, each cluster involves primary healthcare centres, secondary hospitals and medical cities/tertiary care, which is part of the privatisation programme that is being implemented in phases and projected to be completed by 2030 (The Business Year, 2017, King Saud Medical City, 2017).

1.4.3: Digitalisation of healthcare in Saudi

Digital healthcare innovations are key to supporting NTP 2030 (MOH, 2018). Implementation of the E-health system is part of 40 initiatives of NTP, which aims to improve the efficiency of health facilities and accessibility to health services (Figure 2). The MOH aims to have unified electronic health data and services for the entire Saudi population by 2030, called NPHIES (National Platform for Health and Insurance Exchange Services) (Sajjad and Qureshi, 2018, Hassan, 2018). The NPHIES is central to the digital transformation of healthcare in Saudi Arabia (Council of Health Insurance, 2023). It reflects the goals of the Kingdom's Vision 2030 to modernise public services like healthcare and foster economic growth in fields like technology. With the use of the NPHIES platform, regulatory bodies will be able to assess the quality and cost-effectiveness of patient care and adopt a value-based healthcare approach that aligns payment with these factors (Council of Health Insurance, 2023). Having a unified electronic health file across all providers is a game

changer, as the aim is to help with data sharing across facilities, which should reduce issues arising from the existing fragmented care like a conflict of treatments and duplication of unnecessary examinations and efforts, besides ensuring that the patient is receiving appropriate healthcare (Adel, 2018).

The digital transformation of healthcare in Saudi is guided by the Healthcare Information and Management Systems Society (HIMSS) (HIMSS, 2022). HIMSS is a global leader and adviser for achieving digital excellence in healthcare internationally. Electronic Medical Record Adoption Model (EMRAM) is the most commonly used framework for EHRs maturity, which has eight stages from stage 0 to stage 7 (Table 3) (HIMSS, 2021). Stage 7 is a paperless system with advanced technological features, and it is an uncommon achievement around the world (Lagasse, 2020). Remarkably, in 2022, 17 hospitals in Saudi Arabia achieved EMRAM model stage 7 and another 17 hospitals attained EMRAM model stage 6 (HIMSS, n.d.).

Stage	Description
7	Patient safety is improved through EMR optimisation. Patient satisfaction is increased. EMR is designed to meet clinical team needs. Hospital policies and data security governance are in place.
6	HIE integrates structured data from external sources into Clinical Data Repository (CDR). Patient satisfaction is measured using digital tools. Patients can access and update certain clinical data. Adverse events are tracked and trended. Medical devices are integrated into EMR.
5	>75% of clinical documentation is online. >25% of medications are electronically identified. The electronic system monitors patient conditions. Integration with HIE and telehealth services is provided. Clinical governance assesses Computerised Practitioner Order Entry (CPOE) effectiveness.
4	>50% of orders are placed using CPOE. Clinical decision support is implemented. More than 50% of clinical documentation is online. Access to patient database during EMR downtimes. Patient satisfaction targets are identified.
3	>25% of clinical documentation is created online. Electronic Medication Administration Record application (eMAR) is implemented. Access to external data and remote access to patient records is provided. Role Based Access Control is implemented.
2	Clinicians access CDR for results. A clinical governance committee is formed. Policies for clinical activities and IT Change Management are in place.
1	All major ancillary systems are installed. The CDR has > 90% of lab data and images.
0	Key ancillary systems (e.g., laboratory, pharmacy, and radiology) are not installed.

Table 3: EMRAM stages (HIMSS, 2021)

Furthermore, the MOH has launched a beta version of the e-health system, a pre-release version that is ready for real-world testing yet may still require improvements, in three hospitals in different regions in the country, and the implementation for all facilities

across the country will occur in phases (Hassan, 2018). A variety of digital solutions are to be utilised for more efficiency and convenience for both the patient and the health professional such as teleconsultation or doctor e-visits. So, for urgent consultation that does not require personal presence, it can be done by phone or via video meeting (Adel, 2018). Mobile applications can also support tracking health records (i.e., vital signs, sugar level, physical activities), which aim to help with early warnings and proactive intervention.

Although NTP 2030 appears to bring very promising change, there will always be unanticipated consequences (Alharbi, 2018). Bringing huge changes and innovations to the healthcare system in Saudi can be challenging and much must be considered prior to taking any step forward because of the complexity of organisational, cultural, technical, and other factors (Alharbi, 2018).

1.4.4: Overview of the EHR system in the participating hospital for this study (NGHA)

The NGHA is a government-funded healthcare system that provides all types of care to National Guard soldiers and their families, from primary to tertiary care (Asiri et al., 2016). As explained above (in Section 1.4.1), NGHA belongs to the other governmental agencies that are non-MOH or not for the general public. It is affiliated with the Ministry of NGHA as the funding body. NGHA has five large medical cities across the Kingdom of Saudi Arabia located in five regions of the country (Riyadh, Jeddah, Dammam, Al-Ahsa, and Medina). All these five NGHA medical facilities are linked to one EHR system (Ministry of National Guard Health Affairs, 2021). NGHA is considered a leading authority in the application of health information technology within the healthcare sector in Saudi Arabia and the Middle East (Tammy, 2019).

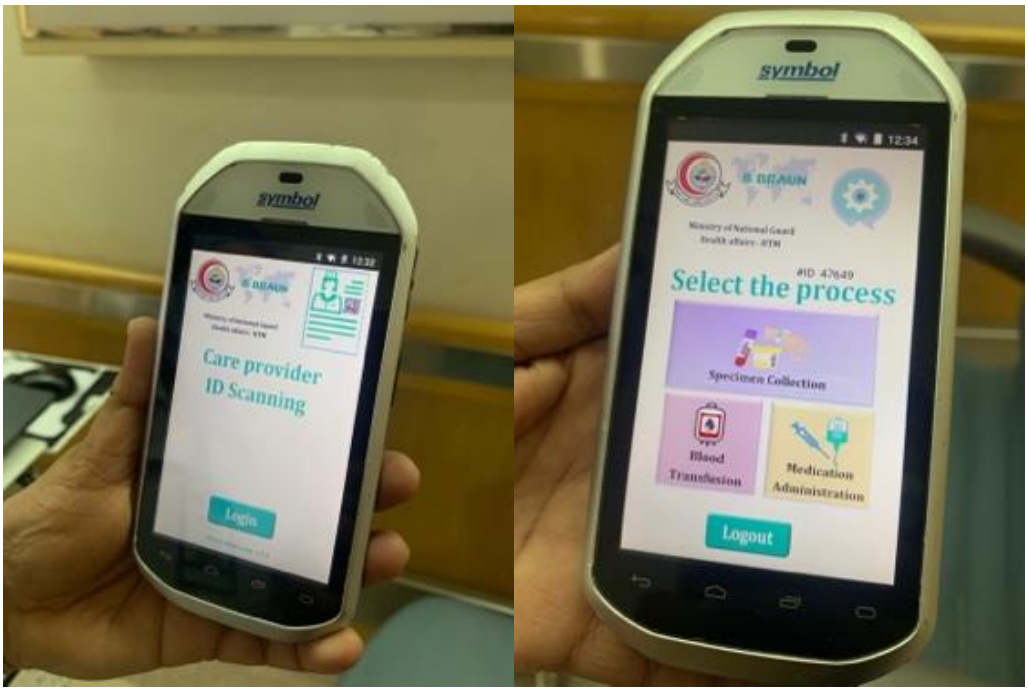
The BestCare EHR system is interoperable among all NGHA medical facilities. BestCare software was initially bought from a South Korean company in 2014, and an agreement was made to customise it to fit the needs of the national healthcare system in

Saudi Arabia while maintaining the requirements of international standards (Ministry of National Guard Health Affairs, 2021). BestCare was first introduced to NGHA hospitals in 2015 and then implemented in 2016 in stages. In 2019, the BestCare system was recognised as HIMSS stage 7 in the NGHA healthcare system in Saudi Arabia (Ministry of National Guard Health Affairs, 2021). The NGHA hospital employed the EMRAM of HIMSS as a framework to guide the implementation of the EHR (Tammy, 2019). BestCare was a fully integrated health information system. It was interfaced with a wide range of medical devices and existing information systems (Ministry of National Guard Health Affairs, 2021).

Below are some pictures of the BestCare system integration that were taken during my visit to the participating hospital. They were approved by the gatekeeper. Although they were not part of the data collected for the study, these images serve a valuable purpose. They provide a clear visual representation of the system's operational context within the hospital, thereby acting as a practical visual aid for the reader, offering an accurate depiction of the system's interface. Their relevance becomes particularly evident in the findings chapter where I discuss the system's implementation and the integration of the EHR with medical devices, as described by the participants. Thus, these images help illustrate the discussion within a tangible, real-world setting.

Picture 1 is a vital machine integrated with the EHR via Wi-Fi. A nurse would first use the scanner (shown by the blue circle) to scan a patient's barcode. This would connect the vital signs data directly to the patient's EHR record.

Picture 2 shows a device that looks like an iPod called CLMA. It is integrated with the EHR via Wi-Fi. Each nurse has one device each shift. It is used before medication administration, laboratory specimen collection, and blood transfusion to ensure patient safety. A nurse can scan his/her barcode, then a patient's barcode, and then follow the procedure steps. When a mismatch occurs, the device notifies the nurse and sends a report to nursing informatics.

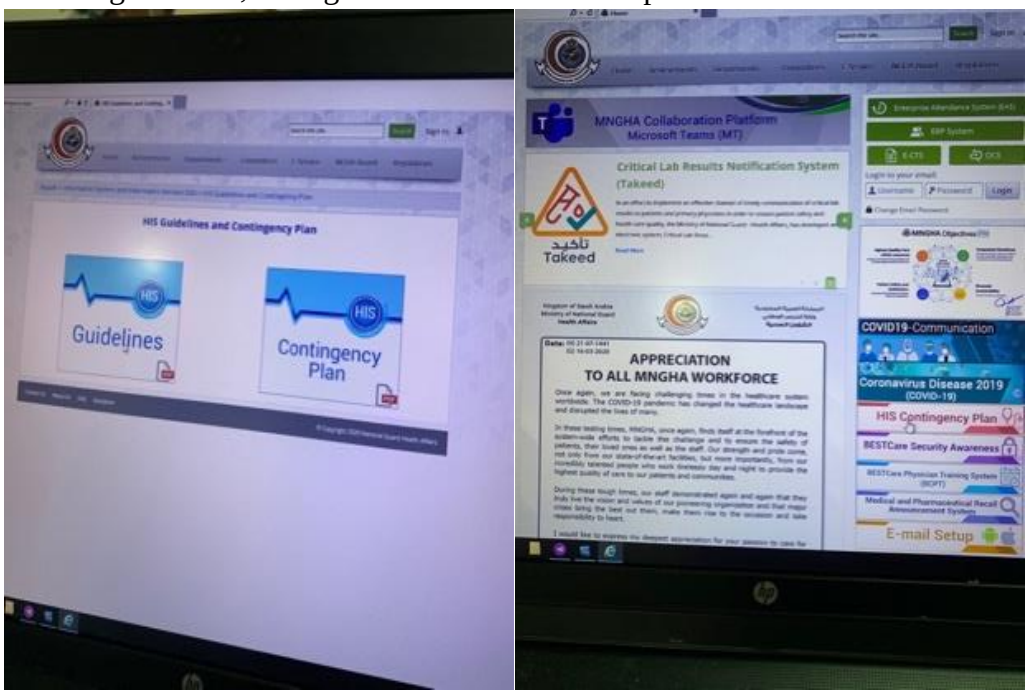


Picture 3 shows that there are enough CLMA devices for nurses each shift. They are being charged when they are not in use. The printer on the right is used to print patients' ID stickers for laboratory specimens.

Picture 4. This large machine (Omnicell) is called an Auto Dispensing Cabinet (ADC). It is regarded as a small pharmacy in a unit. Some units have more than one ADC. It is integrated with the EHR wirelessly. A nurse would use a fingerprint to log in. A nurse would need to scan his/her barcode (badge) before medication preparation.

Picture 5 shows EHR computers—laptops on wheels. Each nurse has one laptop per shift. Nurses in each shift label the computer they are using by writing: “I am NAME. This computer is mine”.

Picture 6 shows the access to online services, including internal communications such as policies and guidelines, through the intranet of the hospital.



1.4.5 Nursing workforce in Saudi Arabia

Nursing workforce in Saudi Arabia presents a unique dynamic, intricately balanced between local professionals and a significant proportion of expatriates. As the country advances towards the goals set out in its ambitious Vision 2030, there is a noticeable impact on the healthcare sector, particularly in the field of nursing as a key component of national development. The evolving nature of this workforce is underscored by the growing number of Saudi nurses, although the dependency on international nurses remains evident (Al-Dossary, 2018).

While the predominant language for most patients and their families in Saudi Arabia is Arabic, the healthcare community, including nurses, largely communicates in English. This situation arises since a significant portion of the nursing workforce in Saudi Arabia consists of expatriates, many of whom do not speak English as their primary language nor are proficient in Arabic (Aldossary et al., 2008). The nursing system in Saudi Arabia heavily leans on international recruitment, drawing professionals from over 52 countries (AlYami and Watson, 2014). The predominant nationalities among these nurses are Pilipino, Indian, and Malaysian (Alluhidan et al., 2020), although there are also significant numbers of migrant nurses who are also recruited from North America, Europe, Australia, South Africa, and the Middle East countries (Aldossary et al., 2008). These migrant nurses, predominantly women, are drawn to Saudi Arabia for various reasons, ranging from financial incentives to religious aspirations like undertaking the Hajj pilgrimage (AlYami and Watson, 2014). The diversity they bring, both in terms of expertise and cultural perspectives, is invaluable to the Saudi healthcare sector.

The proportion of local Saudi nurses has seen a significant rise, moving from 9% in 1996 to 22% by 2006, and then reaching 38% by 2018 (Alsadaan et al., 2021). While this growth is noteworthy, expatriate nurses still comprise about 60-70% of the nursing workforce

in Saudi Arabia (AlYami and Watson, 2014). Although female nurses made up 80% of the nursing professionals in the country, local Saudi male nurses represent approximately 40% of the male nursing segment in comparison to migrant male nurses who account for less than 10% (Alluhidan et al., 2020). Saudi Arabia has undertaken significant efforts to increase the number of local nurses. However, the impact of these efforts is not always immediately apparent, and current growth rates may not be sufficient to meet future demands (Aboshaiqah, 2016). Projections suggest that by 2025, the demand for nurses in Saudi Arabia will likely double (Alsadaan et al., 2021, Aboshaiqah, 2016).

The adoption by the nurses working in Saudi Arabia in integrating technological advancements like EHR, has been commendable (Alshahrani et al., 2019, Al Baalharith et al., 2022). Their experiences from different countries, combined with the training and orientation programs in Saudi Arabia, have equipped them to adopt and integrate EHR seamlessly into their daily routines (Alzghaibi and Hutchings, 2022, Al Baalharith et al., 2022). This diverse composition of the nursing workforce in Saudi Arabia serves as a microcosm of the global nursing scenario. The interplay of different cultures, practices, and experiences offers insights into global nursing trends. It also demonstrates the universality of core nursing values, regardless of geographical or cultural differences.

1.5: Problem statement

Although EHRs have been increasingly seen as a promising tool to enhance healthcare system performance and achieve the Triple Aim, their implementation and use have not been without challenges. The Triple Aim framework developed by the Institute for Healthcare Improvement (IHI) outlines three distinct, yet interconnected goals: enhancing patient experience, improving population health, and reducing costs, all of which collectively work towards optimising healthcare system performance (Lippincott Solutions, 2017). The implementation of EHRs in healthcare systems worldwide, including Saudi Arabia, aims to

contribute to achieving these goals, contributing to the advancement of healthcare delivery and the overall patient experience. However, despite the promise and potential of EHRs, their implementation and use come with challenges and unintended consequences (Colicchio et al., 2019, Gephart et al., 2015). Based on experiences from large HIT adoption projects and reviews of major studies in HIT evaluation, Colicchio et al. (2019) identified the most prominent unintended consequences of EHRs in the United States. These included (1) unmet expectations of HIT benefits, (2) EHR market saturation as healthcare organisations do not replace their EHR, (3) innovation vacuum due to the replacement of new EHRs that are poorly tested, (4) physician burnout due to high demands of documentation for clinical and nonclinical purposes, and (5) data obfuscation resulting from copy-and-paste practices, which are often used as shortcuts to save time during documentation. Furthermore, the authors of a systematic review showed that some nurses have experienced disruptions in workflow and usability issues with EHR use, leading them to constantly use workarounds, and expressed dissatisfaction with documentation functionalities (Gephart et al., 2015). Although there is growing evidence suggesting a connection between EHR use and professional burnout (Nguyen et al., 2021b, Nguyen et al., 2021c, Rotenstein et al., 2018, Yan et al., 2021), this is a complex issue that is still being actively researched to fully understand its nuances and potential mitigating factors.

In response to the rising reports of clinician burnout and dissatisfaction, the Triple Aim framework has been revised and broadened to what is now known as the Quadruple Aim. This new perspective includes an additional goal—the improvement of the work–life balance of healthcare professionals. The additional aim underscores the fact that the success of the original Triple Aim objectives is tied to clinicians' wellbeing (Bodenheimer and Sinsky, 2014, Lippincott Solutions, 2017). In other words, clinicians' burnout can lead to negative consequences on patient satisfaction, health outcomes and costs. EHR is one of the

contributing factors to clinicians' burnout which has become a phenomenon in healthcare and has been identified as requiring attention (Bakken, 2019, Colicchio et al., 2019, Bodenheimer and Sinsky, 2014). The call for attention signifies the need for in-depth exploration of the relationship between EHR use and clinician burnout, to gain a clear understanding of the contributing factors to this issue.

1.6: Significance of the study

1.6.1: Significance of the study in Saudi Arabia

Digital healthcare innovations are key to supporting the Saudi NTP 2030. The plan in the near future is to digitalise the healthcare system, implementing reputable commercialised electronic health systems used in developed countries to improve the efficiency of health facilities and accessibility to health services in Saudi Arabia (Sajjad and Qureshi, 2018, Hassan, 2018). Bringing such significant change and innovations to healthcare systems can be challenging and much must be considered prior to taking steps forward. Clinicians' burnout has been identified as a key phenomenon that has been recognised as relevant to such change (Nguyen et al., 2021b, Nguyen et al., 2021c, Rotenstein et al., 2018, Yan et al., 2021). The evidence in the literature has addressed issues associated with EHRs and the subsequent impact on clinicians' burnout. Cresswell et al. (2016) pointed out that one of the key considerations for the successful optimisation of large-scale HIT is to learn from benchmark sites that have implemented HIT systems where there can be helpful transferable lessons. These lessons often encompass challenges and issues that are experienced internationally. Such issues may potentially resonate within the healthcare context of Saudi Arabia. Therefore, it is critical to explore the phenomenon of nursing burnout related to EHR use in Saudi Arabia, to understand whether nurses in Saudi Arabia are facing the same difficulties. This exploration could help stakeholders to navigate and alleviate potential problems in the

local healthcare environment. Although nursing burnout related to EHR use has been studied before, exploring this issue within the Saudi Arabian healthcare context can provide unique insights and contribute significantly to the existing literature.

Research in this area would indeed extend the current knowledge in the following ways. Much of the existing research on nursing burnout related to EHR has been conducted in Western contexts. However, cultural, societal, and organisational factors vary greatly across regions. Exploring EHR-related burnout in Saudi hospitals equipped with advanced HIT systems may challenge the prevailing assumption that superior technology unequivocally leads to increased quality and satisfaction. It might uncover issues that have been overlooked in previous studies, such as overreliance on technology, or additional stress from advanced systems' complexity. In addition, the study would take a comprehensive approach by looking not only at the occurrence of nursing burnout but also the interactions between EHR use and workplace factors in a hospital environment. This could provide a nuanced understanding of nursing burnout, moving beyond the view that EHR use directly causes burnout. Thus, exploring the impact of EHR use on nursing burnout in Saudi Arabian hospitals can provide pragmatic insights, potentially revealing different contributing factors to nursing burnout related to EHR use and ways to mitigate it.

1.6.2: Significance of the study in nursing

Nurses form the largest portion of the healthcare workforce providing frontline care (Organization, 2016), carrying out many responsibilities including examination, diagnosis, medication administration, patient education, executing physician orders, performing procedures, and ensuring patient safety and comfort besides the managerial tasks. With the introduction of EHRs, many of the work processes have become computerised. For nurses, this includes tasks such as patient records documentation, medication administration, ordering and reviewing patient investigations, scheduling appointments, and coordinating

with other healthcare providers. Because they are the largest group of health workers, nurses frequently encounter challenges associated with these digital work processes and the unintended consequences that may arise from the use of EHR systems. These unintended consequences related to EHR encountered by nurses range from increased time spent on documentation and disturbance to conventional workflows, to dealing with technical issues and user interface problems, all of which could culminate in negative psychological effects such as stress, frustration, and burnout (Carayon et al., 2011, Rathert et al., 2019). Little is known about nursing burnout related to EHR use and the contributing factors associated with the problem (Harris et al., 2018a). Nursing research in this area is minimal in comparison with studies conducted on burnout among physicians (based on the systematic review Chapter 2). A recent systematic review has indicated that the association between nurses' wellbeing and EHR use is an understudied area (Nguyen et al., 2021c). This study will explore the issue of nursing burnout related to EHR use in the hospital context. The reason for conducting the study in a hospital environment because hospital or inpatient settings differ from primary care where nurses in hospitals provide direct continuous care to patients who are critically ill. Thus, exploring the burnout phenomenon associated with EHR among nurses in hospitals was hypothesised to be influenced by the complexity of the context. This was a finding in the systematic review findings (Chapter 2).

This study aimed to provide an understanding of contributing factors to nursing burnout related to EHR in hospitals in Saudi Arabia through a mixed-methods approach. The following chapter presents a systematic review of the literature related to EHR use and clinician burnout. The review will synthesise existing evidence, identify gaps in our current knowledge, and further elucidate the complex dynamics of this topic. The systematic review will, thereby, provide a strong foundation for the empirical investigation that forms the focus of the subsequent chapters of this thesis.

CHAPTER 2: LITERATURE REVIEW

2.1: Introduction

In the preceding chapter, I established the need to explore the impact of EHR use on nursing burnout in a hospital context in Saudi Arabia. To gain insights into previous research findings, a systematic literature review was conducted to provide a rich understanding of this issue. However, due to the scarcity of research investigating EHR-related burnout among nurses, the systematic review was broadened to encompass all clinicians. This chapter consists of five sections. First, it will provide a brief background about the topic. Second, the methods of this systematic review are outlined, including the search strategy, the inclusion and exclusion criteria, the screening and management of studies, as well as the quality assessment of included studies. The third section contains a synthesis of the systematic review results, which includes the characteristics of the included studies, the methods these studies employed to assess clinician stress, burnout, and EHR measures, the contribution of EHR to clinicians' stress and burnout, and various contributing factors to EHR-related stress and burnout as reported by the reviewed studies. Fourth, the discussion integrates these findings within the broader empirical literature, outlining the strengths and limitations of the review. The final section contains a succinct conclusion to the chapter, summarising the significant findings of the systematic review, outlining the research gap and the aim of the study that inform the subsequent chapter of this study. This systematic review has been submitted as a manuscript to the *Digital Health* journal on May 14, 2023, and is currently under review.

2.2: Background

Healthcare professionals have a higher risk of stress and burnout than the general population (Shanafelt et al., 2012, Shanafelt et al., 2015). Shanafelt et al. (2012) found that the highest rates of burnout (over 50%) were observed among frontline, direct-care healthcare workers. Burnout is defined as the final stage of chronic stress that occurs among employees and is characterised by EE, DP, and a lack of a sense of PA (WHO, 2019a, Maslach and Jackson, 1981). Several studies have identified associations between clinician burnout and low-quality patient care, the increased risk of medical errors, patient dissatisfaction and poor outcomes, low productivity, job dissatisfaction, sick leave, absences, turnover, or early retirement (Reith, 2018, West et al., 2018, WHO, 2019b), all of which adversely affect healthcare costs (Shanafelt et al., 2017a, West et al., 2018). Among physicians, burnout is also linked to low resilience, substance abuse (McCain et al., 2018, West et al., 2018), poor self-care, and suicidal ideation (West et al., 2018). Many factors contribute to clinicians' stress and burnout, including busy work environments, the lack of value alignment between leaders and healthcare workers, time and productivity pressure, excessive bureaucratic tasks, and the increasing computerisation of clinical practice (Reith, 2018, West et al., 2018).

EHRs are increasingly being implemented worldwide to improve healthcare quality, safety, and efficiency (Evans, 2016). They are widely seen as a way to tackle key issues in healthcare to achieve the 'Quadruple Aim' established by the IHI to improve patient experience, enhance population health, reduce healthcare costs, and improve the wellbeing of healthcare providers (Lippincott Solutions, 2017, Bodenheimer and Sinsky, 2014). However, the widespread implementation of EHRs has produced unintended consequences, such as increasing the clerical burden by altering patient-provider interaction and may distract from what providers and patients perceive as meaningful aspects of healthcare practice (Black et al., 2011, Califf, 2015, Hennington, 2008, Shanafelt et al., 2016, Marckini et al., 2019,

Downing et al., 2018b, Drees, 2019). This has weakened the effective use of EHRs and introduced risks to clinicians' wellbeing, which threatened the success of IHI goals (Bodenheimer and Sinsky, 2014). Recent studies reveal that the use of EHRs is one of the main factors that contribute to clinician burnout in developed Western countries, which has become a phenomenon in healthcare and has been identified as requiring further attention (Bakken, 2019, Bodenheimer and Sinsky, 2014, Colicchio et al., 2019). The growing evidence on these topics has led leaders and policymakers to advocate for reforming the IHI model introducing a quadruple aim that focuses on clinicians' wellbeing (Bodenheimer and Sinsky, 2014).

The existing literature has provided some insights and understanding in this area. From existing reviews, the focus has been on burnout solely among clinicians, where the EHR was one of the identified contributing factors (DeChant et al., 2019, Abraham et al., 2020). The association between EHR and clinicians' wellbeing has also been the focus of attention recently (Nguyen et al., 2021b, Nguyen et al., 2021c, Yan et al., 2021). However, these reviews focused on a range of clinical settings collectively and the results were not disaggregated (i.e., hospitals from non-hospitals). Given the nature of stressful environments in hospitals, it is acknowledged that EHR-related stress and burnout can be influenced by the complexity and intensity of the working environment (Opie et al., 2011, Embriaco et al., 2007, Poncet et al., 2007, Guirardello, 2017, Kotb et al., 2014). This systematic review aimed to identify and synthesise evidence from all types of study designs regarding clinicians' stress and burnout related to EHR in hospital settings. It also aimed to identify factors that contributed to clinicians' stress and burnout when using EHR in hospital settings.

2.3: Methods

2.3.1: Search strategy

The search strategy was developed following wide reading of the literature, consulting with the university librarian, and insightful discussions during PhD supervision meetings. It was applied to four major nursing and medical databases (i.e., CINAHL (Cumulative Index to Nursing and Allied Health Literature), Ovid Medline, Embase, and PsychINFO). The timeframe was limited from 2000 to 2023, and only articles published in English were included. Studies conducted in hospitals prior to 2000 are unlikely to be comparable to those conducted in recent times because EHRs were developed to include more than medical records after this period, integrating clinical documentation systems for medicine, nursing, and allied healthcare (Kuhn et al., 2015).

Regarding burnout, I included studies that looked at stress related to EHR because burnout is a result of persistent stress in the workplace (WHO, 2019a, Maslach and Jackson, 1981). The search of key terms was guided by PICO (population, intervention, comparator and outcomes) framework (Boland et al., 2017). However, the 'comparator' was not used in the search strategy because the focus was to identify studies related to stress or burnout among clinicians using EHRs, regardless of specific comparative conditions or interventions. Regarding the intervention, I did not limit the search to the term EHR, but I included technologies that include or were integrated with EHRs such as HIT and CPOE to ensure the capture of a wider range of relevant studies. Searching for articles with specific types of study designs and settings might have limited the search. Thus, no restrictions concerning study designs and settings were applied during the database search. Medical subject headings terms, subheadings, and broad scoping searches helped extract the search terms that were used (see appendices Appendix 1 and Appendix 2).

2.3.2: Inclusion and exclusion criteria

Articles that met the PICOSS criteria were included in the review (

Table 4). PICOSS is the modified framework for PICO (Boland et al., 2017), which stands for population, intervention, comparator, outcome, study design and setting. PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines were followed to show the study selection process (Figure 3) (PRISMA, 2009). It is essential to note that while usability issues could be seen as stressors/contributors to stress, such as 'alert fatigue' etc. I decided to exclude specific usability issues in my literature review because I aimed to specifically target studies that explicitly measured or discussed stress and burnout as primary outcomes to avoid branching out into broader usability concerns.

Table 4. PICOSS inclusion criteria for studies

PICOSS	**Inclusion criteria**	**Exclusion criteria**
Population	Nurses, physicians, and other clinicians (such as pharmacists, physiotherapists, respiratory therapists, and midwives).	Non-clinicians, nursing or medical students, and educators.
Intervention	EHRs or technologies that include or are integrated with an EHR system.	Other types of health technology that do not support EHRs.
Comparator	None	None
Outcomes	Burnout or stress related to EHRs.	Other EHR measures that do not directly measure stress or burnout, such as documentation time, adoption, barriers, dis/satisfaction, burden, workload, and specific usability issues such as alert fatigue, and interoperability.
Study design	All types of study designs involve primary data collection and analysis such as quantitative, qualitative, and mixed-methods design.	Studies involving secondary data, non-empirical articles, and conference articles.

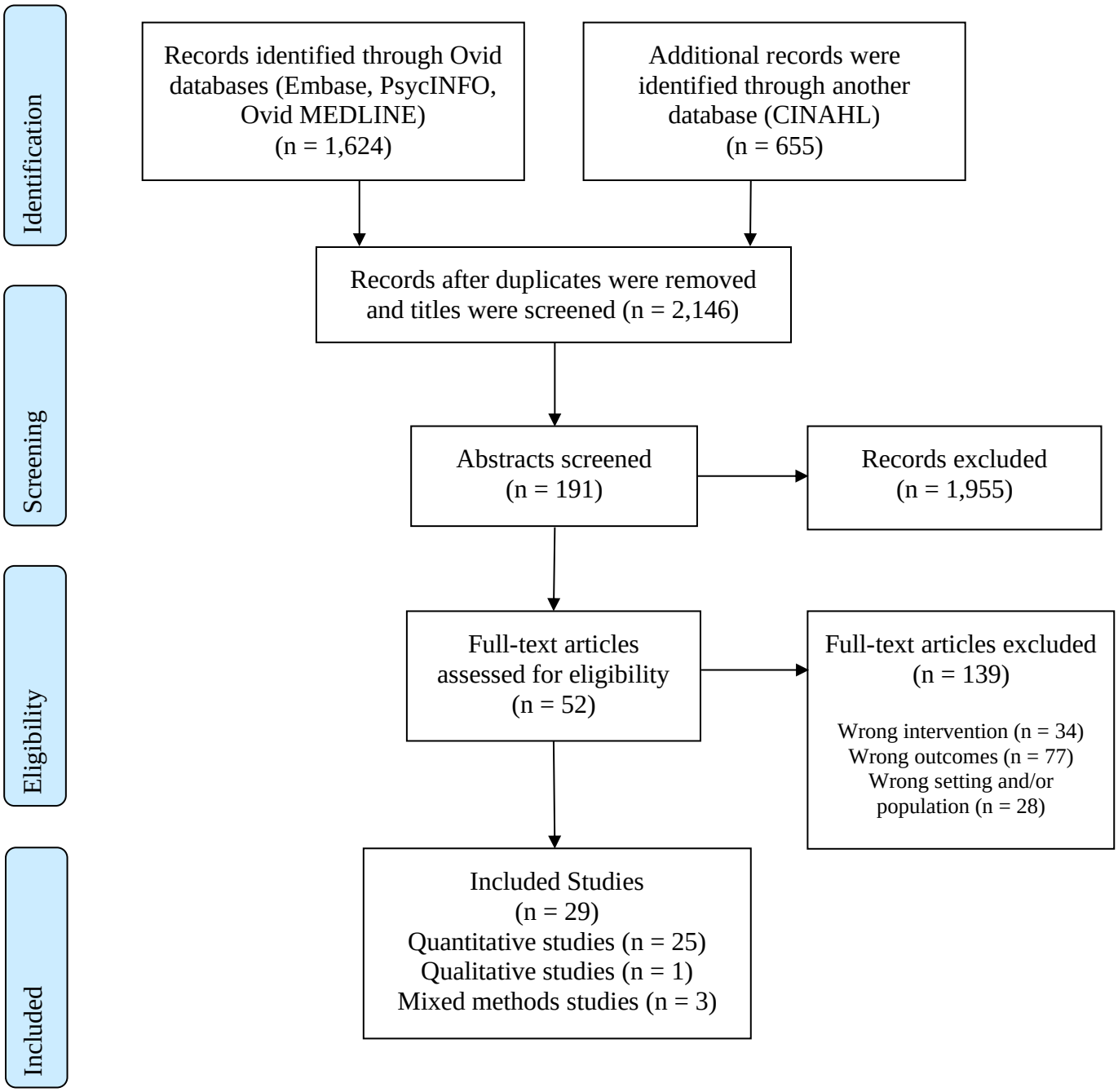
Setting	Hospital, inpatient or mixed settings.	Studies that included only outpatient, primary or community healthcare settings.

2.3.3: Screening and management of studies

Endnote reference management software was used to facilitate retrieval, removal of duplicates, and manage articles. Articles identified through the search process were assessed concerning whether they met the inclusion criteria (see

Table 4) and their relevance to the study topic. There were three stages to the screening process. As a first step, the researcher screened a total of 2,146 article titles. In the second step, the researcher and a second reviewer independently screened abstracts for 191 articles. Finally, both the researcher and the second reviewer independently screened the full texts of the remaining studies (i.e., 52 articles). The reference lists of the remaining studies were also checked, and no additional articles were included. Information about each article's information and reviewer comments and decisions were presented in an Excel spreadsheet. A total of 29 studies were included in the review (Figure 3).

Figure 3. PRISMA diagram for study selection



2.3.4: Quality assessment of included studies

The Critical Appraisal Skills (CASP) programme checklist tools were used to assess the methodological quality of the quantitative and qualitative studies included in the review (CASP, 2018a). CASP Cohort Study Checklist (CASP, 2018b) was used for the cross-sectional survey studies (n=25; Appendix 5), and CASP Qualitative Studies Checklist (CASP, 2018c) was used for the qualitative study (n=1; Appendix 4). Three mixed-methods studies (Califf, 2015, Hennington, 2008, Mazur et al., 2023) were assessed with the Mixed Methods Appraisal Tool (MMAT), applying the appropriate questions for the mixed-methods category (Hong et al., 2018). Two categories of the study design in MMAT were removed from the table; randomised controlled trial and nonrandomised study design as they are not applicable to the included studies (Appendix 3). The critical appraisal was conducted by the researcher and reviewed by an expert academic researcher in nursing informatics. Quality ratings are considered high with 80–100% of the total score per each study, moderate 50–70%, and low less than 50%. Across the 29 studies, three studies were deemed to have a high risk of bias (AlQahtani et al., 2021, Hauer et al., 2018, Marckini et al., 2019), eight had a moderate risk of bias (Califf, 2015, Ghahramani et al., 2009, Hennington, 2008, Jackson, 2019, Vehko et al., 2019, Mazur et al., 2023, Anderson et al., 2022, Chen et al., 2021), and 18 studies had a low risk of bias (Gardner et al., 2018, Harris et al., 2018b, Heponiemi et al., 2017, Kutney-Lee et al., 2021, Melnick et al., 2020a, Melnick et al., 2020b, Melnick et al., 2021, Olson et al., 2019, Shanafelt et al., 2016, Tajirian et al., 2020, Tawfik et al., 2017, Elliott et al., 2022, Eschenroeder et al., 2021, Gesner et al., 2022, Kaihlanen et al., 2021, Peccoralo et al., 2021, Skeff et al., 2022, Almulhem et al., 2021) (see appendices Appendix 3Appendix 4Appendix 5). However, all the included studies were included in the final analysis.

2.3.5: Data extraction and synthesis

Data were extracted from eligible studies and summarised using Excel spreadsheets, which helped facilitate the comparison of findings, the grouping of key concepts, and the identification of the main elements to provide explanations of the findings (Pope et al., 2006). Data were extracted under the following headings: title of the study, name(s) of the author(s), year of publication, journal, country, aims of the study, setting, study design, participants, intervention, outcome measures, key findings, and major themes. The studies identified in this review included different study designs, different burnout measurements, and statistical heterogeneity, which made the quantitative synthesis of the empirical evidence (meta-analysis) unfeasible (Table 5). Therefore, the studies were summarised using thematic analysis to aggregate and compare findings from the included studies (Braun and Clarke, 2006). The review is presented with themes that were generated from the findings of the studies using the deductive approach, drawing on the key findings that answered the review objectives (Table 5). The synthesis involved initially describing the study characteristics and the assessment methods of stress and burnout, which was then followed by a summary of the review outcomes of the EHR contribution to stress and burnout among clinicians in hospitals and the contributing factors to this issue.

2.4: Results

2.4.1: Study Characteristics

Appendix 6 provides a summary table of study characteristics. A total of 29 studies were included in the systematic review, 26 journal articles (AlQahtani et al., 2021, Gardner et al., 2018, Ghahramani et al., 2009, Harris et al., 2018b, Hauer et al., 2018, Heponiemi et al., 2017, Kutney-Lee et al., 2021, Marckini et al., 2019, Melnick et al., 2020a, Melnick et al., 2020b, Melnick et al., 2021, Olson et al., 2019, Shanafelt et al., 2016, Tajirian et al., 2020,

Tawfik et al., 2017, Vehko et al., 2019, Anderson et al., 2022, Chen et al., 2021, Elliott et al., 2022, Eschenroeder et al., 2021, Gesner et al., 2022, Kaihlanen et al., 2021, Mazur et al., 2023, Peccoralo et al., 2021, Skeff et al., 2022, Almulhem et al., 2021), and three doctoral dissertations (Califf, 2015, Hennington, 2008, Jackson, 2019). Twenty-five studies were quantitative that employed a survey (AlQahtani et al., 2021, Gardner et al., 2018, Ghahramani et al., 2009, Harris et al., 2018b, Hauer et al., 2018, Heponiemi et al., 2017, Jackson, 2019, Kutney-Lee et al., 2021, Marckini et al., 2019, Melnick et al., 2020a, Melnick et al., 2020b, Melnick et al., 2021, Olson et al., 2019, Shanafelt et al., 2016, Tajirian et al., 2020, Tawfik et al., 2017, Vehko et al., 2019, Almulhem et al., 2021, Anderson et al., 2022, Chen et al., 2021, Elliott et al., 2022, Eschenroeder et al., 2021, Gesner et al., 2022, Kaihlanen et al., 2021, Peccoralo et al., 2021), one qualitative study (Skeff et al., 2022), and three were mixed-methods studies (Califf, 2015, Hennington, 2008, Mazur et al., 2023), in which both qualitative and quantitative approaches were used. The majority of included studies were conducted in Northern America (n = 23). Of those, 21 were in the United States including one dissertation conducted in the United States and compared the U.S. findings to India and Germany (Califf, 2015), one in Canada (Tajirian et al., 2020), and one in both the United States and Canada (Marckini et al., 2019). Three included studies were conducted in Finland (Heponiemi et al., 2017, Vehko et al., 2019, Kaihlanen et al., 2021), two were conducted in Saudi Arabia (AlQahtani et al., 2021, Almulhem et al., 2021), and one in China (Chen et al., 2021). The majority of the study populations were physicians and nurses, in which 18 studies focused on physicians, ten on nurses and three involved both physicians and nurses with other clinicians (Ghahramani et al., 2009, Tawfik et al., 2017, Almulhem et al., 2021) (see Table 5). To clarify, fellows, residents, and house staff are physicians, but these terminologies are often used in the United States, depending on their medical degree levels (Albany Medical College, 2021).

2.4.2: Burnout and stress assessment

In total, 19 studies measured burnout, and 10 investigated stress related to EHRs. The most common scales used for measuring occupational burnout in quantitative studies were the Maslach Burnout Inventory (MBI; n = 12) and Mini-Z (n = 7; one study used both scales). MBI is a 22-item scale that involves three domains: (1) EE, (2) depersonalisation (DP), and (3) PA. Six studies used all three domains of MBI to measure overall burnout among physicians and nurses (Marckini et al., 2019, Shanafelt et al., 2016, Olson et al., 2019, Hennington, 2008, Anderson et al., 2022, Gesner et al., 2022, Mazur et al., 2023). Four studies involved the use of two domains of the MBI, the EE and DP subscales (Melnick et al., 2020a, Melnick et al., 2020b, Melnick et al., 2021, Peccoralo et al., 2021). One study used only the EE subscale of the MBI (Kutney-Lee et al., 2021), and another study used only four items from the EE (Tawfik et al., 2017). Researchers who used MBI considered people with high scores on EE or DP as having at least one symptom of burnout. As Olson et al. (2019) described, the Mini-Z 10-item scale has three single wellness measures (satisfaction, stress and burnout), and seven workplace stressors (workload control, value-alignment with leaders, efficient teamwork, work atmosphere, and EHR/documentation time). Three items were related to EHR: (1) sufficient time for EHR documentation, (2) the amount of time spent on EHR at home, and (3) proficiency with EHR use. The Mini-Z 10-item scale was used in seven studies. Two of them involved the use of the whole scale (i.e., all 10 items) to measure the overall burnout among physicians (Olson et al., 2019, Hauer et al., 2018). The authors of the other five studies only used a single-item 5-point scale of Mini-Z (using their own definition of burnout) to correlate it with other measures related to EHR (Table 5) (Gardner et al., 2018, Harris et al., 2018b, Tajirian et al., 2020, Eschenroeder et al., 2021, Almulhem et al., 2021). Stress related to EHR was investigated in ten of the included studies using different assessment methods. Of those ten studies, one investigated stress related to EHR

using mixed methods (Califf, 2015), another study used qualitative method to explore EHR-related distress (Skeff et al., 2022), and the other eight were quantitative cross-sectional studies (Ghahramani et al., 2009, Heponiemi et al., 2017, AlQahtani et al., 2021, Vehko et al., 2019, Jackson, 2019, Chen et al., 2021, Elliott et al., 2022, Kaihlanen et al., 2021) using a variety of EHR measures. Table 5 shows the main EHR measures linked to stress and burnout that were used in the reviewed studies.

Table 5. EHR measures, stress and/or burnout, and key themes of the reviewed studies.

	Study, year, country	**Study design**	**Included population**	**EHR measures linked to stress and burnout**	**Key themes**
1	(AlQahtani et al., 2021) Saudi Arabia	Cross-sectional survey	Nurses	EHR-related stress (10 questions)	-EHR-related stress -Professional (years of experience) -Organisational (documentation) -Technological (data correction, data retrieval, training)
2	(Almulhem et al., 2021) Saudi Arabia	Cross-sectional survey	Physicians, Nurses, Pharmacists, and others	Mini-Z (single-item) EHR measures from Mini-Z, perceptions of EHR	-EHR-related burnout -EHR-related stress -Demographic (female) -Professional (speciality) -Organisational (remote access, time, tertiary level of care, COVID) -Technological (usability)
3	(Anderson et al., 2022) United States	Cross-sectional survey	Gastroenterologists (physicians)	MBI (22-item) EHR workload and user-friendliness	-EHR-related burnout -Technological (usability)
4	(Califf, 2015) United States	Mixed-methods	Nurses	Technostress (stress induced by HIT) Five techno-stressors: techno-overload, techno-uncertainty, techno-complexity, techno-invasion, and techno-insecurity	-EHR-related stress -Organisational (time, complex environment) -Technological (ever-changing, complexity, hardware, software, and networks issues)
5	(Chen et al., 2021) China	Cross-sectional survey	Physicians	Stress Basic and advanced features of HIT	-EHR-related stress -Technological (advanced features)
6	(Elliott et al., 2022) United States	Cross-sectional survey	Physicians	Psychological distress measures EHR-related problems (related technical & workload issues)	-EHR-related stress -Technological (usability)

	Study, year, country	Study design	Included population	EHR measures linked to stress and burnout	Key themes
7	(Eschenroeder et al., 2021) United States	Cross-sectional survey	Physicians	Mini-Z (single-item) EHR after hour charting	-EHR-related burnout -Professional (speciality) -Organisational (time after hours) -Technological (vendor, EHR support, training, implementation)
8	(Gardner et al., 2018) United States	Cross-sectional survey	Physicians	Mini-Z (single-item) HIT-related stress measures (frustration, time spent on EHR at home, documentation time sufficiency), perceptions about EHR	-EHR-related burnout -EHR-related stress -Demographic (gender) -Organisational (time, vendors)
9	(Gesner et al., 2022) United States	Cross-sectional survey	Nurses	MBI (22-item) EHR usability (SUS)	-EHR-related burnout -Organisational (documentation) -Technological (usability)
10	(Ghahramani et al., 2009) United States	Cross-sectional survey	Physicians (including fellows and residents) and Nurses	User satisfaction, user-friendliness, system familiarity, frequency of use, stress and frustration, net stress, perceptions about CPOE	-EHR-related stress -Demographic (age) -Professional (speciality) -Technological (training)
11	(Harris et al., 2018b) United States	Cross-sectional survey	Nurses	Mini-Z (single-item), HIT-related stress (frustration, time spent on EHR at home, documentation time sufficiency), perceptions about EHR	-EHR-related burnout -EHR-related stress -Demographic (age) -Professional (speciality) -Organisational (time)
12	(Hauer et al., 2018) United States	Cross-sectional survey	Physicians	Mini-Z (10-item), frustrations related to EHR	-Burnout related to EHR -Organisational (time, work environment, workload, insurance)
13	(Hennington, 2008) United States	Mixed-methods	Nurses	MBI (22-item), Unified Theory of Acceptance and Use of Technology (UTAUT)	-EHR-related burnout -Organisational (time, caseload) -Technological (IT issues, training)
14	(Heponiemi et al., 2017) Finland	Cross-sectional survey	Physicians	Stress related to HIT (2 items; constantly changing information systems and IT issues)	-EHR-related stress -Demographic (age) -Organisational (time pressure)
15	(Jackson, 2019) United States	Cross-sectional survey	Nurses	The Big Five Inventory to measure technostress: techno-overload, techno-uncertainty, techno-complexity, techno-invasion, and techno-insecurity	-EHR-related stress -Organisational (overload) -Technological (techno-complexity, constant change and updating)
16	(Kaihlanen et al., 2021) Finland	Cross-sectional survey	Graduated (up to 2yrs) and experienced nurses (> 2yrs)	SRIS (two items), Stress, psychological distress, nursing informatics competence	-EHR-related stress -Professional (years of experience) -Technological (usability)

	Study, year, country	Study design	Included population	EHR measures linked to stress and burnout	Key themes
17	(Kutney-Lee et al., 2021) United States	Cross-sectional survey	Nurses	MBI (EE subscale), EHR usability	-Burnout related to EHR -Technological (usability)
18	(Marckini et al., 2019) Canada and the United States	Cross-sectional survey	Physicians	MBI (22-item), time spent on EHR (including CPOE & patient portals), perceptions about EHR	-EHR-related burnout -Organisational (time)
19	(Mazur et al., 2023) United States	Mixed-methods survey	Physicians	Quant: MBI (22-item), EHR work processes, usability, and workload. Qual: EHR-related breakdowns and frustration	- EHR-related burnout -Organisational (documentation, billing) -Technological (usability, Epic)
20	(Melnick et al., 2020a) United States	Cross-sectional survey	Physicians	MBI (EE & DP), EHR usability (SUS)	-EHR-related burnout -Demographic (gender) -Professional (speciality)
21	(Melnick et al., 2020b) United States	Cross-sectional survey	Physicians	MBI (EE & DP), EHR usability (SUS) and Provider task load (PTL)	-EHR-related burnout -Demographic (gender)
22	(Melnick et al., 2021) United States	Cross-sectional survey	Nurses	MBI (EE & DP), EHR usability (SUS)	-EHR-related burnout -Demographic (gender) -Professional (years of experience)
23	(Olson et al., 2019) United States	Cross-sectional survey	Physicians	MBI (22-item), Mini-Z (10-item)	-EHR-related burnout -Organisational (time, work environment) -Technological (EHR proficiency)
24	(Peccoralo et al., 2021) United States	Cross-sectional survey	Physicians	MBI (2 items EE, DP) and Mayo Well-Being Index assessed burnout EHR frustration & workload (time spent)	-EHR-related burnout -Demographic (female) -Professional (speciality) -Organisational (time after hours) -Technological (vendor)
25	(Shanafelt et al., 2016) United States	Cross-sectional survey	Physicians	MBI (22-item) Use of EHR, CPOE & patient portal, satisfaction with EHR and CPOE, perceptions of EHR and patient portals	-EHR-related burnout -Demographic (age, gender) -Professional (speciality) -Organisational (time)
26	(Skeff et al., 2022) United States	Qualitative study	Physicians and graduate medical trainees	EHR distressing events	-EHR-related stress -Organisational (documentation, billing) -Technological (usability)
27	(Tajirian et al., 2020) Canada	Cross-sectional survey	Physicians (including fellows and residents)	Mini-Z (single-item) Contribution of EHRs towards burnout (single question)	-EHR-related burnout -Organisational (time) -Technological (usability, proficiency, training)
28	(Tawfik et al., 2017) United States	Cross-sectional survey	Physicians & fellows, nurses, and respiratory therapists	MBI (EE 4-items) EHR use	-EHR-related burnout -Professional (speciality, years of experience)

	Study, year, country	Study design	Included population	EHR measures linked to stress and burnout	Key themes
					-Organisational (daily admission, patient acuity)
29	(Vehko et al., 2019) Finland	Cross-sectional survey	Nurses	Time pressure and psychological distress, EHR usability factors, Nurses' informatics competence	-EHR-related stress -Demographic (age) -Organisational (time pressure) -Technological (usability)

HIT = health information technology, CPOE = computerised physician order entry, this is part of an EHR

2.4.3: EHR as a contributor to clinician stress and burnout

All the reviewed studies indicated that EHR contributed to clinicians' stress and subsequent burnout. In 19 studies, significant associations between reported burnout rate and EHR-related measures were found (summarised in Table 5) among physicians (Gardner et al., 2018, Marckini et al., 2019, Olson et al., 2019, Shanafelt et al., 2016, Tajirian et al., 2020, Hauer et al., 2018, Melnick et al., 2020a, Melnick et al., 2020b, Anderson et al., 2022, Eschenroeder et al., 2021, Mazur et al., 2023, Peccoralo et al., 2021), nurses (Harris et al., 2018b, Hennington, 2008, Kutney-Lee et al., 2021, Melnick et al., 2021, Gesner et al., 2022), and mixed clinicians; physicians, nurses, respiratory therapists, pharmacists, and others (Tawfik et al., 2017, Almulhem et al., 2021). Higher level of stress related to EHR was reported among physicians (Gardner et al., 2018, Tajirian et al., 2020, Hauer et al., 2018, Chen et al., 2021, Elliott et al., 2022, Skeff et al., 2022), among nurses (Vehko et al., 2019, AlQahtani et al., 2021, Jackson, 2019, Harris et al., 2018b, Kaihlanen et al., 2021), and similar with both physicians and nurses (Ghahramani et al., 2009, Almulhem et al., 2021). In interviews, physicians (Mazur et al., 2023, Skeff et al., 2022), and nurses (Hennington, 2008, Califf, 2015) expressed their stress and frustrations with EHR use. Furthermore, stress related to information systems in a longitudinal study among Finnish physicians during a nine-year follow-up period, showed an increased stress related to information systems trend during the study period demonstrating that the stress level was getting worse over time (Heponiemi et al., 2017).

Drawing from the synthesis of findings and emergent themes of the systematic review, I developed a conceptual model (Figure 4) to summarise the review findings and provide an initial understanding of the impact of EHR use on clinicians' stress and burnout. This initial model served as a theoretical foundation, which was then built upon and refined to create a new conceptual model tailored to the unique contexts and emergent themes identified in my study (Chapter 5, Figure 8).

This model provides an explicit answer to the systematic review's two objectives. According to the general agreement of the analysed studies, the association between EHR use and clinicians' stress and burnout was found to be positive (shown in a continuous with one direction arrow). Second, in the review, I identified the factors (i.e., mediators and moderators) that contribute to the impact of EHR use on clinicians' stress and burnout, which will be detailed in the next section.

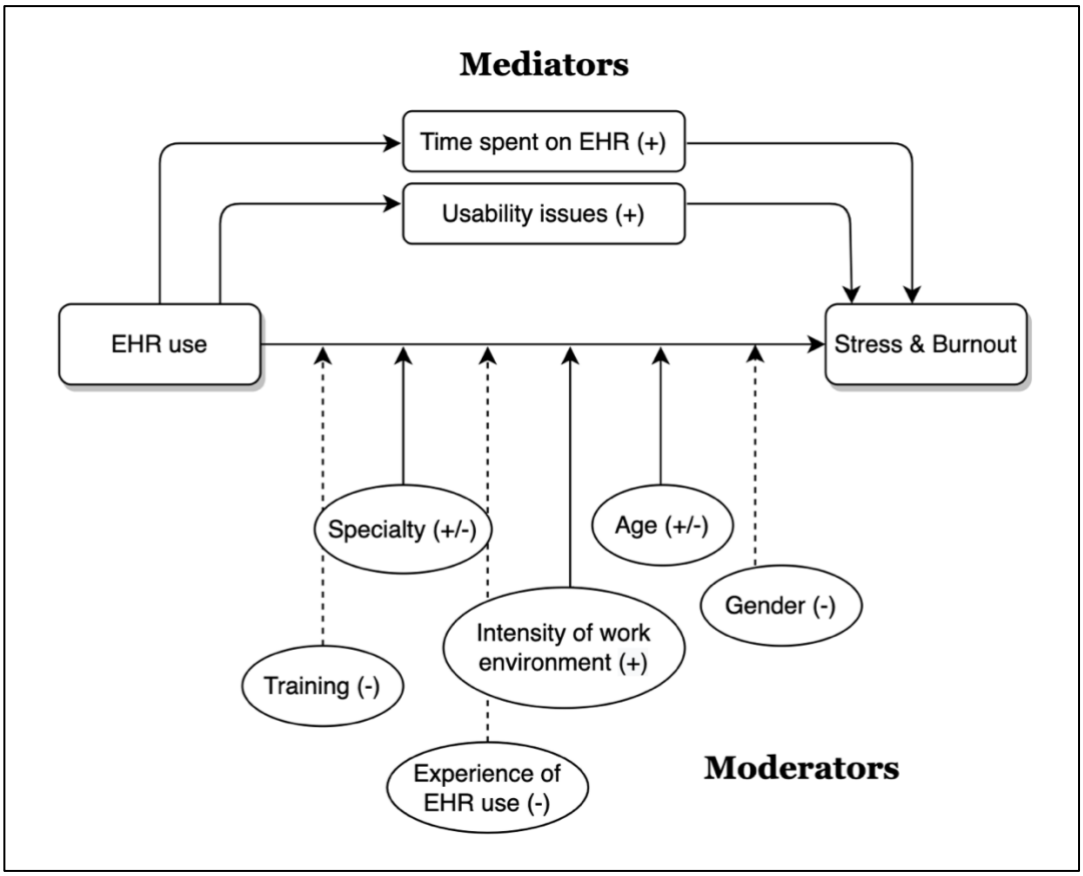


Figure 4: The review findings: a conceptual model

The mediator variable explains the reason for a relationship between two independent and dependent variables, EHR use and stress and burnout, respectively, while the moderator variable affects the strength of the relationship between the two variables (independent and dependent).
(+) a strong influence (most findings were consistent)
(-/+) a moderate influence (some findings were consistent)
(-) a weak influence (mixed/contradictory findings)
The arrows show the direction and strength of the relationship

2.4.4: Contributing factors to stress and burnout related to EHR use

Figure 4 illustrates a conceptual model summarising the review findings of the contributing factors to clinicians' stress and burnout related to EHR use. Overall, EHR-related stress and burnout were mediated/caused by usability issues and time spent on EHR. Although factors considered to be moderators were found to have a moderate to strong influence on the association between EHR use and clinicians' stress and burnout (age, speciality, and intensity of working environment). The strength of each factor was estimated based on a consensus of the findings. All contributing factors to EHR-related stress and burnout were grouped into four themes: (1) organisational factors, (2) technological factors, (3) demographic factors, and (4) professional factors.

2.4.4.1: Organisational factors: Time spent on EHR, and intensity of the working environment

Time spent on EHRs was the most frequently identified factor in 18 studies contributing to clinician stress and burnout. In 13 survey studies, it was found that perceived spending much on the EHR was associated with high levels of stress and burnout among clinicians (Gardner et al., 2018, Harris et al., 2018b, Hauer et al., 2018, Marckini et al., 2019, Olson et al., 2019, Shanafelt et al., 2016, Tajirian et al., 2020, Almulhem et al., 2021, Anderson et al., 2022, Eschenroeder et al., 2021, Gesner et al., 2022, Mazur et al., 2023, Peccoralo et al., 2021). Similarly, based on interviews with physicians (Skeff et al., 2022) and nurses (Califf, 2015, Hennington, 2008), perceived time spent on the EHR was a key factor contributing to their stress. Here, physicians and nurses expressed their frustrations with EHR documentation requirements and processes that were perceived to drive them away

from spending time with their patients. Particularly frustrating to physicians were the insurance and billing regulations that increased their time spent on EHR (Hauer et al., 2018, Mazur et al., 2023, Skeff et al., 2022). In addition, perceived insufficient time for documentation in the EHR (Gardner et al., 2018, Harris et al., 2018b, Olson et al., 2019), and spending extensive time on EHR at home or after hours (Gardner et al., 2018, Harris et al., 2018b, Eschenroeder et al., 2021, Peccoralo et al., 2021) were associated with higher rates of burnout. Furthermore, two studies showed that time pressure related to EHR use was associated with high stress related to information systems among physicians (Heponiemi et al., 2017), and psychological distress among nurses (Vehko et al., 2019). However, I also found evidence that perceived time spent on data entry may differ from actual time spent on data entry. One study compared self-reported time spent on EHR with the actual time spent, gathered by back-end usage logs, and found an overestimation of the time spent on EHR with a 14-minutes difference during working hours, and a 5.6-hour difference after working hours (Tajirian et al., 2020). Only one study in Saudi Arabia demonstrated that 83% of clinicians did not have access to the EHR from home (Almulhem et al., 2021). Thus, time spent on EHR outside work was insignificant.

The results of five studies indicated that the intensity of the working environment in inpatient settings and high workloads influenced stress and burnout related to EHR use (Califf, 2015, Hennington, 2008, Jackson, 2019, Tawfik et al., 2017, Almulhem et al., 2021). The high workload was reported in three studies as a factor causing EHR overload contributing to stress and burnout (Hennington, 2008, Jackson, 2019, Tawfik et al., 2017, Almulhem et al., 2021), explaining that the higher patient volume and patient acuity, the more EHR workload, driving clinicians to spend more time on EHR after working hours to complete required documentation (Hennington, 2008). One study showed that clinicians who provided tertiary care, and those who cared for patients suspected of having COVID-19 were

shown to be at a higher risk of EHR-related burnout (Almulhem et al., 2021). Nurses reported that issues with EHR use within a busy and complex environment were one of the situations that contributed to their stress (Califf, 2015). Two studies identified that work environment was one of the factors contributing to physicians' burnout (Hauer et al., 2018, Olson et al., 2019). However, the association with EHR use was not measured.

2.4.4.2: Technological factors: EHR usability and training

EHR usability was a recurring factor reported in 19 studies as contributing to stress and burnout among clinicians. Five studies examined the association between EHR usability and burnout among physicians (Melnick et al., 2020a, Melnick et al., 2020b), and nurses (Kutney-Lee et al., 2021, Melnick et al., 2021, Gesner et al., 2022), and the findings showed that suboptimal EHR usability scores were strongly associated with higher odds of burnout. In four studies that reported physicians' burnout related to EHR use, Epic EHR was the most utilised system (Eschenroeder et al., 2021, Mazur et al., 2023, Peccoralo et al., 2021, Gardner et al., 2018). However, the authors did not examine the relationship between vendors and EHR-related burnout, considering the possibility that EHR vendors might have an effect on usability through their design and development. Only one study measured the association between EHR vendor types and burnout and identified a negative association. The most frequently cited factors that were associated with clinicians' stress and burnout related to EHR usability were poor functionality (Vehko et al., 2019, Ghahramani et al., 2009, Hennington, 2008, Heponiemi et al., 2017, Kaihlanen et al., 2021, Mazur et al., 2023, Skeff et al., 2022), low reliability (Vehko et al., 2019, Elliott et al., 2022, Mazur et al., 2023, Skeff et al., 2022), design issues (Ghahramani et al., 2009, Hennington, 2008, Tajirian et al., 2020, Elliott et al., 2022, Mazur et al., 2023, Skeff et al., 2022), lack of user-friendliness (Tajirian et al., 2020, Anderson et al., 2022), inflexible order schemes (CPOE) (Ghahramani et al., 2009), confusing terminologies (Ghahramani et al., 2009), difficulties with finding (Tajirian et al.,

2020) or retrieving information (AlQahtani et al., 2021, Tajirian et al., 2020), difficulty editing after the data entry (AlQahtani et al., 2021), network issues (Califf, 2015), frequent software updates (Califf, 2015, Jackson, 2019, Elliott et al., 2022, Kaihlanen et al., 2021, Heponiemi et al., 2017), lack of adaptability of interface design (Califf, 2015), inadequate IT support (Elliott et al., 2022), and complexity of the system (Califf, 2015, Heponiemi et al., 2017, Jackson, 2019). However, just one study in Saudi Arabia with a low risk of bias showed that despite the reported EHR-related stress and burnout, clinicians' overall satisfaction with EHR use was relatively high, at 62% on average, with only 34.1% agreeing that EHR added frustration to their day (Almulhem et al., 2021). A different study in China showed that physicians' HIT-related stress was significantly reduced when they used advanced features of EHR as opposed to the basic one (Chen et al., 2021).

The training was cited in six studies (AlQahtani et al., 2021, Califf, 2015, Ghahramani et al., 2009, Hennington, 2008, Tajirian et al., 2020, Eschenroeder et al., 2021). However, its effect on EHR-related stress and burnout was weak because of contradictory results. Five studies identified EHR training as beneficial but not necessarily reduced the level of stress and burnout related to EHR use (AlQahtani et al., 2021, Califf, 2015, Ghahramani et al., 2009, Hennington, 2008, Tajirian et al., 2020). For instance, the authors of two studies found that EHR training did not have a significant impact on the reduction of stress and frustration among physicians (Ghahramani et al., 2009), and nurses (Califf, 2015). It was only associated positively with system familiarity and user satisfaction (Ghahramani et al., 2009). Training was also perceived as a facilitator of EHR use (Hennington, 2008, Tajirian et al., 2020, AlQahtani et al., 2021). On the contrary, one study found that physicians who agreed that their organisation had done a great job with EHR implementation, training, and support were significantly more likely to report lower levels of burnout than those who disagreed (Eschenroeder et al., 2021).

2.4.4.3: Demographic factors: Age and gender

Age was investigated in five studies as a factor that may influence stress and burnout related to EHR (Shanafelt et al., 2016, Ghahramani et al., 2009, Harris et al., 2018b, Heponiemi et al., 2017, Vehko et al., 2019). However, the findings were inconclusive. Three studies showed that younger clinicians were more generally satisfied with the system (Shanafelt et al., 2016), tended to be more familiar with the system and were frequent users who expressed less stress and frustration when using the system than older clinicians (Ghahramani et al., 2009, Vehko et al., 2019). Vehko et al. (2019) found that the increased age of nurses was associated with high levels of psychological distress related to EHR use. In contrast, the authors of two studies found no association between age and stress related to the information systems (Heponiemi et al., 2017), and between age and burnout (Harris et al., 2018b).

Gender was examined in nine studies (Gardner et al., 2018, Melnick et al., 2020a, Melnick et al., 2020b, Melnick et al., 2021, Shanafelt et al., 2016, Marckini et al., 2019, Almulhem et al., 2021, Peccoralo et al., 2021, Anderson et al., 2022), but its influence on stress and burnout related to EHR use was minimal due to inconsistent findings. The authors of four studies found that female clinicians reported higher odds of burnout related to EHR use than males (Shanafelt et al., 2016, Gardner et al., 2018, Peccoralo et al., 2021, Almulhem et al., 2021). Another study showed that male nurses had a higher rate of burnout associated with EHR usability than females (Melnick et al., 2021). In contrast, two studies did not find a statistically significant association between gender and burnout related to EHR use (Melnick et al., 2020a, Melnick et al., 2020b). Marckini et al. (2019) and Anderson et al. (2022) investigated burnout related to EHR use, and the results showed an association between female gender and burnout. However, the role of EHR in contributing to stress and burnout was not clear.

2.4.4.4: Professional factors: Speciality and EHR use experience

Nine studies showed that professional speciality influenced the outcomes of stress and burnout associated with EHR use (Melnick et al., 2020a, Shanafelt et al., 2016, Eschenroeder et al., 2021, Peccoralo et al., 2021, Gardner et al., 2018, Harris et al., 2018b, Almulhem et al., 2021, Ghahramani et al., 2009, Tawfik et al., 2017). However, the findings were mixed. The results of four studies showed that the risk of burnout related to EHR among physicians varied by medical speciality (Melnick et al., 2020a, Shanafelt et al., 2016, Eschenroeder et al., 2021, Peccoralo et al., 2021). For instance, emergency medicine and anaesthesiology were found to have a higher risk of burnout among physicians than other specialities (e.g., radiology and surgery subspecialties) (Melnick et al., 2020a, Shanafelt et al., 2016), whereas in the other studies, anaesthesiology was among the specialities with the lowest levels of burnout (Eschenroeder et al., 2021, Peccoralo et al., 2021). The results of three further studies indicated that burnout was associated with EHR use and EHR-related stress among physicians and nurses (Gardner et al., 2018, Harris et al., 2018b, Almulhem et al., 2021). However, one researcher found that physicians have a significantly increased risk of EHR-related burnout in a single study compared to nurses and other healthcare professionals (Almulhem et al., 2021). Registered nurses tended to have more positive attitudes and perceptions towards EHR use than physicians (Harris et al., 2018b, Almulhem et al., 2021). Similarly, Ghahramani et al. (2009) found that nurses had higher job satisfaction scores and tended to have more positive perceptions of CPOE use than physicians. On the contrary, Tawfik et al. (2017) identified no association between reported burnout related to EHR use in nursing staff.

The length of experience with EHR use might help with system familiarity and reduce EHR-related stressors, however, the evidence found in three studies (Tawfik et al., 2017, AlQahtani et al., 2021, Kaihlanen et al., 2021) was contradictory and, thus, weak. Tawfik et

al. (2017) found that the prevalence of burnout in Neonatal Intensive Care Units among clinicians with the most longstanding EHR use experience (more than two years) was higher than that among clinicians in units that did not use EHRs. In contrast, AlQahtani et al. (2021) found that EHR-related stress increased with years of clinical experience, and they reported that the transition from paperwork to EHRs may have contributed to senior nurses' stress. However, a study by Kaihlanen et al. (2021) showed that there was an equal association of SRIS with stress and/or psychological distress for newly graduated nurses (under two years of work experience) and for more experienced nurses (above two years of work experience), who were also likely to be more experienced users of the EHR.

2.5: Discussion

2.5.1: Summary of the main findings

EHR use was a perceived contributor to clinicians' stress and burnout in hospitals. Usability issues and time spent on EHR were the most significant predictors, but the intensity of the organisational working environment (high workload, patient volume, and patient acuity) influenced high EHR-related workload and thereby also contributed to stress and burnout. Among a range of clinicians involved in the review, physicians and nurses were the most studied groups, and the differences in their specialities and duties moderated the levels of stress and burnout related to EHRs. Training and younger age facilitated EHR use but did not reduce perceived levels of EHR-related stress and burnout.

2.5.2: Integration of findings within the wider literature

The literature on stress and burnout related to EHR is largely quantitative. This systematic review revealed significant overlap in concepts and inconsistency in how stress and burnout among clinicians using EHRs were assessed. Burnout was measured according to various symptoms including EE, DP, and PA from the MBI scale or a single-item (using

participants' own definition of burnout) from the Mini-Z scale (Rotenstein et al., 2018, Boutou et al., 2019). I observed a lack of clarity of burnout symptoms because they are similar to those of depression (InformedHealth.org, 2012, Bianchi et al., 2015). Yet, authors reported that the single-item burnout measure is more specific and practical to measure burnout in healthcare than the 22-item MBI scale, due to its brevity, validity, and ease of administration (Shanafelt et al., 2015, Dolan et al., 2015, West et al., 2018).

Almost all studies showing that spending increased amounts of time on EHR was associated with high levels of perceived stress and burnout among clinicians relied on self-reported data. This finding concurs with the wider literature (Pinevich et al., 2021, Patel et al., 2018, Chandawarkar and Chaparro, 2021). Only one of the reviewed studies measured both perceived time and actual time spent on EHR and found an overestimation of self-reported time spent on EHR, with a 14-minute difference per patient (Tajirian et al., 2020). There are studies that actually calculated the time spent on EHR including a systematic review of 28 observational studies (Baumann et al., 2018) and a longitudinal study analysing logs from 65 providers (Goldstein et al., 2018), in which the findings showed increased time spent on EHR. Often people tend to report inaccurate estimates of the time length of task durations (Ismail et al., 2019, Roy and Christenfeld, 2008, Robinson et al., 2011), but given the subjective nature of stress and burnout, quantitative measures such as time spent on data entry may not accurately reflect impacts on EHR use. This highlights the importance of qualitative research to study stressors associated with clinicians' experience and time spent using EHRs.

Poor EHR usability was identified as a key factor influencing stress and burnout. This is largely supported by the literature (Gephart et al., 2015, Nguyen et al., 2021b). EHR usability issues were also reported as a reason for increased time spent on the EHR contributing to clinicians' stress and burnout. Improved EHR usability leads to higher EHR

adoption rates, fewer medical errors, less clinician burnout, improved costs, and improved patient safety (Jason, 2020). One of the issues for EHR usability is interoperability (unified, standard format for sharing data between computer systems), which limits customisation opportunities that meaningfully suit local user needs and organisations' unique workflow and preferences (Reisman, 2017, Wong and Osborne, 2020). Simply "one size fits all" solutions will always be challenging because of the countless differences between health organisations, cultures, and systems. Studies that developed or redesigned a specific task in their system to fit local users' needs have measured the task load and identified improved EHR usability and decreased mental workload scores among clinicians (Saleem et al., 2007, Avansino and Leu, 2012). This stresses the importance for all stakeholders including healthcare facilities, vendors, and policymakers to carefully consider all usability requirements, guided by patient and clinicians' requirements and feedback, to inform EHR systems and implementation to ensure EHRs are usable and safe.

Different types of health information systems might have an impact on EHR usability, but this review has given little attention to the vendor types concerning EHR-related stress and burnout. Only Gardner et al. (2018) measured the association between EHR vendor type and burnout and found no association. Still, most of the reviewed studies did not reveal the system types that were used by healthcare professionals in their studies, which might be the result of concerns about endorsing or discouraging the use of EHRs from specific companies or manufacturers. Two authors reported high frustration levels among physicians with EHR usability in critical care settings, which was attributed to the use of Epic EHR systems (Khairat et al., 2018, Khairat et al., 2019). The evidence showed that some of the EHR vendors in the United States were not certified or did not perform rigorous testing that met the certification requirements of the Office of the National Coordinator for Health Information Technology to put the end-users at the centre of the process (Ratwani et al.,

2015). Thus, an increased focus on rigorous methods of testing EHRs with frontline clinicians is needed to identify usability challenges and safety hazards in real-world settings. Furthermore, it is important to incentivise vendors to improve the usability of their systems. There is also the need to be cognisant of the fact that the majority of studies and evidence pertaining to the Global North.

The evidence in this review showed that the hospital environment is a predictor of EHR-related stress and burnout among clinicians, in which the intensity of the working environment influenced this relationship. Factors associated with the intensity of the working environment were patients' acuity, high patient volume, and perceived lack of control over the working environment. This suggests that clinicians working in such busier areas in hospitals are at higher risk of burnout associated with EHR use. I did not find any systematic review in which the author exclusively focused on the association between stress and burnout associated with EHR use in a specific clinical setting. Generally, however, burnout among clinicians specifically physicians and nurses working in hospitals, especially acute and critical care, was reported at high levels influenced by the intensity and complexity of the working environment (Shanafelt et al., 2012, West et al., 2018, Opie et al., 2011, Kotb et al., 2014, Embriaco et al., 2007, Poncet et al., 2007, Guirardello, 2017). Add to this COVID-19 pandemic that killed millions of people around the world and all acute and critical units in hospitals were overwhelmed with patients, which adversely affected clinicians' wellbeing (Barello et al., 2020), which is the case in this review. This finding was broadly supported by other studies in this area linking the COVID-19 pandemic with clinicians' burnout (Hlubocky et al., 2021, Gajjar et al., 2022). Therefore, EHR usability should support the different needs of each clinical working setting to reduce associated burdens.

This review showed that age influenced the relationship between EHR use and clinician stress and burnout. Young clinicians reported fewer stressors related to EHR use

than old ones, but there were some mixed findings. Frequency of use and system familiarity with EHRs among young clinicians were associated with user satisfaction, which contributed to low levels of stress and frustration. This result aligns with those of a large study on U.S. physician IT use, which revealed that young healthcare workers (less than 40 years old) were the most frequent users of EHRs and other types of technology which was significantly associated with overall satisfaction with EHR use (Menachemi and Brooks, 2006). It can be argued that young clinicians are highly technology-savvy (Barello et al., 2020), so they have positive and pragmatic attitudes towards it and, accordingly, lower burnout levels than others. However, mixed results suggest that age is not an important factor influencing EHR stress and burnout the same as system usability and/or organisational factors that have a stronger influence on the EHR stress and burnout outcome. Thus, younger age facilitates EHR use and acceptance, but may not be an important factor in reducing stress and burnout related to EHR.

Clinician speciality was found to have a moderate influence on the relationship between EHR use and clinicians' stress and burnout. The author of this review found that physicians and nurses experience stress and burnout related to EHR use at varying levels. Yet, nurses tend to have more positive attitudes towards EHR use than physicians. This may stem from doctors and nurses being very different types of EHR users, with varying responsibilities and workloads and, thus, different views about the EHR systems and stressors. This is consistent with the findings of previous studies, including systematic reviews (Lee et al., 1996, Weiner et al., 1999, Poissant et al., 2005, Ghahramani et al., 2009, Gardner et al., 2018, Harris et al., 2018b, Almulhem et al., 2021). Nonetheless, nurses and physicians shared the same concerns regarding time spent on EHRs at work and home and felt that EHRs took away from their ability to provide bedside care because the documentation demands increased, thereby contributing to additional stress and burnout. This highlights the importance of involving frontline clinicians in the EHR development

processes, including design, implementation, customisation, evaluation, and legislation. In addition, it is important to consider their needs by role, specialties, and subspecialities to improve EHR usability.

Although training was seen as an important element in increasing healthcare workers' levels of comfort with EHR use and, thus, reducing stress in previous studies (Gardiner et al., 2005, Stratham and Bravo, 1990, Ragu-Nathan et al., 2008), this review does not completely support this evidence. Our findings indicate that the provision of training and sharing of IT knowledge served as facilitators for EHR use but were not necessarily associated with reductions in stressful feelings towards this technology among clinicians. Furthermore, satisfaction with the system did not necessarily reduce or prevent stress and burnout levels. EHR vendors often bypass EHR usability issues that are identified as some of the main drivers of clinicians' stress and burnout and suggest that health organisations and end-users need more training and an aptitude to learn (Kaipio et al., 2017, Staggers et al., 2013). Still, a well-designed EHR system requires training tailored to end-users' requirements, but training should not be used to compensate for poor usability.

2.5.3: Strengths and limitations

To my knowledge, this is the first systematic review that summarised the current literature investigating stress and burnout among clinicians related to EHR use in hospital settings. This work has followed the systematic review steps guided by PRISMA, to reduce the potential of bias and for more transparent information provided. The evidence was synthesised from mixed-methods studies that included both quantitative and qualitative methods, all of which relied on peer-reviewed primary research. The quality of the studies was assessed by appropriate appraisal tools; CASP and MMAT. The information from the reviewed studies was summarised and organised by themes based on a thematic analysis, adding context to quantitative findings.

There are, however, also important limitations that are mainly related to the quality of the included primary studies. Most of the authors of the included studies used self-reported survey measures of clinician stress and burnout related to EHR use, which have a response bias. Thus the lack of rigorous study designs like clinical trials precluded definitive conclusions. It was thus not possible to pool estimates among quantitative studies due to the heterogeneity in the statistics and the assessment tools used for stress and burnout related to EHR use. In addition, most of the studies were conducted in the United States (n = 22), which means that the review findings can be biased, in which EHR might not be a contributor to clinicians' stress and burnout in different contexts.

2.5.4: Future implications

Primary stakeholders including healthcare facilities, developers, vendors, and policymakers need to find solutions to improve EHR usability to reduce clinicians' stress and burnout. EHRs need to offer flexibility in workflow design, data entry, and data presentation, and they can be customised to meet each practice environment and clinicians' specialities needs. Furthermore, policymakers should eliminate administrative tasks that are not essential to clinicians' practice to reduce the documentation burden and, thus, stress and burnout. Therefore, involving clinicians in EHR development to meet their needs may help enhance EHR usability and consequently improve their wellbeing and quality of care. In addition, policymakers should collaborate with clinicians' experts to develop effective institutional health IT policies.

Stakeholders should note the current trend to be turning resources and attention to understanding the factors that contribute to burnout while identifying ways in which the wellbeing of clinicians can be enhanced. The rationale provided by these studies is that burnout contributing factors can be mitigated or eliminated while the factors that contribute to clinicians' wellbeing can be reinforced and built upon which would ultimately benefit the

healthcare industry as a whole and all the stakeholders associated with it. It is for these reasons that burnout predictors have been the main subject of numerous systematic studies carried out recently as well as this one.

Future research should assess the efficiency of multipronged interventions that address the contributing factors to the issue outlined in this review. There is a need for international contributions to this research topic to determine the worldwide prevalence of EHR-related burnout among clinicians and understand the factors that contribute to the problem in different contexts.

2.6: Conclusion

Based on the evidence presented in the systematic review, it can be concluded that EHR use is a significant contributor to stress and burnout among clinicians in hospitals, with usability issues and time spent on EHR being the most significant predictors. The intensity of the organisational working environment also influences high EHR-related workload and thereby contributes to stress and burnout. The differences in specialities and duties moderated the levels of stress and burnout related to EHRs, with physicians being the most studied groups. Training and younger age facilitated EHR use but did not reduce perceived levels of EHR-related stress and burnout. To address these issues, there is a need for qualitative research to study stressors associated with clinicians' experience and time spent using EHRs, as well as the development of EHR systems that are usable and safe, and tailored to meet local user needs and organisations' unique workflow and preferences. Additionally, there is a need to incentivise vendors to improve the usability of their systems and increase the focus on rigorous methods of testing EHRs with frontline clinicians to identify usability challenges and safety hazards in real-world settings. Finally, given that the majority of related studies

and evidence pertain to Western countries, further research is required to understand the impact of EHRs on clinicians in Non-Western countries.

In summary, the results of the systematic review revealed that there is a scarcity of qualitative research on the factors that contribute to nursing burnout related to EHR use in hospitals. There were limited studies available on the association between nursing burnout and EHR in the context of Saudi Arabia. The current study was designed to address this evidence gap by utilising a mixed-methods approach to investigate this issue. Therefore, the research aim was to examine the association between nursing burnout and EHR and to explore the contributing factors to nursing burnout related to EHR use in a hospital setting in Saudi Arabia.

CHAPTER 3: METHODOLOGY & METHODS

3.1: Introduction

This chapter consists of three key sections. The first section presents the study's aim and objectives that emerged from the evidence gap identified following the systematic literature review.

In the second section, the philosophical underpinnings of a mixed-methods study are explored, placing emphasis on pragmatism as the overarching worldview of this study. An explanation of the ontology, epistemology, and theoretical perspective that informed the study's mixed-methods design is also discussed. This is followed by explaining the sociotechnical system approach as the primary framework guiding the study. Additionally, two technology acceptance models are introduced, and their contributions to the data analysis process are explained.

The third section of this chapter discusses the study design and methods used for both the quantitative and qualitative approaches. This includes inclusion criteria, sampling strategy, setting, ethical considerations, recruitment process, data collection, and data analysis. The chapter then concludes with reflexivity.

3.2: Aim of the study

The research aim was to examine the association between nursing burnout and EHR use and to explore the contributing factors to nursing burnout related to EHR use in a hospital setting in Saudi Arabia.

3.2.1: Objectives of the study:

1. To identify workplace factors that contribute to nursing burnout in a hospital setting in Saudi Arabia.

2. To measure the association between nursing burnout and EHR-related factors in the hospital.
3. To gain an in-depth understanding of factors that contribute to nursing burnout when they use EHR in the hospital setting in Saudi Arabia.

3.3: Philosophical underpinnings of mixed-methods approach

Mixed-methods research has gained significant attention in recent years, as evidenced by its increasing adoption across various disciplines (Creswell and Clark, 2017). Some researchers view mixed methods as the third major methodological approach (Johnson and Onwuegbuzie, 2004, Creswell and Clark, 2017). The mixed-methods approach, which is situated within the pragmatic paradigm, seeks to address research questions using a combination of quantitative and qualitative methods. The pragmatic paradigm is a philosophical stance that emphasises the practical application, usefulness, and problem-solving aspects of ideas and methods (Morgan, 2014, Dewey, 1925). The adoption of a pragmatic approach in my study provided the opportunity to effectively explore the relationship between EHR and nursing burnout and facilitated a deeper understanding of the factors contributing to the issue by employing two complementary research methods, quantitative and qualitative.

The paradigm of mixed-methods research is grounded in the works of several philosophical traditions (Creswell and Clark, 2017, Maxwell and Mittapalli, 2010, Tashakkori and Teddlie, 2021), with pragmatism being a significant influence (Johnson and Onwuegbuzie, 2004, Creswell and Clark, 2017, Teddlie and Tashakkori, 2009, Thornhill et al., 2009, Johnson et al., 2007). Pragmatists argue that knowledge is best acquired through action and interaction with the world and that the value of any given concept or idea depends on its practical consequences (Morgan, 2014). This paradigm emphasises the practical

consequences and applications of research findings, and it rejects the idea of a single truth or reality, and instead focuses on the utility of knowledge in addressing real-world problems (Creswell and Clark, 2017, Tashakkori and Teddlie, 2021). The pragmatic orientation of my study is reflected in the emphasis on selecting research methods based on their practical value and suitability for addressing the research problem.

Riazi (2016) argued that a researcher with a pragmatic orientation is concerned with answering the research questions going beyond the routine practices, picturing the problem as conceptually multilayered, drawing on different theories. This allows for the development of a comprehensive understanding of the research issue using a mixture of quantitative and qualitative methods and treating them as a holistic methodology by including different epistemic perspectives in their conceptualisation of the research problem (Riazi, 2016). This is reflected in my focus on the impact of EHR use on nursing burnout, and the use of both quantitative and qualitative methods coupled with applying different theoretical concepts to provide a comprehensive understanding of the research issue. The philosophical underpinnings of the mixed-methods approach of my study can be further explained by analysing the ontological, epistemological, and methodological assumptions underlying each method situated within the context of pragmatism.

3.3.1: Ontological assumptions

Ontology is "the study of being", which concerns the study of "the nature of existence, with the nature of reality as such" (Crotty, 1998). The nature of reality in this research was approached from two worlds: a quantitative study that follows the physical world of existence and a qualitative study that concerns the social world of meaning (Ahmed, 2008). In other words, this study looked at the nature of reality from two perspectives: a quantitative study that focused on measurable, objective facts, and a qualitative study that delved into the subjective, interpretive understanding of social phenomena. The ontological

assumption in my study reflects the pragmatic stance, which allowed consideration of both the objective reality (quantitative data) and subjective experiences (qualitative data) when investigating the impact of EHR on nursing burnout in a hospital. The quantitative researcher assumes that the world operates through cause-and-effect relationships. Whereas a qualitative researcher assumes that the world of human beings involves their own thoughts, interpretations and meanings (Ahmed, 2008). The reality of my study nature could not be reduced to a single objective truth, as it encompasses both; the measurable impact of EHR on nurses (measuring the association between EHR use and nursing burnout quantitatively) and the subjective experiences of nurses (understanding nurses' perceptions of EHR use in hospitals and its impact on them qualitatively).

The pragmatic stance in my study recognises the complex, dynamic, and multifaceted nature of reality in the context of the impact of EHR use on nursing burnout in the Saudi Arabian context. This perspective allowed for a more pragmatic understanding of nursing burnout by recognising that various aspects of reality may coexist and interact. This means that the reality of nursing burnout is considered as not fixed or static, it may change over time as EHRs evolve, as the healthcare environment adapts, and as nurses develop new coping strategies. This approach emphasises the practical implications and usefulness of research findings in real-world situations (Creswell and Clark, 2017). By embracing pragmatism, the aim of this study was to provide a rich and nuanced understanding of the impact of EHR use on nursing burnout in Saudi Arabia, ultimately informing interventions and policies that address this issue.

3.3.2: Epistemological assumptions

Epistemology, in contrast, is concerned with "the nature of knowledge" and it is a way of understanding and explaining "how we know what we know" (Crotty, 1998). My pragmatic epistemological stance in mixed-methods research acknowledges the value of both

objectivism and constructionism as complementary perspectives, allowing for multiple ways of knowing and understanding the world in addressing the research question.

Objectivism, as the epistemological stance for the quantitative survey, reflects the belief that truth and meaning exist independently of the researcher's consciousness (Crotty, 1998), which means that an investigator's mind is thought to be separate from the external reality (Ahmed, 2008). This belief aligns with the positivist perspective, which asserts that knowledge can be obtained through objective observation and measurement (Crotty, 1998). In this study, I adopted an objective approach in the survey method, where I was separate from the participants, and findings were described in variable measures as they 'exist in the world'. Such methods in quantitative research seek to identify patterns, trends, and relationships between variables in a systematic and empirical manner (Crotty, 1998). By adopting this stance, practical insights could be derived from the objective analysis, informing evidence-based interventions and policies to address nursing burnout related to EHR use.

Conversely, constructivism, as the epistemological stance for the qualitative interviews, asserts that meaning is constructed by individuals as they engage with and interpret the world around them (Crotty, 1998). This approach, which is akin to interpretivism, emphasises the importance of understanding the subjective meanings and interpretations of individuals in the context of their social and cultural environments (Crotty, 1998). The interpretive role of the researcher in producing knowledge is essential for meaning and understanding (Goldkuhl, 2012, Lopez and Willis, 2004). Through this approach, I was able to delve into the nurses' experiences and perceptions of the EHR. This perspective complements my pragmatic approach by emphasising the importance of understanding the subjective experiences of nurses and their interactions with the EHR in the hospital setting. It acknowledges the importance of exploring the complexity of human

experiences and the context-specific factors influencing nursing burnout. Such nuanced understanding can inform tailored and pragmatic interventions (Morgan, 2007).

Thus, using a mixed-methods approach provided me, as a researcher, the opportunity to draw on and integrate the strengths of the two research methodological approaches in favour of making more rigorous inferences about the research problem. Embracing both quantitative and qualitative methods demonstrates the flexibility and adaptability of pragmatism, which values the use of diverse methods and epistemologies in the pursuit of actionable knowledge (Johnson and Onwuegbuzie, 2004).

Building on this philosophical and methodological grounding of my study, the next section will delve into the specific theoretical models that were utilised in my study. I will explain how these models significantly informed my analysis and interpretation of the data, providing deeper insights into the relationship between EHR use and nursing burnout in a hospital in Saudi Arabia.

3.3.2: Investigating EHR-related burnout: A sociotechnical perspective

In this study, the phenomenon of nursing burnout related to the use of EHR in a hospital environment was explored through the lens of a sociotechnical perspective, which allowed for a comprehensive understanding by considering both social factors and technological aspects. This section begins by highlighting the purpose and importance of theoretical frameworks in research, emphasising the crucial role they play in guiding and facilitating research work. The application of sociotechnical (STS) theory to the current study and the rationale for adopting a sociotechnical approach as the overarching framework are then discussed. Subsequently, an overview and critique of two theoretical models, the Technology Acceptance Model (TAM) and the Unified Theory of Acceptance and Use of Technology (UTAUT), are presented, along with an explanation of their relevance to the study. The study draws upon elements from both TAM and UTAUT, informed by the

sociotechnical approach, with the aim of establishing a comprehensive understanding of the interplay between social and technical factors contributing to nursing burnout related to EHR use.

The purpose of theoretical frameworks in research is to offer a structured and systematic approach to understanding complex phenomena, providing a lens through which researchers can analyse, interpret, and explain various aspects of their subject matter (Grant and Osanloo, 2014). They are essential in facilitating research work, as they serve to guide the development of research questions, hypotheses, and data collection methods while also assisting in the interpretation and synthesis of findings (Supino and Borer, 2012). By using a theoretical framework, researchers can identify relevant variables, relationships, and potential moderating factors, which can inform the research design and facilitate the development of appropriate research instruments (Maxwell, 2012). Furthermore, theoretical frameworks contribute to the generalisability and transferability of research findings. By linking research findings to existing theories, researchers can demonstrate how their work builds upon or challenges existing knowledge, thus promoting a deep understanding of the phenomenon under investigation (Shoemaker et al., 2003).

3.3.2.1: Sociotechnical system (STS)

The sociotechnical approach refers to the interaction between people (nurses) and technology (EHR) within a social context (hospital) (Ammenwerth et al., 2003). This definition stemmed from the original theory of STS, which was developed in the late 1940s and early 1950s by researchers at the Tavistock Institute in the United Kingdom (Trist and Bamforth, 1951, Bostrom and Heinen, 1977). The STS theory views organisations as working systems composed of two interdependent subsystems, technical and social, formed by the interaction of four key constructs: technology, tasks, people, and structure (Leavitt, 1965). The technical system comprises processes, tasks, and technology for achieving goals

within an organisation. It includes hardware, software, tools, equipment, and work organisation, focusing on efficiency, usability, reliability, and adaptability to align with organisational needs (Baxter and Sommerville, 2011). The social system addresses relationships between individuals and their characteristics, encompassing organisational culture, communication, and leadership. It considers external factors and aims to create a supportive work environment that fosters trust and cooperation (Baxter and Sommerville, 2011). STS posits that changes in one aspect of the system (either social or technical) will inevitably impact the other, and thus, both components need to be aligned and optimised to create an effective and sustainable work environment (Clegg, 2000). A well-designed STS ensures that technology and processes support the needs and goals of the individuals involved while fostering a positive and productive work environment that promotes collaboration, innovation, and adaptability (Baxter and Sommerville, 2011). The application of STS in healthcare organisations has been useful in guiding a system design and development, conducting a risk assessment analysis or evaluating the efficiency of an existing system's implementation, and understanding the efficiency of work processes from a holistic sociotechnical perspective across multiple levels of the healthcare system (Johansen and Rausand, 2014, Clegg, 2000).

3.3.2.2: My stance on sociotechnical as the overarching framework of my study

The STS theory has demonstrated its robustness, applicability, and reliability across various organisational and cultural contexts, indicating its versatile nature and suitability for a range of studies (Trist and Bamforth, 1951, Bostrom and Heinen, 1977, Clegg, 2000, Johansen and Rausand, 2014, Carayon and Salwei, 2021). STS served as a guiding framework during the initial design of my study, informing the research question, methodology, and overall approach. Specifically, the STS perspective encouraged a focus on the interplay between social and technological factors, ensuring that both dimensions were

considered when designing the study, developing research instruments, and analysing the data. The STS played an essential role in informing the data analysis of my study by providing a broader perspective through the sociotechnical framework. This approach enabled me to consider the interplay between STS's four variables (i.e., technology, tasks, people, and structure), thus providing a comprehensive understanding of the relationships between nursing burnout and EHR use within a hospital in Saudi Arabia. From a sociotechnical perspective, I examined how social factors (such as user perceptions, organisational culture, and social context) and technical factors (such as tools, infrastructure, and EHR design) shaped the outcomes of nursing wellbeing associated with EHR use. STS is particularly relevant to my study because nursing burnout is a complex issue that arises from the interplay between social factors (e.g., work environment, organisational culture, and peer support) and technical factors (e.g., EHR design, functionality, and usability). By adopting a sociotechnical perspective, I developed a more comprehensive understanding of the factors contributing to nursing burnout related to EHR use in the Saudi Arabian context.

Furthermore, because my findings support the idea that individuals' acceptance and use of technology are influenced by their perception of its usefulness, as well as the social and environmental factors that can facilitate or hinder its adoption, I adopted elements from two technology acceptance models: TAM and UTAUT. Although these models are not considered part of STS theory, they do share similarities with STS, particularly regarding considering the interplay between technological and social factors that influence technology acceptance and usage (Venkatesh et al., 2003, Davis, 1989), which aligns with the core principles of STS.

3.3.2.3: Technology acceptance model (TAM)

TAM was developed by Davis (1989), describes how individuals come to accept and use the technology, or potentially reject it (Davis, 1989). People's attitudes and intentions

towards adopting new technologies are shaped by two aspects of TAM: perceived usefulness and perceived ease of use (Davis, 1989). Davis (1989) defined perceived usefulness as "the degree to which a person believes that using a particular system would enhance his or her job performance" (Davis, 1989). In other words, individuals are most likely to adopt and use a technology they think will benefit them. Davis defined perceived ease of use as "the degree to which a person believes that using a particular system would be free of effort" (Davis, 1989). This factor captures the user's belief that the technology is simple to understand, learn, and use, without requiring great effort. Thus, a higher perceived ease of use can increase the likelihood of technology adoption and usage (Davis, 1989).

I used the perceived usefulness concept from TAM in my study analysis, as it aligned with one of my findings (Chapter 4, Section 4.3.3.2.1.2), which showed that nurses' perceived usefulness of the EHR contributed to their acceptance of the EHR and reduction of EHR-related stress. However, the 'perceived ease of use' construct in TAM has been criticised by other studies for not being a determinant of attitude and usage intention (Hu et al., 1999, Wu and Wang, 2005, Pikkarainen et al., 2004). Moreover, in this study, the participants' perceived ease of use was associated with their perceived computer literacy, and increased familiarity over time, which did not align perfectly with TAM's definition. There are limitations of TAM that have been identified by researchers. First, TAM exclusively focuses on the perceptions of individuals and neglecting broader social and technical influences (Legris et al., 2003). TAM is viewed as a static model, not accounting for changes in user perceptions or technology evolution over time, thus failing to capture users' changing experiences and perceptions (Bhattacherjee and Premkumar, 2004). The applicability of TAM across various cultural and contextual settings is also debated, with concerns being raised about its generalisability across diverse populations, cultures, and technologies (McCoy et al., 2007). Therefore, researchers have developed alternative technology

acceptance models, and UTAUT is the major one that combines eight models to address TAM's limitations and provide a more comprehensive understanding of technology adoption (Venkatesh et al., 2003).

3.3.2.4: Unified theory of acceptance and use of technology (UTAUT)

UTAUT is one of the major adapted models of TAM, which explains user intentions to use an information system and subsequent usage behaviour (Venkatesh et al., 2003). UTAUT was developed by Venkatesh et al. (2003), which integrates key elements from eight different TAMs, providing a unified model for understanding technology adoption behaviour (Venkatesh et al., 2003). The model identifies four key determinants of technology adoption: performance expectancy, effort expectancy, social influence, and facilitating conditions (Venkatesh et al., 2003). These determinants were described by Venkatesh et al. (2003) as the following. Performance expectancy refers to the degree to which using a technology will provide benefits in performing tasks. Effort expectancy represents the degree of ease associated with the use of a particular technology. Social influence is a measure of the extent to which peers, supervisors, or cultural norms affect an individual's decision to adopt a technology. Facilitating conditions refers to the organisational and technical infrastructure that supports technology use.

Although the UTAUT model offered valuable concepts relevant to my findings, and despite its comprehensiveness compared to other models, its reliability and applicability in different cultural contexts have been criticised. UTAUT proposes causal relationships between its constructs, but these may not necessarily be accurate (Al-Gahtani, 2016). Researchers have questioned the strength and directionality of these relationships, suggesting that other models or factors may be needed to explain technology acceptance (Al-Gahtani, 2016). The generalisability of UTAUT across different cultural and contextual settings has been questioned, suggesting that the model may not be universally applicable (Srite and

Karahanna, 2006, Kaba and Touré, 2014). In addition, it still does not consider all possible factors influencing technology acceptance. For instance, factors such as personality traits, user emotions, and cognitive styles are not explicitly included in the model (Al-Gahtani, 2016).

Consequently, I did not adhere to the UTAUT structure of the four major constructs, but I did use some of its concepts during the data analysis while the sociotechnical perspective served as my primary framework. I employed these concepts as subthemes within my major themes, which were EHR stressors and protective factors (from EHR-related burnout). The subthemes such as time-saving, user-friendliness, customisation, teamwork, technical support, and privacy and security, which were derived from various UTAUT constructs, were then categorised based on my thematic analysis, which was informed by the sociotechnical perspective. This approach allowed for a more flexible and context-specific analysis, as the primary goal of my study was not to examine technology adoption behaviour but rather to understand the relationships between social and technical factors, with the aim of examining nurses' experiences and perceptions of EHR use and its impact on their wellbeing.

3.4: Study design

This study adopted a mixed-methods study using a sequential explanatory design, where the qualitative data collection and analysis phase was followed by the quantitative data collection and analysis phase (FoodRisC Resource Centre, n.d., Cresswell, 2006). This design consisted of two phases: a survey study using validated instruments to measure the association between nursing burnout and EHR use, followed by a qualitative exploration using semi-structured interviews to get an in-depth understanding of the contributing factors concerning nursing burnout related to EHR use.

This section details the study design adopted for this study. It begins by explaining the rationale for choosing an explanatory mixed-methods research design, which offers a pragmatic approach leveraging the strengths of both quantitative and qualitative research methods. Details regarding the inclusion criteria, sampling strategy, study setting, and ethical considerations are also provided. The recruitment process, the hospital visit, and the specifics of data collection, including the survey instruments and interview questions used, are further elucidated. I conclude this section by illustrating the data analysis procedures used for both survey and interview data, and by acknowledging the role of reflexivity in considering the researcher's influence on the study.

3.4.1: Rationale for choosing an explanatory research design

There are various mixed-methods research designs in the related literature. Cresswell (2006) has advanced and simplified the classifications of mixed-methods designs into four major types. These are the triangulation design, the embedded design, the explanatory design, and the exploratory design. First, triangulation design (also called convergent) utilises mixed methods in one phase, at the same timeframe and equal weight (Cresswell, 2006). Even though the triangulation design is regarded as an efficient design for mixed-methods research (Cresswell, 2006), it can be very challenging for a single researcher to use within the time limits of a PhD dissertation. This is due to the fact that both types of datasets are collected simultaneously and given equal weight, and because of the difficulty of resolving discrepancies when the results of the two methods do not agree during the interpretation phase, which could necessitate the collection of additional data (Cresswell, 2006, Grove et al., 2013).

Second, in an embedded design, mixed techniques are used, but one dataset serves as a supplement to the research, primarily based on the other data type because only a small amount of either form of data is necessary for a larger qualitative or quantitative research,

making a single dataset insufficient (Cresswell, 2006). This design can be undertaken in one or two phases. This design is very beneficial when for instance a researcher needs to incorporate a qualitative component into a quantitative design such as an experimental or correlational analysis (Cresswell, 2006), which made it not ideal for my study as I needed rich data in both studies.

Third, an exploratory design is a two-phase mixed-methods design, in which the outcomes of the first method (qualitative) can inform or develop the second method (quantitative) (Cresswell, 2006, Riazi, 2016, Denzin and Lincoln, 2011). This design is especially beneficial when a researcher needs to develop and test an instrument because one is not available, or when a researcher wants to identify significant factors to analyse quantitatively when the variables are unknown. It is also appropriate when a researcher wishes to generalise data to different groups, test features of an emerging theory or classification, or investigate a phenomenon in depth and then measure its prevalence (Cresswell, 2006). Therefore, because my study objectives and the existing literature required an in-depth understanding of the factors that contribute to nursing burnout related to EHR, and because there were already available validated instruments that measure occupational burnout that could be effectively utilised in my study, this design was ruled out.

Finally, a two-phase mixed-methods explanatory approach, in which qualitative data helps explain or expand upon initial quantitative results (Cresswell, 2006). The explanatory design allows for a sequential and iterative process, ensuring that the qualitative phase builds upon and clarifies the findings from the quantitative phase, thus generating a comprehensive understanding of the research problem (Cresswell, 2006). I deemed this design appropriate for the following reasons. First, I needed to get rich data in both quantitative and qualitative studies to enhance the rigorousness of my research. The quantitative phase provides generalisable and measurable data while the qualitative phase offers in-depth and contextual

insights. Second, because of the abundance of quantitative studies on clinician burnout related to EHR and the shortage of in-depth understanding of the problem, there was a need for qualitative interviews to provide deeper insights into the research problem concerning nursing burnout related to EHR use. Despite this, a quantitative study was necessary to measure the prevalence of burnout among nurses associated with the EHR in Saudi Arabia because there were no studies on this topic had been undertaken in the Middle East prior to the data collection in 2020. By employing this design, as discussed above in Section 3.3, my study drew on the strengths of both quantitative and qualitative approaches, thereby effectively addressing the limitations of each method when used alone. The quantitative phase of the study helped me identify the prevalence and associations of nursing burnout related to EHR use in the Saudi Arabian context, whereas the qualitative phase provided an in-depth understanding of the contributing factors concerning nursing burnout related to EHR use.

Due to the subjective nature of burnout, which is based on self-report, other methods such as experimental or observational research would not be suitable for this study. This is because burnout is a complex phenomenon, influenced by personal perceptions, emotions, and experiences, which are difficult to capture and measure objectively (Pines and Maslach, 1978). Experimental or observational research methods primarily rely on observable behaviours or controlled conditions and may not accurately reflect the internal experiences and nuances of burnout (Pines and Maslach, 1978). Consequently, self-report methods, particularly surveys and interviews, were deemed appropriate for capturing the subjective experiences of individuals and providing a deeper understanding of the factors contributing to nursing burnout related to EHR use. In this study, surveys and interviews were employed as part of the explanatory mixed-methods approach, allowing for a comprehensive analysis of the research question.

3.4.2: Inclusion criteria

Clinical nurses who met the inclusion criteria of working full-time in inpatient departments, having worked at the same hospital for more than a year, giving direct care to patients, and making daily use of the EHR were included in the study. Due to the potential differences in participants' EHR knowledge and skill levels based on their working experience and the non-acute environment of outpatient and administrative departments, this study did not include nursing students or interns, administrative nurses, and outpatient departments.

3.4.3: Sampling strategy

The sampling in this study consisted of two sections related to the quantitative method, and the qualitative method respectively. In both cases, purposive sampling was employed. Purposive sampling was used to choose study participants with a wide range of demographic characteristics (according to the inclusion criteria), ensuring that their experiences, backgrounds, and value systems accurately reflected those of the larger study population (Bryman, 2012). The concept underlying purposive sampling involves focusing on participants with specific characteristics that are likely to effectively contribute to the relevant research (Etikan et al., 2016, Bryman, 2012). The identification of the appropriate sample size is rationally dependent on the scientific paradigm within which the study is being carried out. For instance, quantitative research that is oriented towards positivism will require significantly bigger samples than in-depth interpretive qualitative research does to acquire a picture that is typical of the entire population being investigated (Boddy, 2016, Crotty, 1998).

In consultation with an expert statistician, the sample size in the survey study was calculated based on the prevalence of burnout and the logistic regression analyses and it was reasonable with the half-width (precision) of a 95% confidence interval (CI) less than 5%. This was also supported by nursing studies on the same topic (AlQahtani et al., 2021, Harris

et al., 2018b, Almulhem et al., 2021). Thus, the sample size of the survey study, which consisted of a total of 282 completed responses, was sufficient to generalise the study findings.

In the case of the qualitative interviews, an adequate sample was determined to have been collected once data saturation was achieved (Grove et al., 2013). Data saturation refers to the point at which new data no longer provides additional insights or information to the research question or topic being explored (Guest et al., 2006, Fusch Ph D and Ness, 2015). This means that the data collection process will stop when the researcher notices that the same themes and concepts are emerging from the interviews and that no new themes or concepts have been discovered (Fusch Ph D and Ness, 2015). The data saturation was useful as a guide for the construction of qualitative data, and my results demonstrated that data saturation occurred in samples of 21 interviewees. To ensure the sample was representative of a homogenous population, I ensured that there was a sufficient diversity of socio-demographic characteristics to investigate a wide range of perspectives.

3.4.4: Setting of the study

The study was conducted in a large hospital in Riyadh, Saudi Arabia as a case study of EHR-related burnout phenomena among nurses. This hospital was adopting an advanced health information system recognised by the HIMSS (HIMSS Europe, 2018), which is the final stage of digital maturity where the clinical environment is completely paperless. This made a suitable context to examine the research problem considering the confounding variables that might influence the findings. In other words, the results might be predominantly influenced by technical issues inherited in less advanced or hybrid-type EHRs that utilise both electronic and paperwork processes. None of the reviewed studies in the literature review (Chapter 2) reported using a hybrid type of EHRs. Thus, it is important to

control some variables to reduce the risk of bias (confounding variables) in the reported findings.

The study results may have been generalisable if the study setting involved more than one hospital, or even different organisations and different EHR systems, as a case study in Saudi Arabia. There were two (non-MOH) government hospitals in Saudi Arabia that used the advanced HIT system HIMSS stage 7 at the time of data collection in 2020: KFSHRC and NGHA. Each operated a different EHR system: KFSHRC had Cerner since 2002 (Cerner, 2015), and NGHA had BestCare since 2015 (Korean software) (Al-Jazirah, 2017). However, I encountered difficulties in obtaining ethical approval from KFSHRC due to certain requirements that were not met during the process. Other governmental hospitals in Saudi were digitally immature (prior to the data collection in 2020), which had the basic electronic records for laboratory, pharmacy and radiology and some internal interoperability function, but the clinical documentation of nursing and allied healthcare remained paper-based, which did not suit the context of the study, and did not make it suitable to compare to the literature. This is because including such hospitals in the study would have introduced bias in the findings, as it would not accurately represent the impact of nursing burnout related to EHR use in the context of advanced systems. For that, ethical approval was only obtained from NGHA hospital, which utilised an advanced EHR system. While the high level, digitally mature hospital setting of this study does not reflect the majority of hospitals in Saudi Arabia and many countries worldwide, it offers insights into the effects and operations of EHR use in the most digitally mature organisations.

3.4.5: Ethical considerations

Ethical considerations in research are crucial to protect the rights and wellbeing of participants, ensuring that they are treated with respect, fairness, and dignity (Guillemin and Gillam, 2004). In the course of my research, I encountered a number of ethical concerns,

including the requirement of obtaining ethical approval from the designated institutes, the need to protect the participant's privacy and confidentiality, to avoid causing any harm, and to ensure that nurses' participation was both informed and voluntary. This section explains how I addressed these ethical issues.

3.4.5.1: Ethical approval

Ethical approval is the formal consent granted by a designated ethics committee for research to proceed, ensuring that the proposed study adheres to established ethical standards for the protection of human or animal subjects involved (Organization, 2011). I obtained two ethical approvals. The first ethical approval was obtained from the School of Health in Social Science, University of Edinburgh Research Ethics Committee (Ethical Approval Code: NURS043; Appendix 11). This was followed by the second approval from the Institutional Review Board (King Abdullah International Research Centre) of the participating hospital (NGHA; Approval memo number SP19/537/R; Appendix 12).

3.4.5.2: Informed consent and voluntary participation

Informed consent is a research process in which participants are provided with comprehensive information about the study and voluntarily agree to participate in it after understanding its purpose, procedures, potential risks, and potential benefits (Beauchamp and Childress, 1983). I sought informed consent from participants after providing them with enough information about the study. I reassured participants that they were not obligated to take part in the survey or interviews and were able to schedule their participation at their convenience. Before starting to collect data, participants were given information sheets and consent forms to sign (aAppendix 13,Appendix 14, Appendix 15). The information page provided a clear explanation of the purpose of my research, detailed what was expected of participants, explained their rights to withdraw at any time without any penalty, and emphasised that their information would be held in the highest confidence. Furthermore, it

included the contact information of my principal supervisor and the director of research at the faculty.

Because there is a distance between the investigator and participants in online surveys, the written information that was delivered electronically was the only means to inform participants. Having said that, during the interviews, I ensured participants were well-informed about the research and its guidelines. This involved ensuring they read the written information sheet and providing verbal explanations before each interview. I emphasised their complete freedom to withdraw from the study at any time and reassured them that they were not obliged to answer any questions they felt uncomfortable with. Additionally, I emphasised the importance of maintaining their anonymity and the confidentiality of their identifying information.

3.4.5.3: Confidentiality and anonymity

Participants' anonymity and confidentiality of their data were maintained throughout the research process, aligning with the research data management policy of the University of Edinburgh (The University of Edinburgh, 2021). Participants were reassured that all their responses would be held in the strictest confidence. I used coding (letters and numbers) to anonymise participants' identities. I further safeguarded anonymity by removing any potential identifiers for each participant. All study data from the surveys and interviews were safely stored on my password-protected computer and on the University of Edinburgh OneDrive file. The deidentified study data was only shared with my supervisors for their valuable feedback through the email system of the University of Edinburgh.

3.4.5.4: Avoiding harm

The potential harm to participants in this study was mainly psychological, due to the sensitive nature of discussing burnout. To mitigate this, I ensured that the interviews were conducted in a supportive and non-judgemental manner. When one participant showed signs

of distress, I offered to change the question or stop the interview if she felt uncomfortable, but she chose to continue the interview. I also provided her with information about the hospital's available psychological support services, such as the wellbeing clinic. This information was available to all participants I interviewed.

3.4.6: Recruitment process

The director of the nursing education department in the participating hospital was the responsible gatekeeper for me as a researcher. This meant that they were responsible for all communications, requests, and permissions. Email invitations were sent to nurses through their administrative department for both methods (surveys and interviews) in a sequence. The recruitment method for the survey study happened as the following: (1) I sent an email to the director of the nursing education department. (2) They forwarded the email to the nursing directors of the hospital inpatient units. (3) Nursing directors of the units sent it to their nursing managers who informed nursing staff via email and verbally. (4) Nurses interested in participating clicked the survey link and were given the option to contact me (i.e., the researcher) directly via email if they wanted to participate in the subsequent interviews. The survey link was distributed on 5 January 2020 and lasted for eight weeks. The gatekeeper's response to reminder emails played a significant role in facilitating the recruitment process. This helped me minimise the risk of a low response rate in the electronic survey method.

The same recruitment process was followed for the qualitative interviews. However, the recruitment for the qualitative data collection phase was difficult during the COVID-19 situation between April 2020–August 2020. Because hospital visits were restricted during the pandemic, email and phone calls were the only communication methods. Nevertheless, I was able to visit the hospital after meeting the hospital requirements and following the protection guidelines for COVID-19 in the country of Saudi Arabia. The hospital visit facilitated the recruitment process by meeting the gatekeeper who connected me to a clinical team of nurses

who helped deliver the study information to potential interviewees of interest. I emphasised the importance of voluntary participation, the anonymity of the study information and the freedom to withdraw from the study at any time to eliminate any sense of pressure to participate.

Participant information and electronic consent forms for the survey were included in the first two pages of the online questionnaire. A reminder was sent to the gatekeeper via email every two weeks to help get more responses. Concerning the interviews, the participants who initially agreed to participate in the study contact me via email, and I sent them the study information sheet and the consent form, which they then returned to me signed and indicating a convenient time for the interview. There were 110 participants who completed the survey and provided their email to participate in the subsequent in-depth interviews. However, only three of them continued when they were contacted by the researcher in the second phase of the study to ask whether they were still interested in taking part in the interview.

The initial interviews were conducted via online phone calls due to the COVID-19 lockdown situation. To improve the recruitment, initial interviewees were reminded to inform other nurses who would meet the inclusion criteria and might be interested to participate in the study to contact the researcher directly via email. About four months later, once permission was granted to visit the hospital for conducting face-to-face interviews, the remaining interviews took place in a designated quiet room within the unit arranged by a nurse manager of a unit in the participating hospital. Unlike phone interviews, the physical presence of the interviewer helped to establish rapport and capture the social and nonverbal cues of the interviewees that added value to the conversation (Vogl, 2013). Data collection for both studies was collected in the English language because the nursing workforce in Saudi Arabia is multinational and both English and Arabic are official languages used in the

healthcare system. Although I offered the Arabian interviewees the choice to speak freely in Arabic, they spoke in English, and a few of them used a few Arabic words, which were translated into English to convey their meanings.

3.4.7: Hospital visit

The hospital visit happened after the completion of the quantitative study phase, and after conducting initial qualitative interviews via phone calls due to the COVID-19 situation. The reason for the field visit was to make sense of the HIT/EHR structure that had been described by initial interviewees to comprehend technical meanings and processes. The hospital visit also facilitated the recruitment process and allowed for face-to-face interviews to happen during the COVID-19 pandemic from around August 2020 onward. The gatekeeper arranged a meeting for me with the director of the nursing informatics department to have an overview of the nursing informatics system in the hospital. Due to the current situation of COVID-19, I could not visit critical units in the hospital, but I was allowed to visit one inpatient department (renal unit) that had a low infection rate. One of the informatics staff oriented me to that unit (outside patients' room) and to the EHR system and allowed taking pictures of the devices that nurses used to make descriptive information about them so the study findings would make sense to the reader. This visit helped with more understanding and gathering much important information alive and made a short cut of some of the descriptive interview questions about the technical parts of the EHR. It also facilitated the recruitment process after meeting people directly.

3.4.8: Data collection

This section contains an explanation of the data collection instruments utilised for both the survey and interview methods of the study.

3.4.8.1: Survey instruments

3.4.8.1.1: Overview of valid and reliable survey instruments to measure burnout

Early research on burnout was predominantly qualitative and focused on acquiring a deeper knowledge of the phenomena and identifying its subdimensions (Freudenberger, 1974, Maslach and Pines, 1977, Pines and Maslach, 1978, Pines and Maslach, 1980, Maslach and Jackson, 1978). The early 1980s marked a shift towards an empirical approach to study with the creation of the MBI and subsequent instruments for quantifying burnout. The following list describes the burnout instruments.

1) MBI was customised to apply to different professions, such as Human Services Survey (MBI-HSS) a 22-item, Educators Survey (MBI-ES) a 22-item, and General Survey (MBI-GS) a 16-item.

2) Single-item burnout (SIB) measure (Schmoldt et al., 1994) included in the Mini-Z survey 10-item (Williams et al., 1999, McMurray Julia et al., 2000).

3) Oldenburg Burnout Inventory (OLBI) 16-item, (Bakker et al., 2004).

4) Copenhagen Burnout Inventory (CBI) 19-item, (Kristensen et al., 2005).

5) Shirom-Melamed Burnout Measure (SMBM), (Shirom and Melamed, 2006).

6) The Well-Being Index (WBI) 7-item, (Dyrbye et al., 2010).

7) Bergen Burnout Inventory (BBI) 9-item, (Salmela-Aro et al., 2011).

8) Karolinska Exhaustion Scale KES, (Saboonchi et al., 2013).

9) Spanish burnout inventory SPI, (Gil-Monte et al., 2017).

10) The Stanford Professional Fulfillment Index (PFI) 16-item, (Trockel et al., 2018).

3.4.8.1.2: My stance on the burnout measurement tool

The 22-item MBI is considered the ‘gold standard’ for measuring occupational burnout, which has been extensively used in different disciplines (Maslach et al., 2008, Shanafelt et al., 2015, West et al., 2018). It has the strongest psychometric constructs that are

widely applicable to different disciplines compared to other wellbeing instruments (Dyrbye et al., 2018, Maslach and Jackson, 1981). It consists of three scales: EE, DP, and PA. The vast majority of research on occupational burnout involved the use of adapted versions of the MBI. However, the MBI is only used to assess the risk of burnout, but it does not provide a diagnosis of the problem or causal factors. Hence, an examination of burnout-related factors is required alongside the MBI (Altannir et al., 2019) as has been done in some studies that used MBI in the literature review (Chapter 2). Furthermore, the MBI is less practical to my study topic when compared to the Mini-Z tool. In other words, the MBI exclusively focuses on the psychological impact of burnout while the Mini-Z tool is used to examine burnout as an outcome and the factors that contribute to burnout at the workplace including the EHR. In addition, the Mini-Z burnout survey is relevant to healthcare to assess clinicians' wellbeing (American Medical Association, 2015), which was developed from the physician work–life study (Williams et al., 1999, Schmoldt et al., 1994, McMurray Julia et al., 2000), and it has been used successfully in a variety of settings. Particularly, the Mini-Z survey measures satisfaction, stress, and burnout and their risk factors in healthcare (including EHR), which is the most relevant to my topic. Furthermore, Mini-Z includes the SIB measure (using your own definition of burnout), which has been previously tested and shown to have a sensitivity of 83.2% and specificity of 87.4% as a standalone burnout assessment when compared to the longer and more detailed MBI (Dolan et al., 2015). In addition, full MBI length can limit its use for larger population samples within health organisations (West et al., 2018, Shanafelt et al., 2015), which makes shorter assessment tools more practical (Shanafelt et al., 2015). This makes the Mini-Z the most appropriate assessment tool with which to guide the interventions in healthcare due to its brevity, sound psychometric properties, ease of administration, and healthcare-related burnout measures. Furthermore, the Mini-Z survey instrument was deemed

to be relevant to my study aim because it helped me meet my research objectives. For these reasons, I used the Mini-Z tool over MBI for measuring burnout in my study.

3.4.8.1.3: Mini-Z burnout survey

The Mini-Z burnout survey measures burnout and its workplace risk factors in healthcare organisations, where EHR is one of the workplace factors (Appendix 7). The main EHR-related measures of interest in the Mini-Z were four items; sufficient time for documentation, time spent on EHR at home, EHR proficiency, and EHR adds to one's frustration. However, because the systematic review (Chapter 2) showed that other interrelated factors contributed indirectly to EHR stress and burnout such as the intensity of the working environment, I decided to use all the 10-item Mini-Z survey. These other workplace factors (six items) of the Mini-Z were job stress, job satisfaction, workload control, atmosphere (chaos), teamwork, and values alignment. The Mini-Z burnout survey had two versions (worklife, 2020). I used the older version (1.0) 10-item Mini-Z that had been used by several studies. From the new version of the Mini-Z (2.0), I used one item related to the EHR, which is "the EHR adds to the frustration of my day". The Mini-Z survey is free to use and modify for research and education purposes (worklife, 2020), and this is its disclaimer statement:

> *"The Mini Z was developed by Dr. Mark Linzer and team at Hennepin Healthcare, Minneapolis MN. The mini-Z survey tools can be used for research, program evaluation and education capacities without restriction. Permission for commercial or revenue-generating applications of the mini-Z must be obtained from Mark Linzer, MD or the Hennepin Healthcare Institute for Professional Worklife prior to use: www.professionalworklife.com. Questions drawn mainly from the Physician Worklife Study, MEMO study, and Healthy Workplace study."*

The SIB measure in the Mini-Z required respondents to identify their symptoms of burnout: (1) "I enjoy my work. I have no symptoms of burnout;" (2) "I am under stress, and I don't always have as much energy as I did, but I don't feel burned out;" (3) "I am definitely burning out and have one or more symptoms of burnout, e.g., emotional exhaustion;" (4)

"The symptoms of burnout that I'm experiencing won't go away. I think about frustration at work a lot;" and (5) "I feel completely burned out. I am at the point where I may need to seek help." Similar to previous studies, this item was dichotomised as "no symptoms of burnout" (≤ 2 on the 5-point scale) and "one or more symptoms of burnout" (≥ 3 on the 5-point scale) (Gardner et al., 2018, Harris et al., 2018b, Schmoldt et al., 1994).

Thus, to achieve the first and second objectives of the study, I had to identify the workplace factors that contributed to nursing burnout in a hospital setting in Saudi Arabia and then measure the association between nursing burnout and EHR-related factors.

3.4.8.1.4: Other EHR-related variables

The study also used another survey tool, which measured perceptions of the EHR, to provide further insight into how nurses perceived the EHR, and the potential stressors associated with it, which tied back to the first and second objectives of the study. This survey consisted of five items (part 3 in Appendix 7), four of which measured perceptions of the EHR as used in relevant studies (Gardner et al., 2018, Harris et al., 2018b, Tajirian et al., 2020, Almulhem et al., 2021). Participants were also asked whether they had remote access to their EHR and whether they use it. Remote EHR users were asked the reason for their remote EHR use (Gardner et al., 2018, Harris et al., 2018b, Almulhem et al., 2021). Permission was obtained via email from the developers of the survey questions, the Rhode Island Department of Health, to adapt their four-point Likert scale to a five-point scale for use in this research. The four survey items that measured perceptions of the EHR asked participants how much they agreed that using the EHR (1) improves communication among physicians and staff in their practice, (2) improves patient care, (3) improves their clinical workflow, and (4) improves job satisfaction. Although these other EHR-related variables were not tested for validity like the Mini-Z, they demonstrated reasonable content validity as the questions were developed based on an ongoing multi-stakeholder consensus process as

was detailed earlier by the survey developers (Baier et al., 2012). In addition, these questions had been used by relevant studies (Gardner et al., 2018, Harris et al., 2018b, Tajirian et al., 2020, Almulhem et al., 2021).

The online questionnaires were designed by Qualtrics software licensed by the University of Edinburgh. Qualtrics is more secure than other online survey tools like SurveyMonkey and compatible with the common statistics software. The survey questionnaire was reviewed by two academics, my supervisors, and four nursing PhD colleagues, then it was piloted by 30 nurses from the participating hospital (NGHA). Minor modifications were made from the feedback, mainly the design. One comment from a nurse manager in NGHA was that EHR was not allowed to access remotely, but the question was kept to compare the findings to the literature where the use of EHR at home was a contributing factor to clinicians' burnout as explained in the literature review (Chapter 2).

The first part of the survey questions was demographic and practice information (Appendix 7). The second part of the questionnaire involved questions related to the study objectives. First, I measured the prevalence of nursing burnout using the single burnout item in the Mini-Z survey. Then I used 10 items from the Mini-Z burnout tool to examine the workplace factors that contributed to nursing burnout. The other survey tool was used to measure other EHR-related variables. The burnout measure and EHR-related factors were correlated/regressed to explore the association between these factors.

The online survey link was sent to registered nurses employed in NGHA via their administrative departments. The survey URL was kept open for eight weeks, and email reminders were sent to the gatekeeper every two weeks to improve the response rate. Because I did not have access to nurses' emails, I could not get accurate information about the number of emails the survey link had been sent to. The nursing staff count in the hospital was 2,957, and it was difficult for the gatekeeper to limit the email recipients to the targeted nursing

population in my study. This means that the response rate can be inaccurate. Out of 348 responses received (estimate of 12% response rate), a total of 282 completed responses were included in the study.

Due to the differing recruitment methods employed for the survey and interviews, the participants involved in the interviews did not constitute a specific subgroup of those who participated in the survey. Therefore, it was not possible to directly compare the survey responses to the interview responses for all participants.

3.4.8.1.4: The interview questions

The interviews were conducted to achieve the third objective of my study: to gain an in-depth understanding of the contributing factors to nursing burnout associated with EHR use in a hospital setting in Saudi Arabia. Interviews were crucial as they allowed for a deeper exploration of the personal experiences and perceptions of nurses when they use the EHR, which could not be fully captured through the questionnaires. Questions brought up by the quantitative data were probed in depth through interviews, especially those that required explanation or further context.

I employed semi-structured interviews for the qualitative study. Semi-structured interviews are the most popular method because it strikes a balance between structured and unstructured methods, enable participants to express their views freely and answer questions in detail, and maintain the researcher's focus on identifying specific aspects within the area of study (Grove et al., 2013). In addition, the subject of "burnout" does not lend itself well to the use of a focus group because it may limit participants' ability to freely express their thoughts and feelings regarding stress and burnout.

The development of interview questions was a multi-step process, guided by the sociotechnical framework that acknowledges the interaction between nurses and EHR within a hospital. Firstly, the questions were developed based on the literature on the same topic that

addressed the common issues with the EHR, especially among the nursing population. In addition, the quantitative findings informed the development of the interview questions of things that I needed to expand on. The quantitative findings from the survey data revealed key areas that needed further exploration, particularly around the relationship between EHR use, workplace factors, and burnout. Although the survey data showed an association between these factors, it did not provide the nuanced, subjective experiences that could explain why and how these relationships exist. In response, the interview questions were designed to delve deeper into this observation.

Appendix 8 contains the protocol for the interview questions. Like the survey, the first section of the data collection in the interviews was demographic and practice information. Respondents provided information about their age, gender, nationality, level of education, working unit in the hospital, job title or current position, total years of nursing experience, and years of nursing experience in the current hospital. The second section of the interview protocol covered various aspects of nurses' experiences and perceptions of using the EHR in their work environment, and whether EHR contributed to nurses' stress and burnout. The interview questions covered four broad areas. The first part of the questions aimed to understand the type of EHR system used in the hospital, nurses' overall opinions about it, their experiences with different devices, and how the EHR compared to paper documentation. The second part was about the training provided to nurses for EHR use, their thoughts on the training, and their ability to access the EHR outside of work hours. The third part of the questions delved into how nurses use the EHR in patient care, the features they like or dislike, problems they encountered, the support available to them, and how the EHR affects various aspects of their work, including efficiency, nursing care, workflow, communication, and job satisfaction. In the final part, nurses were asked to define burnout from their

understanding and their experiences of burnout related to EHR use, and their strategies for managing stressful situations related to EHR use.

The interview questions were reviewed by two of my academic supervisors and by two PhD students in nursing. They were checked for clarity, and feedback was addressed for the final version. However, given the semi-structured nature of the interviews, the questions evolved and shifted in response to the information gathered from the first round of interviews and subsequent ones. For instance, based on the responses in the initial interviews, I noticed that participants were frequently mentioning the role of the EHR contingency plan and EHR superusers in mitigating EHR-related stressors. As a result, I decided to include questions in subsequent interviews that directly addressed this subject. Conversely, the question about remote access to the EHR was not generating useful information, as initial participants reported that they did not have this access. Therefore, I decided to remove this question from the interview protocol for the remaining interviews.

The interviews were conducted with nurses who met the inclusion criteria mentioned above. As explained above in the recruitment process, initial interviews were conducted via online calls because of the COVID-19 situation. Later after the hospital visit, I was able to conduct face-to-face interviews. A total of 21 nurses participated in the interviews.

3.4.9: Data analysis

3.4.9.1: Survey analysis

First, descriptive analysis was generated to describe the sample characteristics and burnout prevalence. Then univariate regression analysis was used to provide an exploratory overview of all the significant associations with burnout among nurses. The univariate regressions measured the associations between burnout (the outcome) and each individual workplace factor of the Mini-Z, other EHR-related variables, and demographics. Multiple regression then was used for further exploratory analysis, which identified the key variables

among a list of significant variables in the initial univariate analysis as the main variables or the driving cause behind burnout. Significance was assessed at the 0.05 level. SPSS software (version 24) was used for the abovementioned calculations.

Ages were categorised into four groups in the survey responses (i.e., 24–34; 35–44; 45–54; and 55–64). This is because the retirement age in Saudi Arabia is 60, so no one reported being less than 65 years of age. Gender response was binary (i.e., male or female) because it was culturally unacceptable in Saudi Arabia to add a third option. Nationality in the survey responses was categorised into four groups (Philippines; Malaysia; Saudi Arabia; and others) based on higher numbers of participants respectively. Other different nationalities with a small number of participants were combined into 'others' to avoid a long list of variables that would not fit well in the regression model. Likewise, the survey responses in the working area and job title or position were categorised based on the similarities of the clinical practice and nursing role. So "Other" category combined responses of small percentages in nationality, working area, and job position (refer to Table 6 in Chapter 4). Unlike dichotomous (gender) or continuous variables (age and years of experience), categorical variables (nationality, working area and job position) need to be reduced to fewer categories in the regression model to produce a statistical power effect in the analysis (Serdar et al., 2021). For that, the eight categories of the total years of nursing experience, and years of nursing experience in the current hospital, which is every five years, were not reduced and used in the regression model. The same situation applied to the rest of the survey responses.

3.4.9.2: Interview analysis

I used a professional transcription service for the interviews, and I listened again and checked the transcription for precision, modified inaccuracies and anonymised some identifying information. Maintaining respondents' anonymity is critical in research to encourage sincerity while reducing exposure to harm (Denzin and Lincoln, 2011). Participant

nationalities were grouped into three regions: Asia (ASIA), the Middle East (ME), and Europe (EU). This is because the sample size in the interviews was small and some participants, especially those with underrepresented nationalities, could be identified if their nationalities were revealed.

Thematic analysis was chosen for this study due to its flexibility and compatibility with the pragmatic approach adopted in this research. Thematic analysis is a qualitative research method that focuses on identifying, examining, and interpreting patterns of meaning (themes) within data (Braun and Clarke, 2006). It minimally organises and describes the dataset in rich detail and goes further to interpret various aspects of the research topic. These themes can be crucial in describing a phenomenon and are associated with a specific research question (Braun and Clarke, 2006).

Several reasons for which thematic analysis serves as a particularly appropriate method for my study. First, thematic analysis can be applied across a range of theoretical and epistemological approaches, thus allowing for the identification of patterns or themes across diverse datasets (Braun and Clarke, 2006). In this study, it facilitated the connection of findings from the sociotechnical perspective, the literature review, the quantitative findings, and the interview data. Finally, thematic analysis aligns well with the pragmatic approach of the study. It supports the exploration of the complexities and contradictions that may emerge from the data, without requiring the alignment of these findings with a particular theoretical perspective (Morgan, 2007).

In contrast, other methods such as content analysis or narrative analysis might impose restrictions or require specific types of data. Content analysis, for example, is focused on quantifying content in a systematic manner, so it might not allow for the deep exploration and interpretation that was required in this study (Krippendorff, 2018). Narrative analysis requires

a specific type of data (i.e., stories), which might not have been as prevalent or relevant in the data collected for this study (Grove et al., 2013).

In the thematic analysis of my qualitative data, I combined both inductive and deductive approaches to guide the coding process and theme development. The deductive component of the analysis involved using the sociotechnical framework and the literature on EHR issues among nurses to identify themes. This meant that some themes were predetermined based on the existing knowledge and theoretical framework (Grove et al., 2013), and I looked for evidence of these themes within the data. The inductive component involved allowing new themes and subthemes to emerge directly from the data without any preconceived notions or theoretical framework (Grove et al., 2013). In this approach, I closely examined the interview transcripts, looking for patterns, similarities, and differences that were not previously defined. This allowed me to identify additional themes that were grounded in the experiences and perspectives of the nurse participants. To identify themes and subthemes using both approaches, I followed the thematic analysis process developed by Braun and Clarke (2006) as the following.

3.4.9.2.1: Familiarisation

I immersed myself in the data by checking the transcripts against original audio recordings for accuracy, reading and rereading the transcripts. This iterative process was crucial as it helped me to become familiar with the depth and breadth of the content (Braun and Clarke, 2006). This also helped with the coding process and finding meanings, patterns, and concepts. I kept notes in my reflective diary after each interview, and I wrote down any initial thoughts that came to mind.

3.4.9.2.2: Generating initial codes:

NVivo software (version 12) was used for the data analysis (Appendix 9). I started the coding process by uploading all the interview transcripts into the NVivo software and

assigning my first set of codes. The initial codes were generated in a largely inductive manner, where I assigned descriptive labels to the data that appeared interesting and potentially relevant to the research question. This part of the process was data-driven and not restricted by preconceived categories or theoretical perspectives, allowing the unique features of the data to emerge. This initial phase created a long list of different codes to help guide me in theme development.

3.4.9.2.3: Searching for themes:

After the initial coding, I began to search for broader patterns or themes that could connect the various codes. By closely examining the relationships between the codes, I identified overarching themes and subthemes that captured the essence of the participants' experiences and shared meaning. I developed a thematic map of the data (Appendix 10). The construction of the thematic map helped me visualise the relationship between these themes and subthemes, illuminating the ways in which they interact and overlap (Braun and Clarke, 2006). It also illustrated the potential impacts these identified themes might have on nurses' experiences with the EHR system and their potential contribution to stress and burnout.

3.4.9.2.4: Reviewing themes

In this stage, I further refined the themes and subthemes by checking them against the data, and ensuring they accurately represented the participants' experiences and perspectives. This process involved a two-level review process of my themes (Braun and Clarke, 2006). At the first level, I checked the coded data that fell under each potential theme, ensuring that they coherently formed a pattern that conveyed a particular aspect of the data's meaning. For example, under the proposed theme "Perceived Usefulness", codes like "accessibility", "time saving", "user friendly", etc., were thoroughly reviewed to confirm they cohesively aligned under this overarching theme. At the second level, I evaluated my identified themes in relation to the entire dataset. I questioned whether the themes accurately captured the

meanings evident in the data. This led me to occasionally merge separate themes into a broader one or divide a single theme into distinct ones. It also allowed me to investigate the relationships and intersections between various themes, enhancing my thematic map. This phase allowed for a solid understanding of the various themes, how they are interconnected, and the overall story they conveyed about the data.

3.4.9.2.5: Defining and naming themes:

I refined and defined each theme, giving it a clear and concise name that captured its essence, and identifying the main subthemes within it. I also considered how the themes fit into the overall story I was telling about my data. This was a critical stage because it helped me understand my data and guided how I presented the research findings.

The first theme, stress from EHR not reaching the point of burnout, was named to reflect the significant challenges and pressures experienced by the nurses in using the EHR system but not causing burnout. It was composed of three subthemes: perceived burnout, competing pressures, and technological challenges, which encapsulated various aspects of stressors associated with EHR use, as perceived by nurses.

The second theme, protective factors against EHR-related burnout (i.e., resilience), was named to highlight the various coping mechanisms and supportive elements that helped the nurses counteract the potential stress and burnout associated with EHR use. It was made up of two subthemes: individual resilience and organisational resilience to represent the individual and organisational factors that contributed to building resilience against the stressful aspects of EHR use.

3.4.9.2.6: Producing the report

I synthesised the findings, linking the themes and subthemes to the theoretical literature and the research question, and providing evidence from the data to support the identified themes. I presented the thematic analysis findings clearly and coherently. I began

by logically organising the themes. I summarised the main findings and supported my interpretations with data, quotations, and examples. I also connected my findings to the research question and broader literature. My findings, contributions to knowledge, and future research were discussed. Finally, I structured the report in a way that enabled the reader to easily understand the main points, arguments, and conclusions of the analysis. Clear language, appropriate headings and subheadings, and visually appealing data representations were used.

Throughout the phase of the interviews (data collection and analysis), I participated in regular discussions with my supervisors. The primary topics of discussion during these meetings included revising the coding scheme, emerging themes, prospective explanations and hypotheses and discussing some preliminary findings, limitations, and implications for future work.

3.4.10 Validity/reliability and qualitative equivalents: Applicability and transferability

Rigour in research refers to the thoroughness, quality and credibility of the study design and its findings. It ensures that the study's results are trustworthy and grounded in evidence. In quantitative studies, rigour is primarily assessed through concepts like validity (the extent to which an instrument measures what it is supposed to measure), reliability (the consistency of a measure across time and different situations), and generalisability (the extent to which the findings from a sample can be applied to the larger population) (Creswell and Creswell, 2017). In the present study, rigour was ensured by the utilisation of two validated and reliable survey instruments that have been previously used by relevant studies, enhancing the study's validity and reliability. Moreover, the data collection process was methodically designed to adhere to research ethical principles, ensuring the integrity, authenticity, and credibility of the gathered information. Furthermore, the large sample size of the survey, which encompassed a diversity of demographic factors, not only strengthened the

generalisability of the findings but also bolstered the statistical power of the study, facilitating informed and rational conclusions.

On the other hand, qualitative studies prioritise depth, richness, and contextual understanding. Thus, the notion of rigour is conceptualised differently, in which terms like trustworthiness, applicability, and transferability become more relevant. Lincoln and Guba (1985) advocate for these terms in qualitative research to ensure that the findings are authentic and can be applied to similar contexts. Trustworthiness is analogous to validity and reliability, ensuring the findings genuinely represent the participants' perspectives (Lincoln and Guba, 1985). Applicability and transferability, in contrast to generalisability, focus on the relevance and usefulness of the findings in other settings (Lincoln and Guba, 1985). In this study, trustworthiness was attained through several means. Purposive sampling was used to ensure a diversity of participants, capturing a broad range of viewpoints. This was complemented by the use of semi-structured interviews, which allowed for depth and flexibility, and reaching saturation in the interviews ensured that all pertinent viewpoints were explored. The principles of voluntary participation, informed consent, and transparency about the research process were rigorously maintained. Additionally, the reflexivity was an integral part of the research process, ensuring that the findings were a credible representation of the participants' experiences. This involved researcher's constant engagement in self-reflection, intensive literature engagement, and feedback from supervisors to identify and mitigate any potential biases, the details of which are thoroughly described in the dedicated section on reflexivity (Section 3.5). Furthermore, given that the majority of nurse participants working in the studied hospital were migrant nurses, the findings have significant applicability and transferability to the global nursing workforce.

The overall rigour of this mixed methods study was achieved through careful design, thorough data collection, comprehensive analysis, and thoughtful interpretation, all while

considering potential biases and limitations. The integration of both methods ensured that the strengths inherent in one approach could counterbalance any limitations present in the other. Employing this dual methodology empowered the study to capture a comprehensive and holistic understanding of the research question.

3.5: Reflexivity

Over the course of my research, I kept in mind the potential impact I could have had on the data collection, analysis, and interpretation of my study findings. My perspective on my study's context was shaped by my background and prior clinical experience as a nurse. My position as a clinical nurse with direct knowledge of the Saudi Arabian healthcare system and as a researcher had a significant impact on my reflexivity throughout the research process. Having worked in hospital inpatient units in Saudi Arabia, I have a thorough comprehension of the local healthcare system and culture, which assisted me in navigating the research in the Saudi Arabian context. However, I also recognised the need to separate my personal experiences and preconceptions from the research to ensure that the findings were based on the data and not my assumptions.

In addition, I remained aware of my positionality as an "insider" in the Saudi Arabian healthcare context while collecting data from a facility that I was not affiliated with. This nuanced comprehension of the local culture and healthcare system was essential for interpreting the results in their proper context. One of my preconceptions did resonate with the study findings. For example, based on my experience, I anticipated that nurses in Saudi Arabia might not directly associate burnout with EHR use, but rather attribute it to other workplace factors. This assumption was validated in the study. However, I made an effort to interpret the results as they emerged, without forcing my own assumptions into the findings.

Another notable area where my preconceptions may have influenced the research was the question about EHR medical billing. Because billing was not a task typically assigned to nurses in Saudi Arabia, it was overlooked as a potential EHR-related factor in my study. However, during the comparison with other literature in the discussion section, I realised that EHR-related billing was an important factor contributing to clinicians' burnout in other contexts. This realisation highlights the importance of reflecting on and learning from such instances.

In addition, I anticipated that my topic would not be very sensitive, therefore I did not expect an emotional response in the interviews. Yet, one individual who was exhausted from long working hours responded emotionally to the question about burnout. Witnessing such an emotional response made me reflect on my preconceptions and assumptions about the sensitivity of the topic. This reflection influenced how I approached the remaining interviews and the interpretation of the data, as I became mindful of the potential emotional implications of the topic for the participants. I also became cautious in my interpretation, ensuring nurses' experiences were accurately captured and conveyed in the study findings.

Nevertheless, throughout the research process, I consistently engaged in self-reflection and actively sought feedback from my supervisors and PhD-level colleagues, who provided valuable insights and critiques of my work. I also undertook extensive reading to balance my personal experiences with external perspectives, thereby enriching the robustness of my study's findings.

CHAPTER 4: FINDINGS

4.1: Introduction

This chapter contains the study findings. The study had an explanatory sequential design where quantitative data were collected in the first phase (survey) and qualitative data were collected in the second phase (interviews), allowing for a deep exploration and interpretation of the quantitative outcomes. The research objective was to examine the association between nursing burnout and the EHR and to explore the contributing factors to nursing burnout related to EHR use in a hospital setting in Saudi Arabia.

I will present the findings in two sections. First, I will present a synthesis of the survey results, which will answer the study objectives 1 and 2, which were (1) to identify workplace factors that contribute to nursing burnout in a hospital setting in Saudi Arabia, and (2) to measure the association between nursing burnout and EHR-related factors in the hospital. This will involve presenting tables and figures to illustrate the analysis and results of the survey findings. Second, I will present a detailed synthesis of the interview analysis, including the presentation of relevant data in the form of quotations. The interview findings will address objective 3 of the study (to gain an in-depth understanding of factors contributing to nursing burnout when using the EHR in the hospital setting in Saudi Arabia).

4.2: Quantitative results

The results of the quantitative part reported here used self-reported surveys (i.e., the Mini-Z burnout survey and perceptions of EHR survey). Through this survey study, I sought to address the following objectives:

1. To identify workplace factors that contribute to nursing burnout in a hospital setting in Saudi Arabia (objective 1)

2. To measure the association between nursing burnout and EHR-related factors in the hospital (objective 2)

First, I provide a summary of the participants' characteristics and the overall prevalence of burnout among nurses as descriptive data. Then the results addressing objectives 1 and 2 will be presented.

4.2.1: Participant characteristics and prevalence of burnout

Out of 348 responses, a total of 282 completed responses were included in the study. As explained earlier in the data collection (Section 3.4.8.1.4), due to the inability to accurately determine the number of nurses who met the inclusion criteria and limitations in accessing accurate information about the number of emails sent, the response rate of 12% may underestimate the actual participation rate. Participants' demographics and the corresponding prevalence of burnout are shown in Table 6.

Table 6: Demographics of nurses' participants (N = 282) and prevalence of burnout

No.	Characteristic		N	%
1	Age	24–34	123	43.6
		35–44	93	33.0
		45–54	52	18.4
		55–64	14	5.0
2	Gender	Male	31	11.0
		Female	251	89.0
3	Level of education	Diploma's degree or equivalent	40	14.2
		Bachelor's degree	214	75.9
		Master's degree or higher	28	9.9
4	Nationality	Philippines	148	52.5
		Malaysia	59	20.9
		Saudi Arabia	33	11.7
		Other[1]	42	14.9
5	Working area	Critical, Emergency, & Cardiac	103	36.5
		Medical & Surgical	138	48.9
		Paediatric	14	5.0
		Obstetrics & Gynaecology	15	5.3
		Other[2]	12	4.3
6	Job position	Staff Nurse (SN1/SN2)	200	70.9
		Clinical Nurse Coordinator	19	6.7
		Clinical Resource Nurse	22	7.8
		Assistant/Nurse Manager/Supervisor	36	12.8
		Other[3]	5	1.8
7	Working experience as a nurse	Less than 1 year	6	2.1
		Less than 5 years	25	8.9
		Less than 10 years	80	28.4

No.	Characteristic		N	%
		Less than 15 years	76	27.0
		Less than 20 years	33	11.7
		Less than 25 years	27	9.6
		Less than 30 years	20	7.1
		More than 30 years	15	5.3
8	Nursing experience at this hospital	Less than 1 year	21	7.4
		Less than 5 years	79	28.0
		Less than 10 years	83	29.4
		Less than 15 years	70	24.8
		Less than 20 years	19	6.7
		Less than 25 years	6	2.1
		Less than 30 years	1	.4
		More than 30 years	3	1.1
9	Prior training on EHR	Yes	207	73.4
		No	75	26.6
10	Remote EHR use	No, I do not have remote access	246	87.2
		No, I have remote access, but do not use it	28	9.9
		Yes, I use remote EHR access	8	2.8
11	Reason for remote EHR use (N = 8)	Unable to complete work during regular work hours	2	.7
		Have the opportunity to work from home (e.g., to achieve work/life balance)	6	2.1
12	Using your own definition of "burnout"	I enjoy my work. I have no symptoms of burnout.	50	17.7
		I am under stress, and don't always have as much energy as I did, but I don't feel burned out.	138	48.9
		I am definitely burning out and have one or more symptoms of burnout (e.g., emotional exhaustion).	77	27.3
		The symptoms of burnout that I am experiencing won't go away. I think about work frustrations a lot.	12	4.3
		I feel completely burned out. I am at the point where I may need to seek help.	5	1.8
Burnout prevalence*		Yes	94	33.3
		No	188	66.7

Other[1] (14.9%) were from 14 different nationalities in small numbers.
Other[2] (4.3%) were haemodialysis, endoscopy, ambulatory care, and business centre.
Other[3] (2%) were nurse educators, and some did not mention.
*Burnout measure was dichotomised into "no symptoms of burnout" (≤ 2 on a 5-point scale) and "one or more symptoms of burnout" (≥ 3 on a 5-point scale).

Respondents were predominately female, aged 24–44, and the majority were from Western Pacific Region (Philippines 52.5% and Malaysia 21%). Local nurses from Saudi Arabia only represented 11.7%, and the rest were from Europe (5.3%), the United Kingdom (1.4%), Portugal (1.4%), the Czech Republic (1%), Finland (0.7%), Slovakia (0.4%), Moldova (0.4%), South Africa (5%), Jordan (1.4%), South Korea (1.1%), Canada (0.7%), Sudan (0.4%), Australia (0.4%), India (0.4%), and Singapore (0.4%). A total of 63.5% of the participants worked in acute care collectively, and 36.5% were from critical care units. Most of the participants were primary SNs (71%), and 13% were clinical nurse managers (or

equivalent). Most of the participants were seniors (who worked more than five years) regarding (i) total nursing experience and (ii) working at the current hospital. Prior training on EHR was provided for 73.4% of the nurses, and about a quarter (26.6%) reported that they did not receive initial training. Most of the responses (87.2%) identified that there was no remote access to the EHR, but 12.7% could access the EHR remotely. Only 2.7% reported using the EHR remotely for reasons such as having the opportunity to work from home (n = 6). However, during the interviews, this information regarding the EHR remote access was found to be inaccurate. Participants explained that the hospital did not permit EHR access outside work for nurses (discussed in Section 4.3.3.1.2.1). According to the interviewees, it could be that some nurses might have misinterpreted the survey question as having hospital applications on their mobile phones with limited access to certain services. Thus, there was no time spent on the EHR at home in this study.

The Mini-Z burnout measure (for a single item) was dichotomised into "no symptoms of burnout" (≤ 2 on a 5-point scale) and "one or more symptoms of burnout" (≥ 3 on a 5-point scale). I found that one-third of the respondents (33.3%, n = 94) had one or more symptoms of burnout while the other two-thirds did not have any symptoms of burnout.

4.2.2: Workplace factors contributing to nursing burnout (objective 1)

This objective was answered by two survey tools (1) Mini-Z workplace factors (Table 7), and (2) perceptions of EHR (Figure 5).

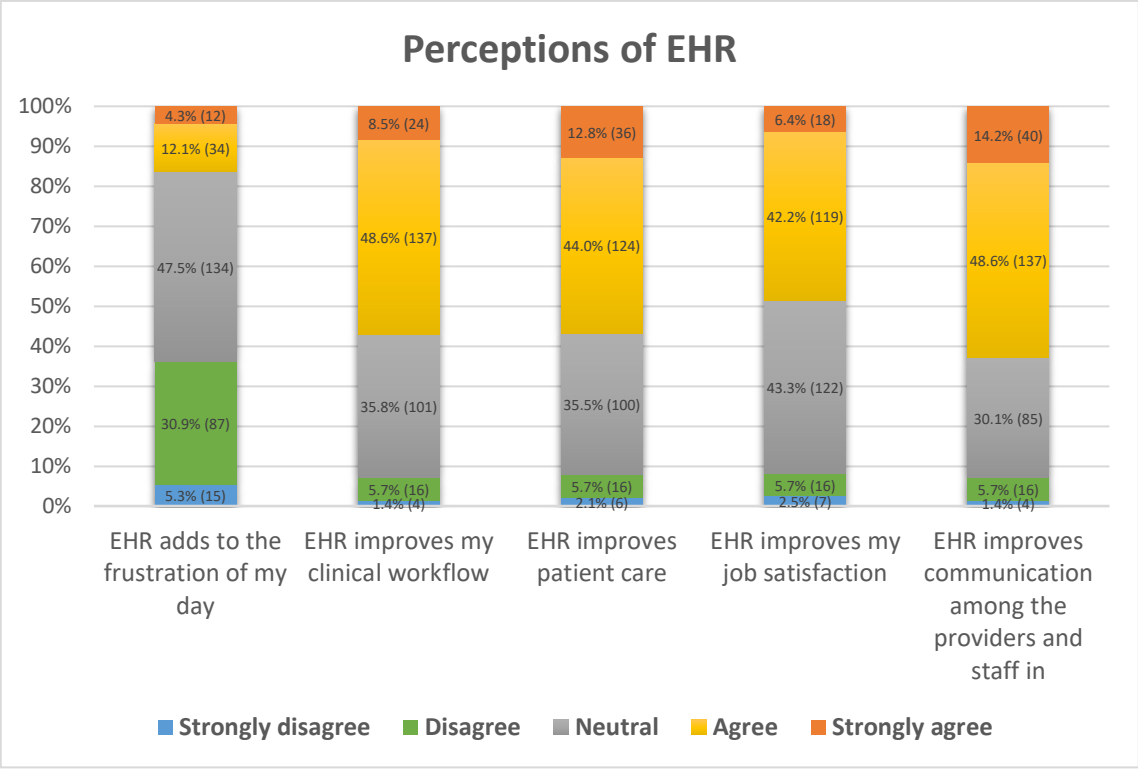
Table 7: Descriptive statistics of Mini-Z workplace factors

Characteristic		N	%
Overall, I am satisfied with my current job:	Strongly disagree	15	5.3
	Disagree	13	4.6
	Neutral	90	31.9
	Agree	122	43.3
	Strongly agree	42	14.9
I feel a great deal of stress because of my job:	Strongly disagree	10	3.5
	Disagree	24	8.5
	Neutral	114	40.4
	Agree	99	35.1
	Strongly agree	35	12.4
My control over my workload is:	Poor	5	1.8
	Marginal	35	12.4
	Satisfactory	125	44.3
	Good	99	35.1
	Optimal	18	6.4
Sufficiency of time for documentation is:	Poor	19	6.7
	Marginal	57	20.2
	Satisfactory	124	44
	Good	75	26.6
	Optimal	7	2.5
Which number best describes the atmosphere in your primary work area?	1 (Calm)	5	1.8
	2	6	2.1
	3 (Busy, but reasonable)	148	52.5
	4	74	26.2
	5 (Hectic, chaotic)	49	17.4
My professional values are well aligned with those of my department leaders:	Strongly disagree	11	3.9
	Disagree	17	6
	Neutral	107	37.9
	Agree	128	45.4
	Strongly agree	19	6.7
The degree to which my care team works efficiently together is:	Poor	7	2.5
	Marginal	25	8.9
	Satisfactory	109	38.7
	Good	126	44.7
	Optimal	15	5.3
The amount of time I spend on the EHR at home is:	Excessive	12	4.3
	Moderately high	22	7.8
	Satisfactory	84	29.8
	Modest	30	10.6
	Minimal/none	134	47.5
My proficiency with EHR use is:	Poor	11	3.9
	Marginal	21	7.4
	Satisfactory	110	39
	Good	112	39.7
	Optimal	28	9.9

More than half of the participants agreed or strongly agreed that they were satisfied with their current job (58.2%, n = 164). Nonetheless, the total percentage of respondents who agreed that they felt stressed because of their job was 47.5% while 40.4% chose neutral. The

responses about control over one's workload were mostly from satisfactory to optimal. Similarly, time for documentation was mostly satisfactory to optimal, but about 27% found it to be insufficient. The atmosphere of participants' primary work area was described as busy (52.5%), and 43.6% described it as hectic, and chaotic. There was a total agreement of 52.1% regarding the statement "My professional values are well aligned with those of my department leaders," yet about 38% disagreed. Teamwork was mostly perceived as satisfactory to optimal. The amount of time spent on the EHR at home was minimal/none for 47.5% of the responses. Most of the participants (88.6%) responded that they were proficient (from satisfactory to optimal) in EHR use.

Figure 5: Descriptive statistics of nurses' perceptions of EHR



The participants' attitudes and perceptions about EHR use illustrated in Figure 5 shows that participants mostly favoured the EHR. There was more disagreement than agreement that EHR added to participants' frustration. However, just under half (47.5%) chose neutral, meaning they either could not decide or were unsure. More than half of the

participants agreed or strongly agreed that EHR (1) improved their clinical flow, (2) improved patients' care, and (3) improved communication among the providers and staff. Just less than half of the participants (48.6%) agreed or strongly agreed that EHR improved their job satisfaction. Still, only 8.2% represented the total disagreement while 43.3% (n =122) neither agreed nor disagreed with this statement.

4.2.3: Association between burnout and EHR-related factors (objective 2)

Table 8, Table 9, and Table 10 show the association between a SIB (using your own definition) and other factors (demographics, Mini-Z workplace factors, and nurses' perceptions of EHR).

Although the Mini-Z survey incorporated workplace factors such as job stress, job satisfaction, workload control, atmospheric chaos, teamwork, and leadership values alignment, these were not directly linked to EHR use. The nature of the survey method posed difficulties in distinctly illustrating how these workplace factors interrelate with EHR use to understand their indirect relationships with EHR-related burnout among nurses. However, the qualitative study comprehensively explored such indirect workplace factors and their relationship with EHR-related burnout. These factors are widespread within the qualitative analysis, with organisational aspects, individual influences, and interpersonal dynamics discussed across the qualitative section (i.e., Section 4.3).

Table 8: Associations between demographic characteristics and a SIB using participants' own definitions (separate/univariate unadjusted logistic regressions)*

Demographic factor	**Mini-Z burnout (own def)**			
	p-value	**OR**	**95% CI for OR**	
Age	0.132	0.802	0.602	1.069
Gender	0.788	0.898	0.411	1.962
Nationality				
− Philippine = Ref				
− Malaysia	0.017*	0.419	0.205	0.858
− Saudi	0.868	1.068	0.493	2.314
− Other	0.414	0.736	0.354	1.534
Level of education				
− Diploma's degree or equivalent = Ref				
− Bachelor's degree	0.038*	2.492	1.051	5.906
− Master's degree or higher	0.012*	4.086	1.356	12.312
Job title				
− Staff Nurse (SN1/SN2) = Ref				
− Clinical nurse coordinator	0.765	0.857	0.312	2.353
− Clinical resource nurse	0.470	0.696	0.261	1.860
− Assistant/nurse manager/Supervisor	0.606	0.817	0.380	1.758
− Other	0.496	0.464	0.051	4.234
Working area				
− Critical, **Emergency, &** Cardiac = Ref				
− **Medical &** Surgical	0.319	1.320	0.765	2.277
− Paediatric	0.907	0.929	0.271	3.190
− Obstetrics **&** Gynaecology	0.799	1.161	0.367	3.679
− Other	0.818	1.161	0.325	4.143
Working experience as a nurse	0.377	0.934	0.803	1.086
Nursing experience at this hospital	0.842	0.980	0.806	1.193
Prior training on EHR	0.568	1.175	0.675	2.046
Remote EHR use	0.698	1.117	0.639	1.953
Reason for remote EHR use (N=8, 2.8%)	0.676	0.500	0.019	12.898

Unadjusted is a regression of X on Y with no other covariates. An **adjusted** is the same regression of X on Y in the presence of at least one covariate.
* Indicates a significant result at a p-value of ≤ 0.05

Table 9: Associations between Mini-Z workplace factors and SIB using the participants' own definitions (separate/univariate unadjusted logistic regressions)

	Mini-Z Burnout (Own Def)			
Mini-Z workplace factors	***p*-value**	**OR**	**95% CI for OR**	
			Lower	**Upper**
Job satisfaction	< 0.001*	0.514	0.389	0.679
Stressful work	0.007*	1.473	1.113	1.951
Control over workload	< 0.001*	0.553	0.403	0.758
Teamwork	< 0.001*	0.507	0.367	0.699
Work atmosphere	< 0.001*	1.917	1.410	2.608
Documentation time	< 0.001*	0.473	0.350	0.638
Values aligned with leaders	< 0.001*	0.446	0.322	0.618
Time spent on EHR at home	0.296	0.897	0.732	1.100
EHR proficiency	0.007*	0.684	0.519	0.902

* Indicates a significant result (*p*-value is ≤0.05)

Table 10: Associations between nurses' perceptions of EHR and a SIB using their own definitions (separate/univariate unadjusted logistic regressions)

Perceptions about EHR	**Mini-Z Burnout (Own Def)**			
	p-value	**OR**	**95% CI for OR**	
EHR adds to the frustration of my day	0.001*	1.692	1.257	2.279
EHR improves my clinical workflow	< 0.001*	0.457	0.322	0.648
EHR improves patient care	< 0.001*	0.575	0.424	0.779
EHR improves my job satisfaction	< 0.001*	0.440	0.310	0.626
EHR improves communication among the providers and staff in my unit or practice	< 0.001*	0.498	0.361	0.687

* Indicates a significant result (*p*-value is ≤ 0.05)

It was identified that increased age was associated with lower odds of burnout, suggesting that older staff may be less likely to experience burnout. However, this relationship was not statistically significant (P = 0.132). There were no statistically significant effects of gender, job position, working area, total experience as a nurse, nursing experience in the current hospital, training, and remote EHR use on burnout (P > 0.05). There was a significant association between race and burnout. In comparison to the reference group of the Philippines, nurses from Malaysia had significantly lower odds of burnout (P = 0.017).

However, no significant differences were found when comparing the reference group to nurses from Saudi Arabia (P = 0.868) or other countries (P = 0.414). There were significant differences in burnout among nurses with varying levels of education. Higher levels of education were significantly associated with higher levels of burnout, with nurses holding a bachelor's degree (P = 0.038) and a master's degree or higher (P = 0.012) showing higher levels of burnout than their less educated counterparts. Except for the time spent on EHR at home, all Mini-Z workplace factors had highly significant relationships with burnout (Table 9). Likewise, all perceptions of EHR items had a strong association with burnout (Table 10). This means that those who agreed that EHR added to the frustration of their day were likely to be burnt out (p = 0.001), and those who had positive perceptions of EHR and found that EHR improved their clinical workflow, improved patient care, improved their job satisfaction, improved communication among the providers and staff in their unit or practice were less likely to be burnt out (p < 0.001).

Using multiple regression with Forward and Backward model selection (Hosmer Jr et al., 2013), key variables contributing to burnout were identified (Table 11). These variables, which appeared in the final model for both methods (Forward and Backward likelihood ratio at 5% significance) were suggested to be the key variables or the main drivers for burnout (highlighted in bold). According to the model and the data, nurses who were burnt out felt stressed, had low levels of job satisfaction, had poor perceptions of their work atmosphere, and did not think that EHR improved their clinical workflow.

Table 11: Multivariate analysis, adjusted logistic regressions using model selection method (Forward and Backward)

Forward likelihood ratio (LR; at a 5% significance level) Final model	**Mini-Z Burnout (Own Def)**			
	P-value	**OR**	**95% CI for OR**	
			Lower	**Upper**
10. Overall, I am satisfied with my current job:	**< 0.001**	**0.547**	**0.399**	**0.750**
11. I feel a great deal of stress because of my job:	**0.008**	**1.557**	**1.120**	**2.163**
14. Sufficiency of time for documentation is:	0.015	0.661	0.475	0.922
15. Which number best describes the atmosphere in your primary work area?	**0.019**	**1.507**	**1.070**	**2.121**
21. EHR improves my clinical workflow	**0.010**	**0.598**	**0.405**	**0.885**
Backward LR (at 5% sig) Final model	**Mini-Z Burnout (Own Def)**			
	P-value	**OR**	**95% CI for OR**	
			Lower	**Upper**
4. Level of education Diploma's degree or equivalent = Ref				
Bachelor's degree	0.156	1.974	0.772	5.045
Master's degree or higher	0.013	4.916	1.396	17.314
10. Overall, I am satisfied with my current job:	**< 0.001**	**0.539**	**0.392**	**0.741**
11. I feel a great deal of stress because of my job:	**0.009**	**1.555**	**1.116**	**2.166**
15. Which number best describes the atmosphere in your primary work area?	**0.012**	**1.576**	**1.105**	**2.245**
17. The degree to which my care team works efficiently together is:	0.015	0.633	0.438	0.914
21. EHR improves my clinical workflow	**0.004**	**0.564**	**0.381**	**0.836**

Bolded items (the overlap among the two models; Forward and Backward) were the key variables associated with burnout.

4.2.3: Survey conclusion

Overall, the analysis revealed that most of the participants were proficient with EHR use, did not spend a high amount of time on the EHR at home (likely due to a lack of remote access), and had favourable opinions of EHR use. However, the regression analysis showed that nurses who had negative views of the EHR, particularly those who did not indicate that the EHR improved their clinical workflow, were more likely than others to experience burnout.

4.3: Qualitative results

Simi-structured interviews were conducted with 21 clinical nurses working in acute and critical care units in a large hospital in Riyadh, Saudi Arabia, which used an advanced EHR system. The nurse participants were selected based on the criteria outlined in Chapter 3, which included registered nurses who were working in inpatient units and using the EHR system on a daily basis. The interviews took place between April 2020–Nov 2020. Each interview had taken between 40–60 minutes, and only two interviews took more than an hour. The qualitative interviews were sought to gain an in-depth understanding of factors contributing to nursing burnout when using EHR in a hospital setting (objective 3). The analysis of the interviews identified two major themes: (1) stress from EHR not reaching the point of burnout, and (2) protective factors against EHR-related burnout (resilience). This section presents a synthesis of the interview findings supported by direct quotations from the participants, including a summary of the participant characteristics, and an overview of the EHR system used in the participating hospital.

4.3.1: Participant characteristics

The age of nurse participants ranged from 25–46 years. They were predominantly female (85%). Most of them were from the Asian region (57%; e.g., the Philippines and Malaysia) and the Middle East (38%). The majority held a bachelor's degree (85%), and the rest had a master's degree. SNs represented 48% of the total interviews. SN I and II are registered nurses but have different clinical levels, in which SN II is more experienced than SN I. The rest of the clinical nurses were charge nurses (CNs; 14%), assistant nurse managers (ANMs; 14%), clinical resource nurses (CRNs;14%), and nurse managers (NMs; 10%). Many of the participants worked in critical care units (62%), which included ER results, cardiac care unit (CCU), paediatrics CCU (PCCU), high dependency unit (HDU), ICU, paediatrics ICU (PICU), neonatal ICU (NICU), trauma ICU (TICU). The rest of them worked

in acute care units that included ER, medical and surgical (MS), and paediatrics (PEDS). The average of the participants' nursing working experience at NGHA was 8.7 years, and 12.5 years as a total of experience working as a nurse. Table 12 contains a summary of the participants' characteristics.

Table 12: Participants characteristics

P	Age	Sex	Region	Level of education	Job title	Working area	Nursing experience at NGHA (years)	Total nursing experience (years)
1	38	F	ME	MSN	NM	ER	15	15
2	31	F	ASIA	BSN	SN I	ER	8	8
3	45	F	ASIA	MSN	CN	HDU	15	15
4	39	F	ME	MSN	NNM	PEDS	12	12
5	33	F	ASIA	BSN	SN II	P.ER	1.5	11
6	45	F	ASIA	BSN	CRN	ER.resus	20	22
7	30	F	ME	BSN	ANM	P.ER.resus	7	7
8	27	F	ME	BSN	SN I	P.ER.resus	4	4
9	28	F	ME	BSN	ANM	P.ER	5	5
10	47	F	ASIA	BSN	CN	P.ER	14	22.5
11	32	F	ASIA	BSN	CRN	PEDS	5	11
12	36	F	ASIA	BSN	ANM	MS	6	14
13	30	F	ASIA	BSN	CRN	PCC	6	9
14	26	F	ME	BSN	SN 1	ICU	3	3
15	32	F	ASIA	BSN	SN 1	NCCU	5	13
16	38	F	EU	BSN	SN 1	TICU	2	12
17	41	F	ASIA	BSN	SN 1	ICU	8	13
18	33	F	ME	BSN	CN	NICU	7	7
19	41	M	ASIA	BSN	SN 1	PCICU	10	17
20	41	M	ASIA	BSN	SN 1	PCICU	12	18
21	46	M	ME	BSN	SN 1	P ICU	19	24

P = Participant
F = Female, **M** = Male
ASIA = Asia, **ME** = Middle East, **EU** = Europe
BSN = Bachelor's degree, **MSN** = Master's degree
Job title and **Working area** are explained in the text 5.2.1

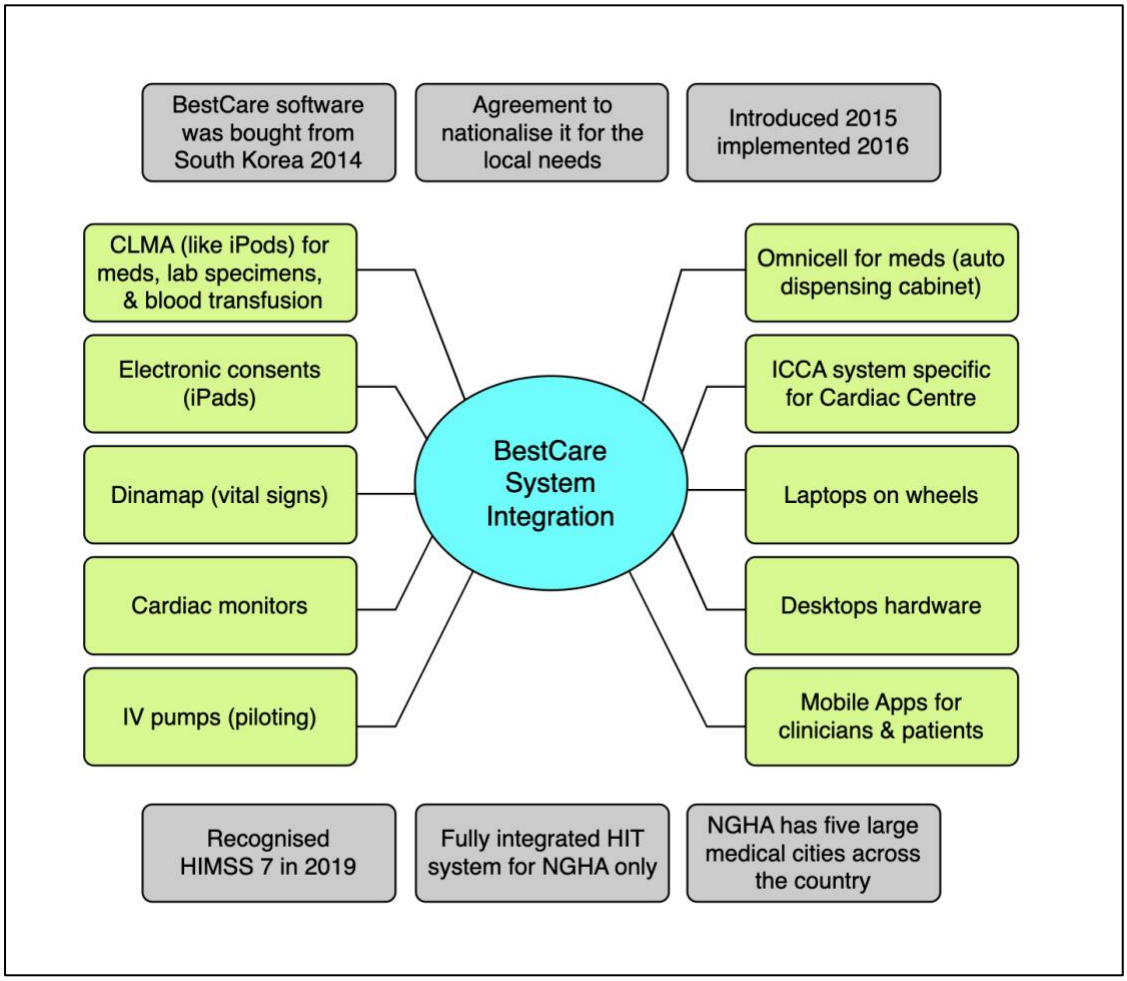
4.3.2: Description of the EHR

From the interviews and the field visit, the NGHA used an advanced integrated EHR system called BestCare, which was described in Chapter 1. BestCare was first introduced to NGHA hospitals in 2015 and then implemented in 2016 in stages. In 2019, the BestCare

system was recognised as HIMSS stage 7 in the NGHA healthcare system in Saudi Arabia. BestCare is a fully integrated health information system. BestCare EHR system is interoperable among all NGHA medical facilities. It was integrated with a wide range of medical devices and existing information systems. Figure 6 shows the devices that were integrated with the BestCare system used by the nurses.

These devices were (1) an Omnicell machine for medication management and administration called an ADC; (2) CLMA (closed loop medication administration) like iPod devices for electronic verification prior to medication administration, laboratory specimen collection, blood transfusion; (3) electronic consent like iPad devices for patients; (4) Dinamap vital signs machines; (5) Cardiac monitors; (6) an existing information system called IntelliSpace Critical Care and anaesthesia, or ICCA, for the cardiac centre; (7) EHR laptops on wheels for each nurse on a shift; (8) EHR workstation desktops for all clinicians; (9) mobile applications for clinicians and patients; (10) smart intravenous (IV) pumps, which was under the piloting phase at the time of the data collection (i.e., 2020). There were other different technologies that were used by other clinicians. However, in this study, I focused on nurses, and the devices listed were the technologies referenced by nurses integrated with the EHR they used on a daily basis.

Figure 6: Description of the EHR (based on the interviews and field visit)

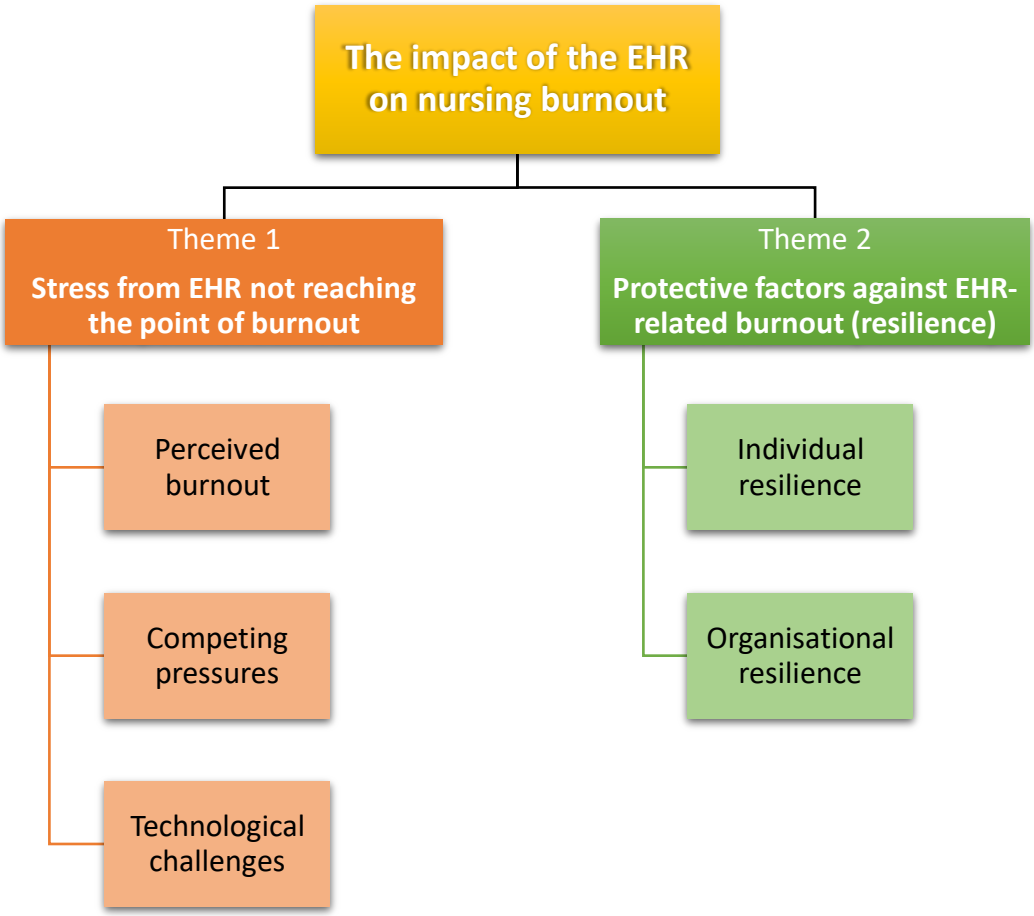


4.3.3: Major themes and subthemes of the findings

The findings describe the participants' experiences with EHR use and their perspectives on burnout in relation to EHR use. Overall, the participants addressed a number of EHR-related stressors caused by organisational requirements and technological challenges. However, nurses did not believe that their EHR-related stress led to burnout. Individual and organisational resilience were identified as protective factors against severe stress and burnout associated with EHR use among nurses. The data were conceptualised under two primary themes, as depicted in Figure 7: (1) stress from EHR not reaching the point of burnout, and (2) protective factors against EHR-related burnout (resilience). Each major theme is composed of subthemes that further categorised each theme's context. Quotes from

the interviews, used throughout this chapter, provide tangible evidence and a deep understanding of these themes and subthemes. Appendix 16 andAppendix ***17*** provide additional insight into the participants' experiences and perspectives that complement the data presented in the main body of this report. Appendix 16 compiles interviewees' responses about their burnout experiences and protective factors against EHR-related burnout, complete with direct quotations about EHR acceptance. Appendix 17 includes participants' quotations regarding their definitions of burnout and their perceptions of EHR as not being a contributor to burnout. These appendices offer supplementary understanding, illuminating further nuances of the interview data.

Figure 7: Major themes and subthemes of the findings



4.3.3.1: Stress from EHR not reaching the point of burnout

The findings revealed that nurses experienced some challenges associated with EHR use that contributed to their stress. However, perceived burnout was attributed to other workplace factors but not to the EHR. Under this theme, I will discuss the three subthemes that emerged from the first major theme: perceived burnout, competing pressures resulting from organisational requirements, and technological challenges.

4.3.3.1.1: Perceived burnout

The participants demonstrated adequate understanding of the burnout concept. Their definition met the standard definition of burnout, in which burnout occurs from unmanaged prolonged or excessive stress in the workplace (Maslach and Jackson, 1981). It is characterised by feelings of energy depletion or exhaustion, depersonalisation or increased mental distance from one's job, and reduced professional efficacy. Participants provided different definitions of burnout that met the descriptions of burnout symptoms (Appendix 17). For example, one nurse viewed burnout as being "super stressed" and "not happy anymore with work". Another nurse described it as being "totally exhausted" and occurring when one "cannot function anymore as a nurse". One nurse described burnout as the final stage of her tolerance before "leaving the job". Here is an example of her definition of burnout:

> *"To me it means I get enough, I'll leave this job. I cannot tolerate anything, everything around me is provoking me or making me stress or making me irritable" (P18, F, CN, NICU)*

One nurse, who became emotional when the subject of burnout was brought up during the interview, used the terms burnout and depression interchangeably. She reported suffering from chronic stress due to her 12-hour shifts in the ICU, which negatively impacted her social life and mental health. Although she demonstrated knowledge of the definition of burnout and exhibited symptoms consistent with work-related burnout, her reported

symptoms also displayed similarities to those associated with depression. This overlap of symptoms between burnout and depression has been acknowledged in the literature (Iacovides et al., 2003), prompting suggestions for addressing this issue. She stated in the following quotations:

> *"I can talk about burnout in recent times. Usually, I get a burnout, and then I try to calm it, another burnout happens, and I calm it again, etc. Sometimes it's too much, I got tired, tired. I keep asking myself, how long am I going to do this for? how long am I going to live this way 12-hour shift? I want to live my life freely… I just felt that I had no joy in life. I felt that my happiness was disappearing. I didn't find any joy in the things that I used to love doing. Now, I'm constantly trying to fight this feeling, I've gone through so much".*
>
> *I felt like depression, thank God it didn't control me, but it [depression] came across me for sure. I thought about death every day. 'til now, I expect to die at any moment, I lost hope. If you ask me what are your goals in three years? I don't expect to live this far to even have plans. I just live the moment; I didn't even think about tomorrow. I don't have plans. I don't know how this happened but I live each day on its own. When mentioning a time in the future, I just say God willing but I don't really picture it, I can't even imagine it" (P14, F, SN, ICU)*

It is important to note that ethical considerations were taken into account during the interview process, including providing appropriate support to this participant, as outlined in the ethical considerations (Section 3.4.5.4).

Nevertheless, all nurses did not associate burnout with EHR use (Appendix 17). They explicitly specified other workplace factors that caused them burnout, such as long working shifts (e.g., 12 hours), COVID, busy working environment and interpersonal conflicts. Besides, some were open about their burnout experience (unrelated to EHR) and how it impacted their wellbeing. However, it was beyond the scope of this study to expand on other topics unrelated to EHR use. Here is an example of burnout being reported by a participant as caused by the COVID crisis:

> *"I felt that burnout many times, especially during this COVID. That you're too tired already stressed, the pressure on your sleep pattern is affected all those things. Sometimes the way you communicate with people, you just find yourself just want to be alone and just like looking straight and then you're just too tired to talk" (P17, F, SN, ICU)*

EHR, in particular, was perceived by some participants as stressful, irritating, and frustrating but was not perceived as a contributor to burnout by all participants. One nurse described the stress associated with EHR as "manageable". Another described the stress volume from EHR as "small" compared to other workplace problems that could lead to burnout. In contrast, other nurses did not see the EHR as a potential source of burnout at all. Here are some quotations:

> *"No I wouldn't say that. It gets me, it irritates me. I get a bit stressed about it, but not burnout because of it" (P16, F, SN, TICU)*
>
> *"I don't expect there is a burnout caused by BestCare at all" (P4, F, NM, PEDS)*

These perceptions appear to be shaped by various individual and organisational factors that have been identified as protective against EHR-related burnout. These protective factors, including the important role of resilience, will be examined in depth in Section 4.3.3.2.

This section has shed light on the nuanced perspectives of nurses regarding burnout and its association with EHR use. These insights reveal that while EHR use can induce stress, it is not universally perceived as a direct cause of burnout. This understanding serves as a valuable foundation for subsequent analyses. In subsequent sections, I delve into the specific EHR stressors reported by participants that caused them stress but did not escalate to the point of burnout.

4.3.3.1.2: Competing pressures resulting from documentation requirements

In this section, I will explore and present the evidence, as reported by nurses, of the competing pressures resulting from organisational demands tied to documentation requirements. These pressures created a conflict of priorities or 'competing pressures' between organisational demands and direct patient care needs, which ultimately contributed to nurses' stress and frustration. These pressures were time spent on the EHR, real-time

documentation policy, and perceived misalignment of standardised documentation with the ER unit.

4.3.3.1.2.1 Time spent on the EHR "nursing a computer not the patient"

The time nurses spent on the EHR for data entry, navigating the system, or due to technical difficulties was identified by the nurses as a significant contributor to their stress. Participants perceived EHR use to be time-consuming due to documentation completion requirements, with some nurses considering these requirements redundant that did not necessarily meet unit or patient needs. A second reason some nurses spent more time on the EHR than paper charts was navigating the system to find information. Participants reported that certain nursing colleagues lacked adequate computer skills, leading them to spend more time than others on the EHR.

> *"I find it quite frustrating. I find it time wasting. I feel like I could be spending time with my patient at the bedside. Whereas sometimes I feel like you're nursing a computer not the patient. You have to spend so much time on the computer to enter everything. Whereas when you have handwritten charts, you can quickly just write them and document and then you can get back to your patient" (P16, F, SN, ICU)*

Nurses also reported a lack of remote EHR access, which meant that all EHR tasks had to be completed within their work hours at the hospital. This policy might potentially compound the stress associated with EHR use, as nurses were unable to spread out their documentation responsibilities beyond their shifts.

> *"From home, No. The access for nurses is only in the hospital. By hospital policy, all documentation has to do from the hospital" (P3, F, NC, HDU)*

As a result, nurses associated the time spent on EHRs as taking them away from the bedside and, as such, providing care to their patients, for example delaying patients' treatment such as medication administration, which for certain medications, may jeopardise patient safety.

"It will delay patient care. Sometimes it really is, if you are not expert into it, it will take you more to the system and you will neglect your patient" (P8, F, SN, ER)

The participants also described the impact of being under constant pressure from competing priorities while trying to balance the work between patient care and EHR documentation. Nurses' priority was their patients. However, the professional and legal accountability for the data entries and real-time documentation on the EHR appeared to create a conflict of priorities. This situation posed a challenge for nurses who had to balance the demands of EHR documentation with the prioritisation of patient care, ensuring neither aspect of their responsibilities was compromised. This feeling could be a source of stress for some nurses when they are unable to manage competing demands.

"That's the one of the issues that we face, computer care and patient care. Computer first, patient first" (P19, M, SN, ICU).

This made nurses deal with competing pressures differently as they struggled to coordinate the work pressures, in which some might spend more time on the EHR than on the patient or vice versa. Here is an example of a nurse explaining this situation:

"You cannot coordinate your work. Like I would just go to the patient. Then I will go to the system and like that. Some of the nurses, they will concentrate either on the patient or on the system" (P8, F, SN, ER).

In addition, the participants explained that they felt that patients disliked seeing nurses on computer screens and demanded nurses spend time with them.

"Even from the patients, even the patient's seater, they complain that the nurses stay more on the system instead of staying on the bedside. This is the most common complaint that we receive" (P6, F, CRN, ER)

This added pressure on the nurses, especially when patients did not fully understand the function and importance of EHR documentation and the organisational requirements for nurses to spend time on the EHR. Accordingly, this caused stress as reported by the nurses

interviewed as they were trying to balance the needs of their patients with those of their organisation.

Nevertheless, there were certain nurses who were capable of navigating complexity and dealing with competing pressures. For instance, some nurses pointed to effective time management as a crucial component in their strategy for overcoming such obstacles.

> *"it's about time management, because you don't know how much time it would take for documentation for each patient. So, we usually take care of the patient and then go to the system. As long we're not pressured by a deadline of the device" (P14, F, SN, ICU)*

This is regarded as part of nurses' adaptability that could serve as a mitigating factor from such stressors, which will be discussed further under the theme 'individual resilience' Section 4.3.3.2.1.3.

4.3.3.1.2.2: The real-time documentation policy clashed with the nurses' priorities

Real-time documentation policy was one of the issues identified by the nurse participants, which collided with the nuanced reality of the dynamic of care. The participants explained that, according to the hospital policy and guidelines, nurses were expected to do their documentation on the EHR within one to two hours (depending on the criticality of the hospital units) of receiving a patient. Otherwise, the nursing administration would consider it a late entry. The problem, as nurses noted, was that most of the time, they could not manage to document on the EHR within such fixed timelines. This is because, as nurses explained, patient health status could be unpredictable, and the vital signs of critically ill patients could deteriorate at any time. There were also some bedside procedures that could take time to complete, such as difficult cannulation and interruptions from nurses' surroundings (people or other administrative demands) that could prevent nurses from starting their documentation on the EHR. Consequently, nurses were sometimes questioned for late entries by auditors

who occasionally made rounds at hospital units to check the EHR system, which nurses described as stressful.

> *"Sometimes I delay my documentation because I'm busy spending more time with the patient, especially if he's a very sick patient. So, my documentation sometimes is really delayed because I have to do late entry" (Participant 9, F, ANM, ER)*

> *"It's very stressful because you need to finish it (documentation) fast because of the timing. And sometimes even if you are back of the time, they [auditors] can track that, that you did the documentation late. Why the documentation was late? (auditors question nurses)" (P8, F, SN, ER)*

As a result of the organisation requiring structured data to be entered into the system within a defined timeframe, nurses felt they were under constant pressure while trying to handle conflicting priorities, organisational and direct patient care.

4.3.3.1.2.3: Perceived misalignment between standardised documentation and the ER unit

Nurse participants working in the ER raised a specific issue regarding the EHR standardised documentation policy in their unit. They explained that in the current system, they were required to complete many patient assessment forms in the same manner as other inpatient units, whereas the old EHR system made this process simpler. This was viewed as misaligned with the nature of the ER as a fast-paced unit with a short length of stay compared to inpatient units with longer stays. One nurse explained that in the previous EHR system, all relevant patient assessments were completed in a single window, whereas in the current system, EHR documentation has increased, and it was difficult to locate all forms, contributing to nurses' stress.

> *"In the old system we have all in one page (patient's assessment forms). I will do my assessment and part of my assessment is the four risk assessments, which is the pressure injury assessment, GCS assessment there, vital signs all in one page. With the new system, I need to open windows to add each one of those and most of the time the people will miss, which costs people they are stressing, and they say it's too much work" (P1, F, NM, ER)*

Nurses explained that the maximum length of stay for patients in the ER was four hours; after that, either patients would be admitted to the inpatient wards or discharged. They perceived that the documentation load in the ER was unnecessary, impractical, and difficult to achieve due to time constraints. They responded that the documentation load in the ER should not be levelled to the long-stay, structured, and steady inpatient units, and it should be reduced and customised to fit the unit's needs and patient needs. This could be highly stressful for nurses working in such a highly dynamic, unpredictable work environment like ER, with many interruptions in providing care (from physicians, patients and their relatives and the work demands). Consequently, there is a risk with working fast and multitasking while trying to fulfil the documentation requirements on the quality of care, patient safety, and accuracy of data entry.

> *"For example, for me as an ER nurse, I think our documentation should be different than the wards, but in ER, sometimes they require the same documentation what is required in the ward, and here it's different, because in the ward, you know, more details about the patient because the patient is staying for a long time with them, including the nursing care plan. In ER, the patient length of stay should not exceed ideally four hours in the hospital. And then after that he goes and get to the disposition either to the wards or to be discharged. So, during this four hours they are asking us to do documentation (on EHR), for example they asked us to do teaching and education documentation, fall assessments, many other documentations, even the nursing care plan…" (P7, F, NM, ER).*

4.3.3.1.3: EHR technological challenges contributing to nurses' stress

I will discuss in this section seven technological factors identified by the nurse participants as contributing to their stress. These are perceived ineffective use of the EHR during emergencies, poor usability of the EHR for nurses because of the design, technology surveillance (monitoring system) causing discomfort among nurses, invasion of privacy by unauthorised health professionals, EHR inflexibility to make modifications to the system, EHR downtime disturbing nurses' work, and difficulty adjusting to new changes in the EHR.

4.3.3.1.3.1: Perceived ineffective use of the EHR during emergencies

Nurses perceived that EHR could be ineffective during emergency situations. Nurses explained that during emergencies where patients required immediate resuscitation or medication administration, the care team would not delay care to register a new patient in the EHR system or wait to log in due to access difficulties. Time is crucial in emergency care to save lives, and all decisions and responses from the care team must be immediate.

> *"But we will have problem if we have emergency. You know we will not wait for the system to scan, scan, scan (for logging-in). The doctor shouts… you give now, now" (P15, F, SN, CCU).*

One head nurse mentioned a stressful experience that happened to her when the EHR was unresponsive, and a doctor was shouting at her, needing a piece of immediate information from the system to know whether the deteriorating patient was a full code (which would require resuscitation) or comfort care (which would not require resuscitation). The care team could not wait for the EHR system to log in and did resuscitate the patient, and when the nurse could eventually access the system, she found that the patient did not require resuscitation. The nurse stated that she cried from this stressful situation and from the unintended mistake that could have been avoided if she had been able to access the system instantly. Although the mistake was because of the slowness of the system, it affected her so that she felt angry and embarrassed and felt responsible as a head nurse:

> *"I want to break that laptop, just to get the information. I was very angry. I want the information now… they were shouting. And I am the head nurse. Like I am the one responsible, the most responsible person. So, I really want to cry because even the nurses are looking at me. I need to have that information now. It should come from me" (P8, F, SN, ER)*

4.3.3.1.3.2: Poor usability of the EHR for nurses because of the design

Nurses also identified some design issues of the EHR software that seemed to cause poor usability. Nurses reported two problems regarding the EHR design. First, nurses were required to complete many forms placed in different windows. These included patient

assessment forms (e.g., vital signs, pain, pressure injury, fall risk, Glasgow Coma scale), nursing notes, nursing care plans, patient teaching and education, and others. They indicated that they had to open multiple windows to complete the documentation for a single patient, which made it difficult to locate and memorise all the forms, and that they occasionally missed certain documentation. Here is a quotation from a nurse manager who experienced this issue and conveyed her SNs' complaints as well:

> *"Sometimes the nurses forget…because there's too many things to document in different forms. They miss sometimes to do skin assessment for example because it's in another form. They have to look for the forms to fill them up" (P9, F, ANM, ER)*

The second issue nurses reported related to the system design was that the system did not allow for free text options in the assessment forms to add remarks when necessary, apart from the nursing notes. Nurses explained that when physicians or other multidisciplinary care teams checked patients' assessment data, they often did not read the nursing notes that would involve extra details and explain some discrepancies. Accordingly, the care team would base their treatment plan according to the registered data in the system. This might involve risk to the patient when the treatment plan was based on inaccurate assessment findings because of the system design. One staff nurse working in ICU gave an example of this issue:

> *"If I have a patient that is passing urine and just go to the toilet himself, then I can't measure it, I should just put approximate, but in BestCare I can only just put the number, I can't write approx. there's no free text, so I have to say 300 ml" (P16, F, SN, ICU).*

One participant, who had two years of nursing experience at the participating hospital, perceived the EHR as completely unusable. She perceived the EHR as not easy to use and challenging compared to the paperwork. She stated:

> *"I'm not a fan of the computer system. I come from a hospital where we have big flow sheets and paper charts for our patients in ICU. And I feel like it works much better. I feel like on the computer system, you're looking for things all the time. You can't find things easily. I feel like it doesn't work as well as paper" (P16, F, SN, ICU)*

4.3.3.1.3.3: Technology surveillance created discomfort for nurses

Technology surveillance—whereby administrators monitor nurses from the system—was perceived by the participants to be one of the stressors. The EHR technology keeps records of all operations and data transactions, including modified and deleted entries done by the nurses, which can be tracked by authorised people. Because of that, nurses felt as if their superiors were monitoring them via the system. For instance, as explained above in the real-time documentation policy, EHR documentation should be completed within a timeline. Otherwise, nurses would be questioned for late entries by their managers or auditors, who could reveal data operations in the system. Unlike paperwork, where nurses felt like they had some autonomy in their time management, perceived EHR surveillance created discomfort among nurses. Here is an example of auditors tracking nurses' documentation:

> *"They (auditors) can see what is the real-time the nurses put their documentation. And if a nurse change it, even if they delete information, still they can see it" (P9, F, ANM, P.ER)*

One of the participants was a nurse manager in the ER unit and explained how she could monitor nurses from the system and the impact on nurses' stress when feeling like they were under observation all the time:

> *"The staff feel that they are being watched (monitored) like all the time. I can know everything, who used the pump, who doesn't use the pump, who did something wrong, who didn't do something wrong. They check with this one, every single movement, the staff they're doing, they are being watched. So, this gives them more chances that they will be called to the nurse manager office for a mistake. And this gives them more stress" (P7, F, NM, ER)*

Despite the perceived discomfort reported by nurses, technology surveillance is an essential component of integrated health information management. It is utilised by health organisations globally to improve patient safety, protect sensitive health information, and effectively address incident resolution in accordance with standard rules (Pinsonneault et al., 2017). However, the discomfort expressed by nurses might not necessarily stem from the

surveillance itself. It might stem from the apprehension that occurs when mistakes are detected through this surveillance. Being questioned in such instances could add to their stress levels.

4.3.3.1.3.4: Invasion of privacy by unauthorised health professionals

One of the concerning issues that a few participants have identified was the invasion of patient privacy by healthcare workers from different departments, which made them feel insecure when patient information leaked outside the working area. The participants indicated that healthcare staff could use the EHR system from any location in the hospital, making it simple for them to get patient information unrelated to their designated work unit. Once the patient's medical record number (MRN) was entered into the EHR, the entire medical history could be viewed.

> *"the problem with the existing health record system that we have now that if you got an access from the other area, you can just enter the medical record number of a patient, and you can view the whole story of the patient in one shot…That's why we really have an issue on the breach of confidentiality on patient information, because you can easily access every information of patient once you entered the MRN in the system." (P4, F, NM, PEDS)*

> *"What I don't like really about it, is the violation of the privacy. I think it's a weakness in the electronical medical record because anybody can access the medical record number and can review the data" (P7, F, NM, P.ER)*

As described by the participants, even though the design of the EHR system emphasised safeguarding the privacy and confidentiality of patient information, it appeared insufficient. They explained that before logging into the EHR, users were required to answer a question regarding their reason for using the system and agree to the confidentiality and privacy of the data.

> *"When you log on, your name will be recorded that you logged in and it will ask you a question. What's the indication for you to log on to this specific medical record of the patient? If you have a direct-care, if you are having it for a research or whatever. And it will warn you that this is a part of patient confidentiality and privacy" (P1, F, NM, ER)*

However, one nurse reported that some hospital staff were just not being honest with their log-in reasons and the system allowed their access.

> *"The system will ask you every time you will access the patient file or any other person file, what is the reason to log on… but it depends on the honesty. Most of the staff they will click for the documentation while it's not. So, it's depending on the moral of the staff" (P7, F, NM, P.ER)*

Nurses described the seriousness of this issue when it recurred to the extent that one patient's information was leaked outside the hospital. They reported that the information system department (ISD) was aware of this issue, and they could track the person who accessed any patient data, yet the problem still existed.

> *"We have some concerns, serious events where in a patient's information was accessed by the nurses and the patient is not existing in their area. I think the hospital is very aware of that existing problem. There was a serious event few months back where a number of nurses accessed one patient in the system and the information was leaked even from outside the hospital" (P4, F, NM, PEDS)*

This problem was perceived as very concerning because it could affect healthcare workers themselves. This means that the hospital staff might feel uncomfortable seeking medical treatment at their hospital, fearing that other working colleagues might access their information. One nurse reported that this might happen to a colleague who would be admitted to the hospital:

> *"If we have our colleague is sick, we will also find the other people access their info, if they can easily in the other hospital area enter the staff MRN or just search in the location, they can find the name, the diagnosis, the medication everything. Really, they can open and read x-ray and everything. Although the ISD department can track that, they cannot control it" (P7, F, NM, P.ER)*

4.3.3.1.3.5: EHR inflexibility to make modifications to the system

Some nurses complained that the system's procedure for requesting a modification was complicated or time-consuming compared to their previous system. Nurses explained that the current EHR system was interoperable with all NGHA care facilities in five regions across the country (explained in 4.3.2) and that any modification request in one hospital

required approvals from all other regions, which could take a significant amount of time. The problem for nurses was that the system was not adaptable to their specific needs on the unit level or even at the regional level of a single organisation.

> *"a simple thing, like I want to add the doctors' team who's working in ER, it took more than one year until now to be added in the system, it will take time because it will need to have approval from all regions. This is one of the negative things" (P1, F, NM, ER).*

Nurses identified another issue related to the process of correcting information in the EHR system, which could take longer than what they usually used to do on paper or previous system. Nurses explained that the EHR system allowed some editing on nursing documentation which could be tracked, but there were sensitive data that could not be easily changed or corrected once recorded, such as information related to patient identification and patient consent. This is because the patient's safety is greatly associated with the accuracy of the patient's personal information (Hodge and Varndell, 2020). Nurses reported that this difficult process of correcting mistaken data could disturb the workflow and care delivery. Here is an example of EHR inflexibility:

> *"For example, the consent, when we are going to do the consent for the patient, and once you submitted this and you missed something or it's wrong, you need to do all over again. And this one several times maybe we had like argument with the doctors because they will do the consent and then somebody will just confirm it. So it will right away goes with the patient records, and then when we check it's missing something like signature and they need to redo the process all over again, unlike the paper, you can just [inaudible] and throw it, right? or you can just erase one and then you can put error and then you can sign in and then we can stick with it. But here, no, you need to do it all over again" (P10, F, NC, ER).*

However, not allowing the easy modification of patients' information is recognised as a safe measure guided by the Joint Commission International Patient Safety Goals to enforce safe practices and prevent the recurrence of events (Rodziewicz et al., 2021). Therefore, individual clinicians need to be careful when entering sensitive data because some errors in the practice come with legal accountability. This means that individuals are responsible for

their actions and decisions that meet the legal requirements for safe and effective practice, and they will be accountable for any deviation or unintended consequences.

Despite this, it is important to note that nurses also acknowledged ongoing efforts to improve the system. These improvement endeavours, including customisation of the EHR, will be discussed in Section 4.3.3.2.2.1.2.

4.3.3.1.3.6: EHR downtime disturbing nurses' work

System downtime, where the EHR would become unavailable or offline, was one of the reported stressors made by the participants. Nurses perceived the downtime as disturbing, as it caused interruptions to their workflow. They explained that during the system downtime, nurses had to document their work on paper to continue their work. They would also enter data manually in the EHR when the integrative devices (e.g., cardiac monitors, vital signs, medication machines) failed to transmit patients' data automatically, which was perceived by nurses to reduce the accuracy of data entry. When the system was restored, nurses were required to re-document what they had done during the downtime in the EHR system. This was perceived to create an extra burden in relation to data entry.

> *"When there is a system down, really the nurses are struggling by manual work then there is a chance for error to happen… paper consent, paper forms, doctors need to order in papers. Uh, many things we go through" (P3, F, NC, HDU)*

Nurses also reported that the downtime could delay the admission of an emergency patient while waiting for the patient registration in the system.

> *"If the patient will go from emergency to impatient and if the system is down, we don't admit the patient until it will be converted in the system. So, it will delay the patient transfer from the emergency room to the impatient unit" (P1, F, NM, ER)*

However, nurses had access to a risk management plan for the EHR downtime if this incident occurred, which seemed helpful for nurses. This will be addressed in a subsequent section (i.e., Section 4.3.3.2.2.1.3) titled 'EHR contingency plan'.

4.3.3.1.3.7: Difficulty adjusting to new changes in the EHR

Some participants deemed the process of adjusting to new changes in the EHR to be stressful. According to the nurses, since the implementation of the EHR system, the hospital has periodically updated and modified the EHR system. Introducing new documentation forms in the EHR was particularly bothersome to nurses because it would increase their workload, and nurses had to adapt to such a change. Nurses described the process of adjusting to a new change as irritating and difficult. According to nurses, adjusting to change could take time and slow the work pace, contributing to nurses' stress. These quotations illustrate the point:

> *"we started 2015, 2016, actually until now, we are, I mean, there is some modifications in some forms of the nurses are using, every now and then we have a new form in the system, we have a new changes in the system, This is actually what stress the staff, and stress them as a bedside nurse, because you have to update every now and then there's something new, which makes it sometimes difficult for them, because they're just adjusting" (P9, F, ANM, P.ER)*

> *"The problem was that each time they introduce new forms and documents frequently which consumes more of our time. It really irritates me a bit" (P14, F, SN, ICU)*

Despite these challenges, nurses demonstrated significant resilience in adapting to change and embracing the EHR. Nurses' adaptability to change, which is part of the broader theme of 'individual resilience', appears to play a significant role in reducing the impact of these stressors and protecting them from potential burnout associated with EHR use. This leads us to the following section, protective factors from EHR-related burnout (resilience), which will explore nurses' coping strategies and the available support in their workplace environment that contributed to mitigating the impact of EHR-related stressors.

4.3.3.2: Protective factors from EHR-related burnout (resilience)

Resilience is the individual ability to bounce back from adversity (Southwick et al., 2014). It is also known as coping with stress. Although this concept of resilience is often explored at the individual level, organisational resilience, reflecting the ability of an

organisation to withstand and recover from disruptions (Barasa et al., 2018), is equally significant. In the context of this study, two levels of resilience were evident in the findings that acted as a barrier against severe stress and burnout related to EHR use: individual resilience and organisational resilience, which will be explored under this second theme.

4.3.3.2.1: Individual resilience

The findings indicated that nurses presented a certain level of resilience towards stressors from EHR use. They developed resilience from their ability to adapt to changes or challenges and learning by experience. The findings, based on participants' reports, revealed four factors that facilitated nurses' acceptance of the EHR, thereby reducing their stress levels. These include computer literacy, perceived usefulness of the EHR, nurses' adaptability to change, and workarounds.

4.3.3.2.1.1: Computer literacy

Computer literacy, which is the ability to use computers and modern technology (McMillan, 1996), was found to have a substantial impact on nurses' acceptance of the EHR. The interview findings highlight the relationship between perceptions of computer literacy and/or perceived ease of use and the acceptance of EHR technology. In other words, the nurse participants who had positive perceptions about EHR demonstrated a high level of EHR adoption and reported a low level of stress towards its use. This is because, as stated in the literature, some nurses are better equipped than others to carry out the EHR system's complex functionalities due to their familiarity with computers and other forms of modern technology (Ramukumba and El Amouri, 2017). This was evident in many participants who reported being in favour of the EHR system and did not find the system's technical difficulties to be too much of a problem for them. Here are some quotations from computer-literate nurses:

"I really love computer. That's why maybe, I cannot see any disadvantage about this EHR…We're under modern world now. Everybody is very good in computer. So there's no problem regarding documentation" (P2, F, SN, ER).

"I am a computer person, so I prefer the computer anyway. This is my own opinion. I don't like the paperwork" (P1, F, NM, ER)

4.3.3.2.1.2: Perceived usefulness of the EHR

The perceived usefulness of the EHR, which is the degree to which an individual believes that using a certain technology would enhance their work performance (Davis, 1989), was identified by most of the nurse participants as a factor influencing EHR acceptance. This is evident in many participants recognising the benefits of EHR use from their experience, which promoted its adoption.

"We accepted it (EHR) especially when we sensed the benefits" (P20, M, SN, PICU)

One nurse responded that the EHR had improved workflow and streamlined work processes. She described how the system's communication, access to patient data, and referral system were fast and easy, leading her to view the EHR as efficient.

"The clinical flow and communication is faster. Yes, that is a very advantage of the system because the doctors can easily access the information in the system before even coming to the ER, they already have reviewed all the information from the ward and they can easily access the patient. Yeah, and the referral system is also quicker because all the information is in the patient's record in the BestCare… maybe 80% it's efficient for us, I consider" (P6, F, CRN, ER)

Here are some quotations that show the participants' acceptance of the EHR was influenced by their perceived usefulness of the EHR.

"I do like the whole entire system. I see it in a way that actually helps me a lot in terms of my nursing care, even though it's not perfect" (P11, F, CRN, PEDS)

"I can summarise…time saving and friendly use, comprehensive… It's like a good impact. Really, it's helpful. I really appreciate the transformation of the system" (P8, F, SN, P.ER)

The participants presented many examples to support their claims of the perceived usefulness of the EHR. For instance, some nurses viewed the EHR as a time-saver because

patient information was readily accessible and searchable. They also mentioned that the automatic interface of the connected medical devices with the EHR had saved them time compared to manually inputting data on the EHR. Here is an illustration of the point:

> *"for me, BestCare is really helpful. You know, you don't have a redundancy of doing a lot of things. Everything is in the flow chart, the vital signs is there, easily everything is synchronised, like from the Dynamap (vital signs machine), we don't enter manually because when you take it in the Dynamap, it's already interfaced. So, you don't need to spend a lot of time doing things that already done" (P12, F, ANM, MS)*

In addition, other nurses mentioned that the interface design cut down on the amount of time spent documenting by providing them with a variety of pre-programmed checklists from which to select while still enabling them to utilise free text and add remarks.

> *"In terms of documentations, it will actually minimise a lot of writing because a lot of it is pre-programmed, like options they can choose from, instead of writing the details in full sentences. It's time saving. It's really more user-friendly" (P11, F, CRN, PEDS).*

One participant described how the registration process for a newborn infant had become simpler and quicker with the current EHR system, saving time for both the nurse and the newborn's parent. She explained that under the previous system, infants were registered manually, and the process of establishing an MRN and a birth certificate for the newborn was lengthy and required paperwork from multiple locations. Nevertheless, the existing system was fully paperless; the MRN would be generated automatically after delivery, and the birth certificate would be readily available for collection from the registration office.

> *"The registration for the newborn babies, who just delivered will be done in the BestCare. Once you open the form for the delivery and discharge and you register the baby, it will automatically create a medical record number for that patient. Before that, we were doing it manually and it was really difficult. Before, the father needs to come to the unit, we will give him either blue or pink card it depends if it's a boy or a girl. He will go to the registration office; they would give him the birth notification. Now, no need, it's easier, for medical file, birth certificate all in the system, everything. Once the baby is registered in the system, and got her/his medical record number under the mother's file. The father can go to the registration and they will get their birth documents. It's faster" (P18, F, CN, NICU)*

Another example of the perceived usefulness of the EHR frequently reported by the participants was mismatch detection (identification of errors). Nurses stated that the EHR had improved patient safety and improved the quality of nursing care. They explained that the EHR was integrated with a system called CLMA (picture 2 in Chapter 1: Background). It was used for medication administration, laboratory investigations, and blood transfusion to prevent errors. They explained that the system operated through a small device available for each nurse on the shift. One participant described it by saying:

> *"We have a small electronic device, we call it CLMA which is the closed loop medication administration, so it is a small iPod, usually we give it to the nurses we have in each unit and the nurse can scan the patient's armband for the blood and for the medication. It's will show the patient medication and the patient information, and it's connected to the system" (P1, F, NM, ER)*

One nurse explained how effective the CLMA was in detecting errors. She gave an example of how it would alert or prevent a physician from prescribing a medication to which a patient may be allergic.

> *"It's very good for detecting the medication error, prevent actually the medication error. For example, for the doctor order, it will stop them from ordering something, It's not in the system. It will alert the doctor if he wants to order something that the patient is allergic to, it will stop him" (P1, F, NM, ER)*

Accordingly, the integration of the CLMA system with the EHR was perceived positively by most of the participants. It may have alleviated some pressure from the nurses by preventing them from making mistakes when it detected the mismatch, which made them feel comfortable working in a safe environment. This integration influenced the EHR adoption, as evident from the participants' responses, as they seemed to view this integration of CLMA with the EHR as beneficial for safety.

> *"Actually, all the system is good for patient safety, 100% agree about that. It will protect yourself and also the patient, because it will notify you if it's wrong*

medication or no, wrong sample or no, that one is the good thing for it" (P15, F, SN, NCU)

4.3.3.2.1.3: Nurses' adaptability to change

Adaptability (the ability to adjust to change or difficulty) of some nurses was identified in the findings as a protective factor against stressors associated with EHR use. According to the literature, being adaptable can be considered a personality trait of being flexible to learn new ideas and experiences, which is part of personal development (Lam and McBride-Chang, 2007). It can also be a skill used to adapt to change or recover from adversities to preserve mental wellbeing. Some nurses demonstrated resilience by being open-minded and flexible, which helped them to accept the EHR. This quotation illustrates the point:

> *"I try to, I mean, convince myself, to try to switch the mind-set to say that, okay, this is an EHR, this is something created by human beings. So me as a human being using it, I should be smarter than it and should overcome it, instead of letting it to control me back" (P11, F, CRN, PEDS)*

Moreover, some resilient individuals have a high degree of adaptability to environmental stressors in the sense that they have confidence in their problem-solving abilities. Here is an example of a resilient nurse who demonstrated confidence in her ability to manage and overcome challenges from the EHR.

> *"To tell you the truth, I know how to manage (EHR) if there is a problem. There are always ways to solve the problem" (P3, F, CN, HDU)*

Some participants understood that the hospital had been introducing new rules and systems from time to time and that they had no choice but to adapt to change. Consequently, as they explained that there will always be changes, and one must adapt to the changes. Here are statements made by nurses:

> *"Every day or every week you get surprise, a new learning, a new guideline that comes out…So rather than fighting the system, we adapt ourselves to the changes" (P20, M, SN, PICU)*

"So the girls (nurses) are very understanding because they know that there is no choice. Okay. We need to finish our work and we need to give the proper care to the patient. That's the most important is the patient" (P12, F, ANM, MS)

The findings also indicated that participants developed adaptability over time, as they reported becoming accustomed to the EHR as they used it daily since its implementation in 2015. Nurses reported that they got used to the EHR system and the regular problems associated with its use to the point where they no longer found it particularly bothersome. They all made it apparent that the EHR deployment was first difficult for them, but as time passed, they grew accustomed to it and found it to be beneficial. This is because they learnt through experience and acquired the computer skills necessary to manage some of the challenges associated with its use. Here are quotations that illustrate how nurses originally struggled but eventually adapted and accepted the EHR:

"For me initially it was difficult, but with time of course, we're getting used to it. So it's becoming easier and easier" (P10, F, CN, P.ER)

"Initially we are hesitant, we won't adapt, but time comes because really it helps in identifying errors specially medications. So, day by day, we managed to adjust on it and accept" (P20, M, SN, PICU)

A nurse explained that adapting to the EHR resulted from experiential learning or applying lessons learnt from difficult situations. She was able to manage her stress after encountering difficulties with the EHR. She stated that nurses would not know how to perform tasks in the future if they did not experience challenges. It appeared that her personal development was aided by her ability to adapt over time by acquiring EHR knowledge and skills and by being understanding of changes, as it takes time for someone to adjust to changes and to be able to effectively manage stress and perceive the positives.

"I'm used to it already… how do we manage to remember all of these things? Because we're used to it… From that we learnt how to manage our stress. Yes. If we didn't experience it, we will not know what we do in the future. At least we learn" (P15, F, SN, NCCU)

Another participant with around 20 years of nursing experience at the participating hospital provided a great example of how she was adjusting herself to accept the current EHR technology. She explained that she had struggled a lot in the past years since they introduced the new system and was still feeling stressed.

> *"I think it's just a matter of acceptance perhaps on my side, perhaps because I use the paper documentation for ages for how many years, and this is something new that we need to adapt to. When it comes to stress, if I grade myself, I am moderately distressed at this point" (P6, F, CRN, ER)*

She went on to describe how she could develop resilience and learn how to cope with EHR-related stress by being open-minded and viewing EHR technology as part of a wider future movement. This made her accept it, and she did not wish to return to the previous system. She stated the following:

> *"I believe that I need to be more open-minded with the existing system. We cannot go back to the old practice, yeah, because we are in this stage now where artificial intelligence is widely used, and we really need to adapt to the system. I think we are coping… I believe there is a future in this EHR a big future in EHR, because when you think about time is sensitive thing, I think this is more flexible because if you need patient information, you can just open the system and you can view all the things that you needed, like lab works, history of the patients in one screen. Yeah. I think this is our future now. I believe it is there to help us to make the workflow easier, faster and more reliable. So I think it's just a matter of acceptance and a little more time for us to adjust then it will be okay" (P6, F, CRN, ER)*

4.3.3.2.1.4: Workarounds

Participants also reported employing workarounds to compensate for perceived system weakness and to prevent interruptions to their workflow. They indicated that if they experienced problems with EHR use, then they would find alternatives to continue working until the issue was resolved. One participant, for instance, described how she adapted herself to deal with recurring connectivity issues in her unit. She mentioned that when she was unable to access the system due to a poor connection, she would leave the computer to complete other tasks so as not to interrupt the workflow, then return to the EHR later.

> *"Sometimes if the connection is too bad, okay, it's fine. I would just leave the computer there first. I just leave for a while five minutes, then I come back later or else, like I will try to, you know, be more patient with it. And instead of letting it to control me, I will manage my time to make sure that I can still do the documentation and I can still access the system very well" (P11, F, CRN, PEDS)*

Another nurse, whose unit's laptops were inoperable due to depleted batteries, indicated that she would share her laptop with her colleagues or utilise the primary desktop device to keep the workflow continuing.

> *"I just find for alternatives, you know, I already know this (laptop battery) cannot be fixed and it takes longer time, so I cannot stop that, it has to be fixed, I tell them what they should do. So, I will just continue my work, use options, like I'm sharing the laptops and then I alternate with the desktops. So as much as I can utilise things like that" (P12, F, ANM, MS)*

Yet, EHR workarounds may have implications for the quality of care, as suggested by the literature (Boonstra et al., 2021). Although they seem harmless, they offer short-term benefits and might carry risks to patient safety if they persist. For instance, when SNs bypass the EHR built-in safeguard processes due to connectivity issues, workarounds potentially endanger the safety of patients. Thus, workarounds can be mitigated with system improvements and resolving issues related to the EHR that nurses identified.

4.3.3.2.2: Organisational resilience

Organisational resilience is the ability of the organisation to anticipate, prepare for, respond to, and adapt to change and sudden disruptions to survive and thrive (Barasa et al., 2018). The findings showed that the hospital organisation appeared to demonstrate strategic capabilities towards acceptable usability of the EHR and reduction of severe stress and burnout related to EHR use among nurses. There are two subthemes identified under this theme: (1) organisational preparedness for EHR implementation contributing to stress reduction related to EHR use, and (2) organisation support system mitigating EHR-related stress.

4.3.3.2.2.1: Organisational preparedness for EHR implementation contributing to stress reduction related to EHR use

Organisational preparedness is a key aspect of the successful implementation of the EHR system (Keshavjee et al., 2006). I will explain in this section four key elements that emerged from the findings regarding the preparedness of the organisation, which seems to contribute to the pragmatic implementation of the EHR system as conveyed by the nurses' accounts. This might be reflected in the widespread acceptance of the EHR by nurses and the accompanying reduction in stress levels associated with its use. These elements were the integration of the EHR system with medical devices, EHR customisation, the EHR contingency plan, and training and continuous learning.

4.3.3.2.2.1.1: The integration of the EHR system into medical devices

The EHR software was designed to integrate and automatically transfer patients' data generated from various medical devices to the EHR system wirelessly. The HIT structure in the hospital and the integration of medical devices with the EHR, including the design and customisation to meet the needs of the national system, were explained in Section 4.3.2 (description of the EHR). Nurses explained that the integration of the EHR system helped reduce the time taken to manually record and input readings into the EHR. This was perceived to improve the workflow and increase the accuracy of patient data in the EHR, which consequently contributed to lower stress related to the EHR.

> *"When the BestCare was implemented and linked with ADC (automated dispensing cabinet) and we started using the narcotic medication through it, we found it way better to use. It made it very easy for us." (P4, F, NM, PEDS)*

The availability of EHR resources, such as laptops and CLMA devices, was also perceived by nurses to be adequate (1:1 device-to-nurse ratio) and automated dispensing medication cabinets (two per department), which minimised the interruption to the nurses' workflow. Here are some quotations that illustrate this point.

"There are enough laptops and scanners for nurses. I have two medication rooms with two dispensing medication cabinets. so, there is no long queue" (P4, F, NM, PEDS)

"We have desktop and laptop. In our unit, we have one to one, we have enough gadget for the EHR" (P2, F, SN, ER)

4.3.3.2.2.1.2: EHR customisation

The EHR customisation, which was designed to meet the needs of the local practice and could still be modified, was also identified by the participants as a useful tool that, to some extent, gave the system flexibility and contributed to its acceptability. Some nurses had a favourable impression of their customised EHR system that catered to their needs.

"BestCare is very flexible to adapt and any modification you want to do is now possible" (P4, F, NM, PEDS)

Despite the largeness of the organisation (NGHA) and the interoperability of its EHR system among different regions around the country that might limit its flexibility, some nurses seemed to understand the process and appreciated the effort of improvement attempts. Nurses reported that the ISD and nursing informatics were considering their feedback and working on some modification requests to make improvements to the system. Here are some quotations that highlight the point:

"They can modify the system. It is not a fixed system. It's flexible, you will email them, send them a letter saying that you want this added into the system and it will be done. It takes time, it is time consuming because it is a big organisation, and we take approvals from many people, but it will happen" (P13, F, CRN, PCC)

"Anything we raise it to them. They will act on it, and they would come by themselves even. So that's why we really appreciate their efforts" (P7, F, NM, P.ER)

4.3.3.2.2.1.3: EHR contingency plan

One of the strategies to manage EHR-related risk (downtime) was the contingency plan policy, as identified in the findings. The hospital's contingency plan policy provided clear guidance to nurses when the EHR would become unavailable or offline. The

participants explained that there were two types of system downtime: planned and unplanned. Planned downtime happened when there was regular maintenance or updates to the EHR system, and nurses would be notified about them by email. Unplanned downtime occurred due to internet connectivity issues or the system would crash suddenly. There were two pathways for the contingency plan, depending on the duration of the downtime. For instance, when the downtime was more than two hours, all the paper documentation would be sent to the medical records department to scan the documents and enter them into the system, but when the downtime was less than two hours, nurses would re-enter the paper documentation into the system when it got recovered. Some participants explained the contingency plan policy:

> *"We have a backup system which is a paper system, we have a contingency plan in case of the system will go down. When it's more than two hours, all the paper documents will be scanned and enter in the system. But if it's less than two hours, we need to re-enter all the data for the patient during the system down" (P1, F, NM, ER)*

> *"If the system is down for more than two hours, all paper needs to be sent to the medical records so that they can enter them in the system" (P4, F, NM, PEDS)*

In this instance, nurses seemed prepared for what to do when the system downtime occurred, and it seemed to reduce their stress as they knew how to act accordingly. Furthermore, many nurses reported that the frequency of the EHR downtime was not as often as the organisation attempted to plan it during off-peak hours, even some nurses would not notice that the system went offline. They also reported that the hospital was continuously improving the system performance to lessen the chances of unexpected downtime and solve the issue immediately. Here are some statements that demonstrate the frequency of system downtime experienced by nurses during their work:

> *"In my experience from 2015 until now, the downtime never lasts more than 30 minutes. Even the planned one never lasted more than an hour. So, nothing affected us"… as I told you it became better by 70%. We are not allowed to enter the information manually. The manual input stopped around in 2018 to 2020. (P4, F, NM, PEDS)*

"It's actually weekly the ISD will do the maintenance, they will send us an email that they will do maintenance or [inaudible] for 30 minutes like that, but we will not feel that one … it's very rare, so far during this crisis (COVID), I did not encounter system down" (P2, F, SN, ER)

4.3.3.2.2.1.4: Training and continuous learning

Training and continual learning to use the EHR were highlighted as critical elements in the findings that facilitated EHR use and contributed to a lower level of stress among nurses. The findings revealed that there were several resources accessible to nurses to educate them on the use of EHR. These were (1) an initial training on the EHR during the nursing orientation programme for new nurses, (2) a one-month preceptorship period during which a new staff member would work alongside a senior nurse and learn everything from them, including EHR use, (3) the CRN or a clinical instructor, whose main responsibility was to provide continuous learning to nurses in the unit, with the EHR being one of the learning essentials, (4) EHR superusers, who were essentially clinical nurses but were given intensive EHR training to teach other nurses in their working unit EHR use, and (5) ISD and nursing informatics, which were the main responsible departments for the EHR, providing all learning materials and technical support.

"They provide initial training. When the employees are first hired, they will get a BestCare training session with the nursing informatics. Then after that, they will be trained with the CRN, what we call it, critical resource nurse, which is mostly responsible for the staff education and competency" (P7, F, NM, P.ER)

"We got training when we first arrived here. And if there's something you can't find and you don't know, then all of the other nurses will help each other. Then you have your perception period, which is, I think three or four weeks. So then you have time that your perceptive will help you, figure your way around the computer" (P16, F, SN, ICU)

Training and the different resources for learning how to use EHRs available to nurses might have an impact on the safety, quality, accuracy, and timeliness of care. EHR training

and continuous learning seemed to reduce nurses' stress and burnout by improving their EHR knowledge and reducing the amount of time spent interacting with all aspects of the EHR.

> *"I didn't actually need an extra training. We have superusers usually in the unit to refer to if something is new" (P1, F, NM, ER)*

4.3.3.2.2.2: Organisational support system mitigating EHR-related stress

In this section, there are four elements that added extra support for nurses when using the EHR at the hospital, which contributed to their stress reduction associated with EHR use. These are the EHR informatics support, understanding leadership, teamwork, and wellbeing clinic.

4.3.3.2.2.2.1: Informatics support

The finding showed a consensus participants' acknowledgement of the continuous support provided by the ISD regarding EHR use. They explained that the ISD and nursing informatics subdivision were always available, easily reached, and very responsive to their needs whenever needed. For instance, they reported that even during off-working hours, they had a hotline and pager for the informatics personnel for urgent issues. Otherwise, nurses used email when the problem was not urgent, and the informatics would resolve it quickly during office hours. This sensible support appeared to alleviate nurses' stress from EHR use, and nurses appreciated it. Here are some quotations that illustrate the point:

> *"We have their (the informatics) pagers, we have their extension, and we have their emails and each department have their own assigned superusers to troubleshoot, so I don't think we have a problem with how long they will show up on any issue that we encounter" (P7, F, NM, P.ER)*

> *"They're (ISD) quite good. Yeah. And if there's a problem with the computer or the BestCare. Then they will guide you through on the phone or they will take control of the computer that you're working on to try and resolve the problem. So, they're good. Yeah. They're very helpful" (P16, F, SN, ICU)*

4.3.3.2.2.2.2: Understanding leadership

The nurses felt that their managers and leaders understood the challenges they faced while using the EHR, which occasionally got in the way of providing nursing care. According to the participants, the nurse management team worked on difficulties that their nursing staff had encountered while using the EHR and raised them to the upper administration to solve and enhance them.

> *"If we encounter something wrong, we'll just escalate it either to the management team, then to the informatics, then they will try to solve… Our nurse manager office is open for everyone. You have something you just go and talk. Yeah, she's listening" (P18, F, CN, NICU)*

Nurses explained, in some instances, how considerate their nurse managers or leaders were towards their concerns regarding EHR use, which relieved their stress and potential burnout. One nurse expressed that her leader was a reason for relieving the stress and burnout that she encountered from workplace stressors. Another stated that leadership could play an important role in easing nurses' stress at work.

> *"She was a great leader so that's why the stress was less, and the burnout was relieved" (P4, F, NM, PEDS)*

> *"It also depends on the leadership, how they ease the stress on nurses. I am talking from my experience" (P4, F, NM, PEDS)*

4.3.3.2.2.2.3: Teamwork

Teamwork was perceived as one of the significant factors that relieved nurses' stress related to EHR use. The findings showed that the nursing team of each unit consisted of SNs, EHR superusers, a charge nurse, a CRN, an assisted nurse manager, and a nurse manager. The findings showed how they contributed differently to facilitating EHR use for the SNs. For instance, superusers assisted nurses with problems they encountered with EHR use, troubleshot some technical problems, and the CRN audited and checked the completion of

the documentation requirements, instructing and updating nurses on EHR use. On top of that, nurses helped each other with using the EHR and providing bedside care.

> *"When the primary nurse is doing the documentation, or she is on break, the other one would relieve her, so she will help at the bedside. This is how we help each other" (P10, F, CN, P.ER)*

One nurse believed that her support team was the reason that she did not experience burnout at work. Another nurse stated that, with the assistance of her colleagues, she was able to use the EHR system on her own and overcome obstacles resulting from its use. This demonstrates how teamwork can have a significant impact on reducing EHR-related stress among nurses. These quotations demonstrate the point:

> *"I never experienced burnout at work. I have good supportive team. That's what I said. The team that I work with, it's really a great team" (P12, F, ANM, MS)*

> *"With the help of my seniors and the help of my colleagues as well. And then the experience, later on, I was able to use the BestCare on my own and overcome those things (difficulties)" (P5, F, SN, P.ER)*

4.3.3.2.2.2.4: Wellbeing clinic

A few nurses reported that the hospital had a wellbeing clinic for the staff to seek help or counselling for stress or burnout. They stated, however, that the clinic was recently opened during the COVID pandemic (i.e., during the year of the data collection, 2020), and there were no experiences reported by the nurses dealing with the wellbeing clinic themselves. Yet, they stated that the clinic provided psychological counselling for all staff, whether the stress was from COVID or other workplace stressors.

> *"Currently, we have the well-being clinic for the staff. If they are experiencing the stress or burnout. They can go either walk in and no name will be shown. They will be seen by a psychiatrist or psychologist if they need. And no record, it will not be shown to anyone" (P1, F, NM, ER)*

> *"It's like just a month or two months ago. It's for the nurses if we've been stressed psychologically because of the COVID, but even we can go if we feel like we are stressed, the clinic is like counselling, that is the purpose of that" (P10, F, CN, P.ER)*

4.4: Conclusion

The findings of this study directly align with the study's aim and objectives, drawing on both survey data and in-depth interviews to provide an expanded perspective of factors impacting nursing burnout related to EHR use in a hospital setting in Saudi Arabia. In doing so, I measured nurses' burnout and its association with their perceptions of the EHR, which addressed the first part of the research aim, examining the association between nursing burnout and the EHR. Then I explored nurses' views and experiences of EHR use at their hospital and the contribution of the EHR to burnout, thereby addressing the second part of the research aim, exploring the contributing factors to nursing burnout related to EHR use in a hospital setting in Saudi Arabia.

The findings of the study showed that there was a slight inconsistency between the quantitative and qualitative results regarding burnout outcomes. The quantitative results identified that nurses who reported negative perceptions about the EHR (representing a minority) were likely to experience burnout while the interviews showed that all participants who reported stress related to the EHR did not respond that EHR-related stress would lead to burnout. Despite the overall acceptance of the EHR among the nurse participants being relatively high, negative EHR perceptions and stress related to EHR use were identified. These stressors reported in relation to EHR use mainly resulted from (1) the EHR documentation requirements that caused nurses to compete with pressures between organisational demands and direct patient care and (2) technological challenges that contributed to nurses' stress and discomfort at work. However, two levels of resilience were observed that acted as protective factors against severe stress and burnout for nurses, individual and organisational resilience. Participants developed resilience from their ability to adapt to changes, perceived usefulness of the EHR, and from learning by experience. Nurses also recognised the support from the organisation that facilitated its use and eased some of

the workload pressures. It is essential to highlight that the study's transferability to the global workforce is evident in the findings where migrant nurses, who constituted the majority of the sample, demonstrated adaptability, with their acceptance of the EHR serving as a prominent indicator.

CHAPTER 5: DISCUSSION

5.1: Introduction

This chapter contains a discussion derived from the findings of the survey and interviews, as reported in Chapter 4. The utilisation of a mixed-methods approach enriched my understanding of the impact of EHR use on nursing burnout in a Saudi Arabian hospital by validating and complementing the insights gained through both quantitative and qualitative methods. Although the quantitative data offered a statistical foundation for examining the association between nursing burnout and the EHR, the qualitative data helped me develop an in-depth and nuanced interpretation of the results, thus satisfying the aim of exploring the factors that contribute to nursing burnout related to EHR use in a hospital setting in Saudi Arabia. This chapter contains a discussion of the study's key findings, drawing on the emergent themes and situating them within the existing literature. First, I present a conceptual model that summarises and visualises the key insights of the findings, reflecting the research aim and objectives of the study. Then I cover three main discussion points. The first point is perceived burnout in relation to the EHR, exploring how my study's findings align with or challenge existing literature on the impact of EHR use on nursing burnout. The second point discusses the organisational and technological challenges associated with EHR use. The third point is the influence of resilience on EHR acceptance and burnout prevention. The chapter critically evaluates the strengths and limitations of the study. Finally, I translate these findings into implications for policy, practice, and future research, highlighting the study's contribution to the existing body of knowledge.

5.2: Mapping the findings: A conceptual model

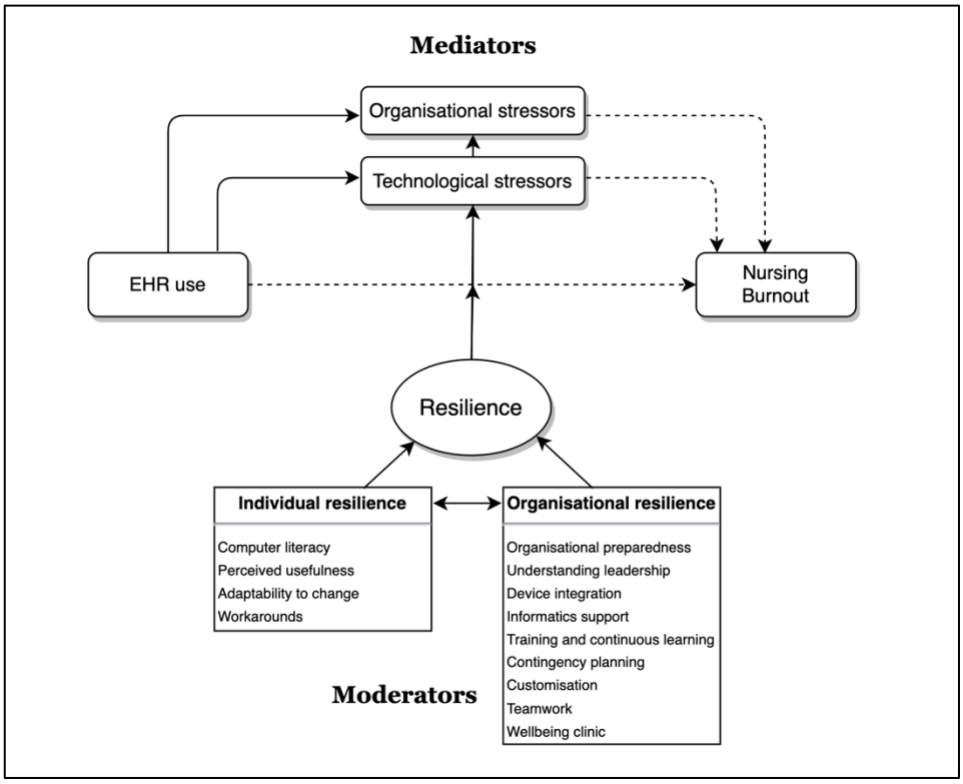


Figure 8: Conceptual model of the impact of EHR use on nursing burnout in a hospital in Saudi Arabia derived from the study findings

***Mediators**: Highlight the underlying factors explaining the relationship between EHR use and nursing burnout.*
***Moderators**: Factors that can alter or influence the strength of the relationship between EHR use and nursing burnout.*
***Solid Arrows**: Represent a positive influence or relationship between the factors.*
***Dashed Arrows**: Indicate a negative influence between the factors.*

***Note**: While the use of + and – indicators was effective in the systematic review model (Figure 4) due to the consensus of findings (mostly quantitative studies), it is challenging to apply the same in the qualitative study. The qualitative data primarily reports identified factors without hierarchical weight, making it difficult to determine the relative strength of each factor against another.*

The conceptual model developed in this study (Figure 8) offers a novel understanding of the impact of EHR use on nursing burnout within a hospital in Saudi Arabia. This model, uniquely tailored to the findings of this study and the specific context of a Saudi Arabian hospital, encapsulates the research aims and objectives: it visually illustrates the association between nursing burnout and EHR use, and the contributing factors to nursing burnout related to EHR use. The systematic review model (Chapter 2, Figure 4) served as a theoretical foundation, which was then built upon and refined to create this new conceptual

model tailored to the unique contexts and emergent themes identified in my study. This conceptual model significantly contributes to the body of knowledge in this area, considering the complex interplay of individual, organisational and technological factors in the context of EHR use and its impact on nursing burnout. As such, it extends our understanding of individual, organisational and technological aspects, and importantly, it included the role of resilience in moderating the relationship between EHR-related stress and burnout. Detailed discussions of these findings and their alignment or contrast with existing literature will be provided in the subsequent sections of this chapter. Before diving into the detailed discussion, a broad overview of what the model represents is provided.

This model illustrates that EHR use was not simply leading to nursing burnout. Instead, the relationship was influenced by other important factors, namely organisational and technological stressors, and resilience. These factors, however, showed some variation among individuals, indicating the multifaceted nature of this issue.

Stress related to EHR use arose from organisational requirements and technological challenges, both played a significant role in shaping nurses' experiences. These challenges, which manifested as demanding documentation requirements and usability issues disturbed the nursing practice and caused stress and frustration among nurses. However, the resulting stress did not automatically translate into burnout. Here, resilience came into play.

Resilience in this context is twofold: individual and organisational. Nurses developed resilience from their perceived usefulness of the EHR, their ability to adapt to work pressures, learning by experience and workarounds. At an organisational level, health information infrastructure and the support system provided by the hospital to facilitate EHR use and alleviate workload pressures also played a key role in building resilience.

Nurses demonstrated resilience at both individual and organisational levels, which emerged as a protective factor from EHR-related burnout. This resilience moderated the

impact of EHR-related stress, preventing it from escalating into burnout. Thus, the model underscored the importance of considering diverse factors such as the usability of the EHR system, organisational support available for EHR use, individual resilience factors, and teamwork dynamics in the nursing unit that collectively interweave to shape nurses' experiences with EHR use and its impact on their potential burnout.

In the subsequent three sections, I delve into a detailed discussion of this narrative, as reflected in the model. These discussions directly align with the research aim and objectives of examining the association between nursing burnout and EHR use and exploring the contributing factors to nursing burnout related to EHR use in a hospital in Saudi Arabia. They contribute to a comprehensive understanding of the issue and offer valuable implications for policy, practice, and further research.

5.3: Perceived burnout in relation to the EHR

In this study, two complementary methods were employed to provide insight into the specific issue regarding the impact of EHR use on nursing burnout in a hospital setting. The survey method provided a statistical analysis of the association between EHR measures and nursing burnout. The qualitative interviews provided a rich understanding of factors contributing to this issue, drawing from nurses' personal experiences with EHR use and their perceptions of its contribution to burnout. Participants' overall impressions of the EHR and their feelings of burnout because of the EHR were relatively consistent across both the survey and interview components of this study. Most of the nurses who took part in the study had favourable impressions of the EHR, and their perceptions of burnout were not primarily attributable to EHR use. In this section, I specifically concentrate on exploring the connection between EHR use and nursing burnout as the outcome, based on the findings of this study. Other EHR-related outcomes, such as EHR stressors and acceptance, will be discussed in the following sections (i.e., sections 5.4 and 5.5).

The single item of the Mini-Z burnout survey, "using your own definition of burnout", showed that most of the participants (66.7%, n =188) reported no symptoms of burnout while nearly a third of the respondents reported one or more symptoms of burnout. This 33% of burnout result was largely attributable to non-EHR-related workplace factors (identified in the Mini-Z survey), such as low job satisfaction, a busy to chaotic work environment, and insufficient time for documentation at work. Consistent with the interview results, none of the participants attributed the burnout experience to the EHR. The interviewees explicitly indicated that some challenges related to EHR use caused them stress but not burnout. Whereas some participants attributed their burnout experiences to other workplace factors such as COVID-19, long working hours, interpersonal conflicts, and a busy working environment. This finding is contrary to what I found in the systematic literature review (i.e., Chapter 2), in which, I concluded that EHR contributes to burnout among clinicians in hospital settings. This inconsistency may be explained by the fact that the participating hospital used an advanced integrating EHR system that was rated with great satisfaction by nurses in my study. The participants did not spend time on the EHR at home in this study due to the lack of EHR remote access, which was identified in the systematic review as a key factor that contributes to clinician burnout (Gardner et al., 2018, Harris et al., 2018b, Eschenroeder et al., 2021, Peccoralo et al., 2021). However, a study among primary care nurses supports my findings because 25.3% of the participants who reported feeling burnt out found that the use of multifunctional EHRs did not contribute to nurses' feelings of burnout (Abraham et al., 2021). Their explanation aligns with my findings, suggesting that nurses may be familiar with and equipped to use EHRs, and the benefits of EHRs like reliable prescribing, comprehensive documentation, and improved care coordination potentially reduced their workload, thereby reducing burnout (Abraham et al., 2021). Another study that supports my findings revealed that local work culture factors such as commitment and work–

life balance may contribute more to clinicians' burnout than EHR usage, in which EHR use accounted for only 1.3% compared to 17.6% variance for work culture (McPeek-Hinz et al., 2021). They explained that it might potentially reflect the increased efficiency of EHR usage by clinicians (McPeek-Hinz et al., 2021), which could be the case in my study.

There is little discrepancy in the responses between the quantitative and qualitative findings concerning the burnout outcome related to EHR among nurses. The regression analysis showed that the minority who had negative views of the EHR, particularly those who felt they were not proficient with EHR use (11%) and those who disagreed that EHR improved their clinical workflow (7%), were more likely than others to experience one or more symptoms of burnout. In the interviews, none of the participants who experienced EHR-related stress stated that EHR use would lead to burnout. Although there might not be direct research supporting this finding, there are two possible explanations for this variation in the responses. It could be because none of those who participated in the survey study (n = 282), who had potential burnout from the EHR, participated in the subsequent interview study. In other words, only participants who did not experience burnout from the EHR chose to take part in the interviews. Another reason explained in other studies in which it was found that phone interviews gave more positive answers than surveys is that participants might feel reluctant to express negative views in the presence of the interviewer in ways they may moderate their opinions that they would not anonymously (McPeek-Hinz et al., 2021, Ye et al., 2011). However, during the interviews, my study participants were open about their burnout experiences, which were attributed to workplace factors besides EHR use, as mentioned earlier. It seemed that the EHR was viewed as a less sensitive topic compared to other interpersonal and organisational issues the participants expressed distressing feelings about.

In accordance with the systematic review findings (Chapter 2), I hypothesised that EHR would be a contributor to nurses' burnout in the hospital setting. However, the findings of the current study did not fully support this hypothesis, in which the EHR contributed to nursing stress, but not burnout. It is possible that the resilience mechanisms in place at both individual and organisational levels were effective in mitigating the potential impact of EHR-related stress on nurses' burnout. These include nurses' adaptability to change, perceived usefulness of the EHR system, supportive teamwork and leadership, organisational infrastructure, integration of the EHR system with medical devices, continuous education, and IT support. These factors are discussed in depth in Section 5.5. The abovementioned variations between the survey and interview results also suggest that there is a weak link between EHR use and burnout may exist. Therefore, based on the findings of my study, conducted in a specific hospital in Saudi Arabia, EHR does not appear to be a significant contributor to nursing burnout in this context. Further research is required to validate this finding in other hospital settings across Saudi Arabia.

Moreover, the relationship between demographic factors and EHR-related burnout in both methods employed in this study (survey and interviews) was insignificant. These demographic factors (i.e., age, gender, job position, working area, total experience as a nurse, nursing experience in the current hospital, training, and remote EHR use) did not mediate burnout in the survey results. Only race and higher education in the survey were found to have a significant effect on burnout. The survey showed variations in burnout levels across different nationalities in the sample. In this instance, nurses from Malaysia were less likely to be burnt out than nurses from the Philippines. It might be that there is a cultural influence on the levels of burnout. A study compared the burnout level across different cultures and found that Australian nurses were at a higher risk of burnout than Chinese nurses (Fish et al., 2022). This was attributed to the individualistic culture of Australia, which values autonomy and

self-reliance, contrasted with China's collectivist culture that emphasises group belonging and hierarchy, thereby creating greater acceptance of unequal power in China (Fish et al., 2022). However, it is difficult to explain the difference between similar cultures (e.g., those of Malaysia and the Philippines), besides that the literature explaining this difference in relation to burnout seems to be lacking or less explored.

Furthermore, the survey results showed that participants with high levels of education (i.e., a master's degree) were more likely to experience burnout than those with a bachelor's degree. This outcome is contrary to that of Shanafelt et al. (2012), who found that physicians with lower educational degrees were at higher risk of burnout than those with higher educational degrees. Although they did not provide a clear explanation for this result, they implied that burnout experiences among physicians do not necessarily mirror larger societal trends (Shanafelt et al., 2012). In the qualitative study, except for the working area, I did not observe any differences in the stress and burnout reports related to EHR regarding age, gender, race, job position, total experience as a nurse, and nursing experience in the current hospital. Nurses working in the ER unit reported EHR-related stress (but not burnout), which will be discussed in Section 5.4.

Consistent with the literature, I found that burnout symptoms are similar to depression, with one participant conflating the two conditions. The WHO recognises depression as a clinical illness but burnout as an occupational phenomenon, not a medical condition (WHO, 2019a). However, the symptomatology of depression and burnout still share similar qualitative characteristics (Iacovides et al., 2003). An extensive review investigated the overlap between burnout and depression and found that in studies that used MBI, depression was strongly correlated with EE, the core component of burnout (Bianchi et al., 2015). Another study indicated that burnout and depressive symptoms were similarly correlated with the three stress-related factors: stressful life events, job adversity, and

workplace support (Schonfeld and Bianchi, 2016). It was argued that burnout is unclear because its symptoms are similar to depression, making it difficult to diagnose and know how common it is among workers in the health sector globally (InformedHealth.org, 2012, Bianchi et al., 2015, Reith, 2018). Furthermore, it was argued that when burnout signifies depression arising from chronic occupational stress, this might lead to misdiagnosing the problem and ineffective medical interventions for burnout prevention (Iacovides et al., 2003). Thus, the conflation of burnout and depression definitions poses a significant challenge, potentially leading to inaccurate diagnoses and ineffective treatment plans (Schonfeld and Bianchi, 2016). It might also result in flawed research outcomes, compromised healthcare policy decisions, and misunderstanding of the condition's true prevalence and impact within the healthcare workforce (InformedHealth.org, 2012). The authors of the burnout-depression overlap review raised concerns about the accuracy of the MBI, the current standard for measuring burnout (Bianchi et al., 2015). They concluded that the MBI's development lacked a strong clinical or theoretical basis, leading to potential inaccuracies in distinguishing burnout from other conditions, such as depression. They suggested that there is a need for systematic clinical observation to refine our understanding of burnout and determine whether it requires a separate nosological category (Bianchi et al., 2015).

5.4: Organisational and technological stressors related to EHR

Despite the fact that overall satisfaction with EHR was generally high among nurses in both the survey and the interviews, there were notable negative views and stress associated with EHR use, reflecting variations in the responses and some conflicting views. In the survey data, EHR stressors included insufficient time for documentation (27%), EHR added frustration to the nurses' day (16%), and lack of EHR proficiency (11.3%). A minority (8%) disagreed that EHR use improved clinical flow, patient care, job satisfaction, and communication among providers and staff. These issues emerged from a predefined list of

EHR-related measures, which were limited by the set of questions asked in the survey. The interviews, however, revealed more diverse and complex EHR-related stressors. This is because the semi-structured format allowed for an open-ended and deep exploration of the nurses' experiences with EHR use. The main stressors highlighted were (1) EHR documentation requirements, which created a conflict between fulfilling organisational demands and providing direct patient care, and (2) technological challenges, which caused discomfort among nurses and disruption to their work processes. This section will further discuss the identified organisational and technological factors that contributed to nurses' stress in relation to EHR use positioning them within the broader literature.

Time spent on EHR was a key factor identified in the systematic review chapter contributing to clinicians' stress and burnout (Gardner et al., 2018, Harris et al., 2018b, Hauer et al., 2018, Marckini et al., 2019, Olson et al., 2019, Shanafelt et al., 2016, Tajirian et al., 2020, Almulhem et al., 2021, Anderson et al., 2022, Eschenroeder et al., 2021, Gesner et al., 2022, Mazur et al., 2023, Peccoralo et al., 2021). This study partially supports this outcome, indicating that the time spent on EHR documentation contributed to nursing stress but not burnout. This might indicate that the EHR documentation strategies in the studied hospital might be effective in preventing stress from escalating to the level of burnout among nurses, especially nurses in this study, presented an adequate understanding of the burnout concept. In addition, there is another difference between my study results and relevant studies. The results of previous studies indicated that clinicians spent a greater amount of time on EHR at home, which impacted their work–life balance and contributed to their burnout (Gardner et al., 2018, Harris et al., 2018b, Peccoralo et al., 2021). In contrast to this result, however, I demonstrated that nurses did not have access to the EHR from home, so they had to complete their documentation at work. This organisational strategy might have positively influenced

work–life balance of nurses, thereby potentially contributing to organisational resilience, which will be discussed in the next section (i.e., Section 5.5).

The results of this study align with those in the related literature in that EHR use was perceived to be time-consuming due to the excessive organisational requirements for documentation that were not perceived to serve the patient's care needs (Ommaya et al., 2018). This study results also support the view that EHR use was perceived to take away clinicians' ability to provide care to patients at the bedside (Califf, 2015, Skeff et al., 2022, Hennington, 2008). My participants described the impact on their stress when some nurses could not manage competing pressures between documentation completion requirements that can be time-consuming and patient needs for nurses' time and attention for direct care. This finding highlights a crucial tension between organisational requirements and nursing care needs. A literature review addressed a tension where nurses under time pressure may alter their care routines to fit in with rigid EHR systems rather than the EHR system being tailored to suit their clinical workflow, potentially leading to less individualised patient care (Stevenson et al., 2010). The authors of the review suggested that EHR system designers should work collaboratively with nurses at the ward or clinic level to understand the complexity of their role. This cooperation can facilitate the development of flexible, intuitive systems that are tailored to suit nursing practice (Stevenson et al., 2010). Addressing these tensions necessitates a balanced approach that considers various stakeholders, including nurses, hospital administration, patients, and EHR developers, and involves them in the decision-making process to ensure that the EHR system aligns with nurses' workflows, hospital efficiency, and patient care quality.

In addition, the literature predominantly from the United States, including three studies identified in the systematic review (Hauer et al., 2018, Mazur et al., 2023, Skeff et al., 2022), showed that time spent on EHR documentation for billing purposes was a key factor

contributing to clinicians' stress and burnout (Downing et al., 2018a, Fred and Scheid, 2018, Kroth et al., 2019, Greep et al., 2022, Shanafelt et al., 2017b). However, the author of this study found no evidence of nurses performing billing tasks. This information has also not been previously described elsewhere. Nonetheless, based on my familiarity with the Saudi healthcare system and insights from the interviews in this study (although I did not directly address this question), it seems that nurses did not deal with billing responsibilities. It is important to note that during the time of data collection (2020), billing was not identified as a significant factor contributing to EHR-related stress from the literature review. It was only later, after I updated my literature review, that the role of billing became apparent, particularly in the context of U.S. healthcare settings. This could explain why my findings differ from those of other studies in which the authors found that clinicians, especially physicians, experience burnout as a result of the extra work involved in billing requirements. It was noted that clinical documentation in the American healthcare system is heavily dependent on billing requirements (Kim et al., 2019, Ommaya et al., 2018). This also might explain why nurses in this study did not feel that EHR-related stress would reach the point of burnout. Considering the influence of billing-related EHR stress and burnout in the U.S. healthcare system, it would be worth investigating the impact of EHR-related billing tasks on physician burnout in hospitals in Saudi Arabia.

Real-time documentation, where nurses were expected to complete their documentation within a defined timeframe, was identified in this study as a factor contributing to nurses' stress. Besides, 27% of the study nurses reported that the time for documentation was insufficient. The results of previous studies showed that perceived insufficient time for documentation in the EHR was associated with burnout among clinicians (Gardner et al., 2018, Harris et al., 2018b, Olson et al., 2019). Nurses in this study reported feeling under constant pressure while trying to handle competing priorities: real-time data

entry and direct patient care. Although it can be challenging for nurses to document detailed information in real time, maintaining updated patient records in real time is a legal requirement of nursing practice. Furthermore, real-time documentation is very important as clinical decision-making depends on real-time data (Balestra, 2017). The results of a study showed that real-time documentation improved nursing documentation and increased patient involvement (Jepsen et al., 2022). Yet, nurses in this study reported that they did late entries when they were unable to document on time, a practice which then subjected them to stressful questioning by auditors. Consistent with the literature, this practice could serve as a double-edged sword for nurses as they were obligated to ensure the completeness of patient information by adding, correcting, or deleting some entries, while this practice of editing entries could expose them to liability by the nursing management (Balestra, 2017). However, the results of this study showed that the integration of the EHR system into medical devices helped nurses with automated data entry in real time, a factor most nurses perceived to reduce their EHR-related workload and consequently stress, thus potentially protecting them from EHR-related burnout. The perceived reduction in EHR documentation workload due to the integration of the EHR system is part of a large discussion on organisational factors that contribute to nursing resilience in the face of stressors, which will be discussed in Section 5.5.

This study recognised that working speciality contributed to nurses' stress in relation to EHR documentation requirements. Nurses working in the ER unit perceived the standardised documentation as misaligned with their unit needs. They perceived that the ER's documentation load was unnecessary and difficult to achieve due to time constraints. They suggested that it should be decreased and tailored to the unit's needs, not levelled to the long-stay, structured, and stable inpatient units. ER nurses reported experiencing stress due to the tension between the rapid pace of patient care in ER, time constraints imposed by the four-

hour maximum length of stay, and the need to complete EHR documentation within this timeframe. There is a high risk of working fast and multitasking while trying to fulfil the workload demands on the quality of care, patient safety, and accuracy of data entry. A previous study found that time pressure related to EHR use was associated with psychological distress among nurses (Vehko et al., 2019). In addition, this study result supports the systematic review finding (Chapter 2), which concluded that clinicians working in such busier areas in hospitals were at higher risk of burnout associated with EHR use (Hennington, 2008, Jackson, 2019, Tawfik et al., 2017, Almulhem et al., 2021). The ER is among the most demanding and fast-paced stressful environments in healthcare. Nurses working in ER units are confronted with daily conflicts from demanding workloads, navigating constant change, extremely vulnerable patients, and sudden deaths, compounding with unrealistic expectations of the organisation (Johansen, 2014). Thus, it can be difficult in ER settings to provide high-quality patient care in a smooth, holistic, and speedy manner (Johansen, 2014, Portela et al., 2010). A study in the United States showed that 70% of ER nurses reported that EHR use negatively impacted patient care by limiting the amount of time nurses had for patient interaction and nurse–physician communication about patient care (Dobich, 2022). Because settings differ, patients' needs differ. Thus, EHR documentation requirements should be tailored to meet the unique needs of the ER setting as a fast-paced and short-stay environment. This adaptation could potentially reduce the burden on nursing staff, improve their wellbeing, and subsequently improve the quality of patient care.

I found that nurses' stressors were associated with the EHR's poor usability. The participants reported a number of issues that may have affected the usability of the EHR. These included the system's impracticality in emergency situations that require immediate medical response, fragmented and inflexible design of patient assessment forms, complexity of use, unreliable connectivity, limited customisability due to interoperability concerns, and

difficulties adjusting to new changes to the system such as the introduction of new assessment forms. Consistent with the systematic review (Chapter 2), cited usability issues that were associated with clinicians' stress and burnout related to EHR use were design issues such as complex interface, unintuitive navigation, and inflexible layout (Ghahramani et al., 2009, Tajirian et al., 2020, Hennington, 2008), difficulties with finding (Tajirian et al., 2020) or retrieving information (AlQahtani et al., 2021, Tajirian et al., 2020), difficulty editing after the data entry (AlQahtani et al., 2021), network issues (Califf, 2015), frequent updates or changes that require constant adjustment and learning (Califf, 2015, Jackson, 2019, Elliott et al., 2022, Kaihlanen et al., 2021, Heponiemi et al., 2017). Furthermore, studies that measured EHR usability using the 10-item SUS identified a significant link between lower usability scores of EHRs and high rates of burnout among doctors and nurses (Melnick et al., 2020a, Melnick et al., 2020b, Melnick et al., 2021). Nurses routinely use the EHR to perform one of their crucial responsibilities which is patient surveillance (Lopez and Fahey, 2018). Nurses are typically the first in the medical team to notice and respond to signs of clinical deterioration because of their close patient contact (Kutney-Lee et al., 2021). Poor usability of EHR systems can severely impair a nurse's ability to quickly access reliable information for decision-making and communication with other healthcare teams (Kim et al., 2017). Even though the technological issues cited by nurses in this study did not cause them severe stress and burnout, these IT issues must be addressed to prevent their persistence and potential risks to nurses' wellbeing and patient safety. Addressing the complexities of EHR system effectively requires a nuanced approach. This may include, but not be limited to, regular user training sessions to ensure nurses are comfortable with all aspects of the system, including updates. Constant evaluation of the EHR system might also be necessary to identify and promptly rectify problematic areas, and it could be beneficial to have an open channel available for nurses to report any difficulties they encounter. Regular collaboration and

feedback sessions with EHR vendors could help ensure system updates and changes align with nurses' actual requirements, making the system user-friendly and less stressful to use.

Potential invasion of patient privacy, including nurses' own medical information at their hospital, by healthcare staff from unrelated departments, was noted as a source of discomfort for nurses. Participants indicated that EHR could be accessed by unauthorised health workers inside the same institution, resulting in a breach of patient data privacy. Participants expressed concern that, if they were hospitalised, then their coworkers would be able to view their medical records. There are similarities between the attitudes expressed by the nurse participants in this study and those described by Wallace (2015), which showed that nurses have an ethical obligation to protect their patients' private health information. The same study also showed that the lack of trust in confidentiality could lead to reluctance to seek medical care and compromise the trust relationship between the patient and healthcare providers (Wallace, 2015). Furthermore, the literature showed that when a patient's private health information is compromised for any reason, it could potentially harm their life physically and emotionally (Almaghrabi and Bugis, 2022). It is important to address challenges in EHR concerning patient confidentiality protection. The Saudi National Cybersecurity Authority released its quarterly bulletin report for the fourth quarter of 2020, which revealed that the healthcare sector was the third most targeted industry worldwide by 14%, with unauthorised activity ranking as the first threat and information leakage was ranked fourth in Saudi Arabia (Saudi National Cybersecurity, 2020). Therefore, the findings of this study add to the existing literature by providing nuanced insights into the specific concerns of nurses regarding EHR-related patient confidentiality breaches within the Saudi healthcare context. By revealing that nurses expressed concern for the privacy of not only their patients but also themselves should they be hospitalised, this study's findings emphasise

the urgent need for concrete measures to enhance data security within the EHR systems used in Saudi hospitals.

5.5: The influence of resilience on EHR acceptance and burnout prevention

Overall, my study findings demonstrated a high level of EHR acceptance among the nurse participants. According to the qualitative study results, nurses appeared to demonstrate resilience in the face of EHR-related stress. Individual resilience and organisational resilience were found to be protective factors against severe stress and burnout related to EHR use among nurses. In this section, I discuss the findings that contributed to nurses' acceptance of the EHR, as well as explore resilience aspects that helped in the adoption of EHR and prevention of EHR-related burnout among nurses. I connect this discussion to the larger body of literature comparing the study findings to existing research, highlighting the study's contributions and implications in the broader context of EHR use in healthcare.

The findings of both the survey and interviews showed that there was a high acceptance level of the EHR among nurses. The survey responses of the participants' perceptions about EHR use showed that nurses were mostly in favour of the EHR. The statistics revealed that most participants were proficient with the EHR, had sufficient EHR documentation time at work, did not spend extra time on the EHR at home due to the lack of EHR remote access, and had favourable opinions of the EHR. This is consistent with the study's qualitative findings, where nurses mostly reported positive views about the EHR, and their reported stress related to the EHR was perceived as "manageable" and "not causing burnout". My study findings contradict the findings of the systematic review (Chapter 2), which concluded that EHR use contributed to EHR burnout among nurses (Harris et al., 2018b, Hennington, 2008, Kutney-Lee et al., 2021, Melnick et al., 2021, Gesner et al., 2022, Tawfik et al., 2017, Almulhem et al., 2021). However, my study results broadly support a similar work in this area, which examined the impact of EHR use on clinicians in different

settings during COVID-19 in Saudi Arabia and found a high rate of EHR proficiency, high positive perceptions of the EHR, and low time spent on the EHR at home, together with a low rate of remote access (Almulhem et al., 2021). This difference in the results may be explained by the fact that nurses and the organisation developed resilience from individual and organisational factors (explained in Chapter 4 at 4.2.3.2) that facilitated EHR use and thereby contributed to their acceptance of the EHR and prevention of EHR-related burnout. Furthermore, the consistency of my study results with the similar work of Almulhem et al. (2021) in Saudi Arabia may suggest two possibilities. First, it could indicate that Saudi healthcare organisations have used effective HIT implementation strategies, facilitating a smoother transition to the EHR system, such as incremental system implementation, extensive training, continuous technical support, and an EHR contingency plan. Secondly, the Saudi Arabian cultural context may also play a role in shaping clinicians' attitudes and perceptions towards the EHR. The nature of interpersonal relationships, communication styles, hierarchical dynamics in the workplace, or cultural attitudes towards technology and change could potentially influence how healthcare professionals adapt to the EHR. However, these possibilities require further investigation to fully understand the impact of these culturally specific or organisational factors in Saudi Arabia on EHR acceptance and resilience.

Organisational culture is one of the resilience dimensions or indicators identified in a systematic review (Barasa et al., 2018). Schein (1990) defined the organisational culture as basic assumptions and values that are collectively held and shared by members of an organisation, which function unconsciously and inherently shape the organisation's view of itself and its surroundings. Sleutel (2000) explained that groups of people within units or subunits might develop cultural systems within the broader organisational culture. In the context of my study, nursing culture was manifested in shared patient care values,

cooperative workload management, mutual support, knowledge sharing, and collective efforts to alleviate the burden of EHR use. The resilience that appears to be cultivated through these interpersonal dynamics seems to be reinforced by the organisation itself through providing EHR use support and resources, fostering a cooperative and team-focused work environment, and exhibiting understanding leadership that might have worked towards mitigating EHR-related challenges. Shared beliefs about the usefulness of the EHR, along with perceived pragmatic implementation strategies, further contributed to this resilience. Thus, just as individuals can learn to develop personal traits of resilience, so too can organisations. In the following sections, I delve into the aspects of individual and organisational resilience, exploring their roles in mitigating the challenges presented by EHR use.

Individual resilience was observed to be a protective factor against EHR-related stress and burnout among nurses. The nurses in this study demonstrated resilient attitudes that might have helped them cope with the EHR challenges. Factors such as computer literacy, perceived usefulness of the EHR, nurses' adaptability to changes, and workarounds were found to contribute to a high level of EHR adoption, positive perceptions of the EHR and consequently, a lower level of stress towards its use. These findings align with those of previous studies (Yu et al., 2017, Carayon et al., 2011, Tubaishat, 2018) and systematic reviews (Spatar et al., 2019, Kruse et al., 2015, Nguyen et al., 2021c) in which the authors identified a positive correlation between the abovementioned factors and EHR satisfaction, ease of use, high adoption, and reduced stress among nurses and other healthcare professionals. This may be because nurses who understand or see the value in EHR use might become motivated to use or adapt to it because they believe it will help them improve their work processes and patient care. This is in line with the findings of another study in which the author found workers' intention to use the technology and their motivational processes of

work engagement to be influenced by the perceived ease of use and usefulness of the device, which was also related to the organisational social support they received (Panari et al., 2021). Afifi (2018) argued that many stressors are shared experiences, necessitating collective action within relationships as individuals are inherently part of larger relational systems that influence their responses to stress. Thus, although individuals can manage stress at a personal level, they frequently rely on social interactions to navigate these pressures (Afifi, 2018).

The social environment or nursing culture appeared to play a significant role in shaping nurses' perceptions and attitudes regarding EHR acceptance. This, in turn, seemed to influence their resilience by fostering a collective mindset of adaptability and acceptability of the EHR system. This was observed in this study, such as nurses' shared perceptions of the usefulness of the EHR, peer support and the utilisation of workarounds, which facilitated EHR use and reduced EHR-related stress for nurses. Ludy-Dobson and Perry (2010) elaborated on the importance of supportive and healthy relational interactions in regulating the brain's stress response systems and the powerful effects these have on an individual's protective mechanisms to survive and thrive in stressful situations. It can be argued that, on one hand, the influence of nursing culture may have inadvertently shaped or swayed the attitudes and perceptions of individual nurses towards EHR acceptance. This potential bias stems from the shared values and beliefs within the nursing culture, which could have subtly influenced individual nurses to align their views with the prevalent norms. This has been discussed in the literature that the social influence in the workgroup can produce pressure for conformity where employees develop and maintain common perceptions reinforced by the organisational culture or subculture (Sleutel, 2000). On the other hand, however, social interactions and support have a beneficial impact on mental wellbeing, reduce the damaging effect of stress, foster a sense of safety and security, and increase individual resilience (Afifi,

2018). Therefore, it is essential to promote a supportive work culture to foster individual resilience, thereby promoting EHR adoption and reducing the risk of stress and burnout.

Nurses' adaptability to change was a key factor that built up their resilience, which contributed to their acceptance of the EHR, and protected them from EHR-related burnout. This was demonstrated in some personalities of the study's participants as being flexible and open-minded while others developed adaptability over time via skills and experiences learnt. Some participants also viewed the EHR as part of future technological advancement, highlighting our increasing digital literacy in this era where we are becoming increasingly reliant on technology. These reports are in line with those of previous studies. According to the literature, resilient individuals can see the positive aspects and potential benefits of a situation instead of being consistently pessimistic or cynical (Jackson et al., 2007). The literature further supports the idea that resilience is built through a process encompassing positive adaptation within the context of adversity (Barasa et al., 2018). On the contrary, other nurses in the study reported that they had to adapt to the system because simply there was no other choice. This result supports the idea of Hennington (2008), who found that one of the predictors of the system usage behaviours was linked to 'behavioural intention', in which nurses had no choice but to continue using the system because they had intentions to remain employed with the organisation. Fear of losing one's job can be a major motivator for nurses, which helps explain why they are so committed to their profession and compliant with organisational demands (Naidoo et al., 2009). However, resilient nurses who strive within very demanding organisational situations and thrive in the face of ongoing challenges should make their own wellbeing a top priority to avoid the risk of burnout due to accumulated or prolonged stress. The organisation should also promote self-care practices to build nurses' strengths as individuals and collectively (Jackson et al., 2007).

One of the organisational factors that seemed to influence resilience in this study, based on my observations, was that the use of the EHR did not appear to impact the work–life balance of nurses. This is because the participating hospital did not permit remote access to the EHR for nurses. Thus no time is spent on the EHRs at home. This was evident in the survey item response (remote EHR use) where the majority reported, "No, I do not have remote access" (87.2%), and many reported that they did not spend time on the EHR at home. This study statistics also showed that there was a negative relationship between perceived burnout and time spent on the EHR at home. In the qualitative data, nurses confirmed that the hospital did not permit remote access to the EHR for them, and they completed their documentation at work. This outcome accords with our earlier observations, which showed that one of the significant problems among clinicians associated with burnout was the negative impact of time spent on the EHR at home or after hours on clinicians' work–life balance (Gardner et al., 2018, Harris et al., 2018b, Frintner et al., 2021, Peccoralo et al., 2021, Robertson et al., 2017). Although some clinicians used the EHR at home as an opportunity to achieve work–life balance or when they were unable to complete work during regular hours, researchers revealed that there was a negative consequence on their work–life balance, as stated earlier. This may suggest that the Saudi healthcare organisation had taken an effective strategy in maintaining work–life balance for nurses as well as other clinicians by preventing or restricting EHR access outside work, which was the case in the similar study of Almulhem et al. (2021). This observation may support the hypothesis of 'switching off' after work, which was seen to reduce nurses' work-related stress and burnout, increase their resilience and contribute to improved organisational outcomes (Manomenidis et al., 2016). Therefore, the results of this study suggest a nuanced approach towards clinicians' access to EHRs beyond their working hours to maintain their work–life balance and mental wellbeing. Potential strategies might include sufficient staffing to help with workload management, task

delegation, and additional support during peak times to avoid the need for out-of-hours EHR access. However, these strategies should be tailored to the specific needs and circumstances of each organisation.

The findings of my study highlighted the role of organisational resilience in the participating hospital, which emerged as a crucial factor in safeguarding against nursing burnout related to EHR use. Denyer (2017) characterised organisational resilience as the capacity of an organisation to anticipate, prepare, respond, and adapt to both gradual changes and sudden disruptions, with the ultimate aim of survival and prosperity. This necessitates a proactive culture of management and leadership that actively identifies and addresses potential risks and opportunities (Denyer, 2017). Findings from a systematic review underscore the multifaceted nature of organisational resilience, citing influences ranging from material resources, preparedness and planning, and information management, to the existence of alternate pathways and redundancy, governance processes, leadership practices, organisational culture, human capital, social networks, and collaboration (Barasa et al., 2018). Within the healthcare domain, this resilience extends to the system's ability to adapt to changes and challenges, maintain functionality during crises, and recover effectively from disruptions (Hollnagel et al., 2015).

The organisation in this study appeared to have created a culture of values, support, shared perceptions, skills and behaviours, and collaborative practices among nurses, which were reflected in their attitudes towards EHR use and its satisfactory impact on them. Those shared beliefs and values helped in the execution of operations relevant to organisational achievements, including the EHR. This positive culture guided employees in their routine and strategic roles and responsibilities recognising the organisational aspirational objectives (Martins and Terblanche, 2003). My finding supports the work of Vest et al. (2019) in this area, which showed that the adoption and effective use of EHR could be facilitated by the

organisational culture that fosters innovation and awareness education among its professionals. More importantly, when combined with rational managerial strategies and material tools, the organisation's culture could significantly impact behaviours and change (Martins and Terblanche, 2003). In this study, it appeared that the organisation's culture might have been influential in enhancing nurses' readiness and willingness to utilise the available tools and resources effectively. Other factors observed in the study that might have facilitated nurses' adoption of the EHR include strong clinical leadership and organisational support, clear communication and expectations, and a culture of collaboration and innovation. These organisational elements collectively seemed to play a substantial role in promoting nurses' adoption of the EHR and reducing its associated stress and burnout. Ensuring all these factors are in place can help create a positive and supportive environment in which nurses feel motivated to adopt and use the EHR to its full potential (Martins and Terblanche, 2003, Vest et al., 2019).

Consistent with the literature (Barasa et al., 2018, Keshavjee et al., 2006), my findings suggest that the organisation appeared to meet the crucial requirements for the EHR system implementation, which might have contributed to organisational resilience. Keshavjee et al. (2006) that an organisation's preparedness for EHR implementation necessitates proactive identification of core values, a clear vision for change, understanding of end-user needs, and being responsive to organisational stress resulting from change, all while addressing potential barriers and clear benefits to doctors, nurses, and other staff members. Indicators of this could include the customisation of the EHR to fit the needs of the local healthcare system in Saudi Arabia while meeting international standards (Ministry of National Guard Health Affairs, 2021). Furthermore, the participating hospital achieved the highest level (level 7) of digital maturity according to HIMSS (Tammy, 2019), making it the most digitalised hospital and a leader in healthcare services in the Middle East (Tammy, 2022, Yousef et al., 2020).

Consistent with HIMSS objectives (HIMSS, 2021), the findings of this study showed that nurses reported high adoption of the EHR, reduced errors in care, reduced duplicated orders, improved patient safety, and improved care delivery. In addition, based on the perspectives of the participants, the participating hospital established a culture of knowledge sharing, learning from disruptions, and international benchmarking. This seemed to contribute to the development of risk-mitigation strategies and disaster readiness, as observed through the hospital's EHR contingency plans, training and continuous learning initiatives, and EHR-related ongoing support available for nurses. Consistent with the literature, these measures aimed to ensure continuity of patient care and prepare nurses to respond to potential disruptions (Keshavjee et al., 2006), which seems to play a significant role in the successful adoption of the EHR and reduction of EHR-related stress (Keshavjee et al., 2006, Nguyen et al., 2021c). According to the study findings, there were various learning resources and support accessible to nurses educating them on EHR use and responding to their concerns. These were focused training during the orientation and preceptorship periods, unit CRN, unit superusers, ISD and nursing informatics, teamwork, and clinical leadership. The findings of a recent study align with these observations. The author found that physicians who agreed that their organisation did a great job with EHR implementation, training, and support were twice as likely to score lower on the burnout survey question than those who disagreed (Eschenroeder et al., 2021). Therefore, it appears that the organisation was perceived to have implemented the EHR system effectively, which may have contributed to fostering organisational resilience and potentially mitigating nurse burnout related to EHR use.

Consistent with the literature (Keshavjee et al., 2006), the integration of the EHR system into medical devices and information systems processes in the hospital was one of the implementation strategies that might have added value to the EHR and greatly contributed to its usability and acceptability among nurses in this study. The integration of the EHR system

was a key factor identified by the participants that could have facilitated the EHR adoption and reduced EHR-related stress and burnout. The participants reported that this integration allowed for real-time data updating of patient data, minimised manual data entry errors, and enabled early detection of mismatches in patient data, potentially preventing medical errors. There are similarities between the attitudes expressed by nurses in this study and those found in a systematic review on the influence of EHR-related factors on nurses' wellbeing in which the author found that EHRs with integrated displays were associated with improved wellbeing among nurses compared to those who work with non-integrated systems (Nguyen et al., 2021c). The perceived usefulness of the EHR in this study was greatly attributed to the integration of the system that helped with error prevention aided by the CLMA device that detected mismatch information, automated data transfer from different devices that reduced nurses' time spent on the EHR for manual input, and elimination of duplicate diagnostics aided by interoperability and 'paperless' system. Therefore, the study's participants regarded their EHR system as "comprehensive", and they perceived its benefits as it improved communication among clinicians and improved quality, care, and efficiency.

Nonetheless, the study findings partly align with those of Keshavjee et al. (2006), who found that standardisation and interoperability between systems, as well as the fit of processes between EHR systems or legacy systems, were two major issues with EHR integration. This limitation of the EHR system has been raised by nurses in this study because it could restrict the customisation process. This is because the EHR system in the participating hospital was interoperable with other healthcare facilities in five regions across the country. Thus, any modification request in one hospital required approvals from all other five regions. However, because managers and nursing informatics were considering nurses' feedback and working on some modification requests to improve the system, nurses seemed to appreciate and understand the process and did not regard this issue as bothersome.

Therefore, despite the complexity associated with the system modifications due to interoperability, this issue did not appear to greatly diminish the perceived benefits of the EHR. The supportive leadership also seemed to foster positive attitudes and resilience towards EHR use among nurses.

Although the perceived usability challenges of EHR use were notable stressors in this study, participants also reported positive aspects of the EHR system that seemed to support their resilience. This was observed in the nurses' reports of the perceived usefulness and variety of technical support, the integration of the EHR system, and consequently, the low levels of stress associated with EHR use. In alignment with this study's results, researchers have demonstrated that low EHR usability scores were significantly associated with an increased risk of burnout among physicians and nurses (Melnick et al., 2020a, Melnick et al., 2020b, Kutney-Lee et al., 2021, Melnick et al., 2021, Skeff et al., 2022), and effective HIT usability was associated with decreased levels of IT-related stress and techno-overload, which is the pressure from technology to work faster and longer than normal (Gaube et al., 2021). Several factors contributed to the EHR's acceptable usability among the nurse participants in this study. These included enough computing resources for nurses, a user-friendly and intuitive user interface, a customisable design, seamless integration with other systems and processes, and ongoing learning and support (Videha Sharma et al., 2021). Still, nurses in this study addressed the abovementioned usability issues that needed to be improved, which were discussed in Section 5.4. However, the findings of this study showed that these issues were compensated with improvement efforts to the system, such as regular maintenance or updates to the EHR system and risk-mitigating strategies (contingency planning). It is important to improve the EHR system design and infrastructure to optimise its usability and alleviate stressors associated with its use (Keshavjee et al., 2006). This study, therefore, adds to the knowledge of EHR usability and its impact on work-related wellbeing

by highlighting the nuanced interplay of various factors - sufficient computing resources, customisable design, system integration, contingency planning, and ongoing support, all within the backdrop of an organisational culture that fosters innovation and continuous learning - in the unique context of a specific healthcare setting.

5.6: Strengths and limitations

One strength of this study is the use of a mixed-methods approach, which allowed for a comprehensive understanding of the impact of the EHR on nursing burnout in hospitals and the contributing factors to this relationship. The explanatory sequential method, in which in-depth interviews were conducted after the survey was completed, allowed for the in-depth comprehension of nurses' lived experiences and perspectives while also compensating for the limitations inherent in the survey questionnaires, which lacked the richness and context that qualitative explanations from interviews could provide. The large sample size in the survey part of the study enhanced the statistical power and the generalisability of the results to a larger population. Additionally, semi-structured interviews provided flexibility and allowed for critical examination of the interactions between nurses and the EHR system. This approach also encouraged participants to share detailed experiences, perceptions, and strategies related to EHR use, leading to comprehensive insights about the factors that influenced their stress levels and resilience associated with EHR use. The employment of the sociotechnical framework to inform the study design, analysis and interpretation of the data is another quality of the study. This framework facilitated a comprehensive understanding of the interplay between nurses and EHR use within a hospital in Saudi Arabia. In addition, the development of a novel conceptual model based on the findings of this study is a notable strength. This model presents an integrated perspective of the stress-burnout dynamic in the EHR context, showcasing the multi-layered nature of the issue and the role of resilience as a protective factor against EHR-related burnout. This model serves as a significant addition to

the existing literature, offering a tool for future research in the field. Another notable strength of the study is its potential transferability to the global nursing workforce, as demonstrated by the adaptability of migrant nurses, who formed the majority of the sample, particularly in their acceptance of the EHR.

There are a few limitations to the present study. First, the research was conducted in a specific geographic location, the city of Riyadh in Saudi Arabia. Hence, the results may not apply to the entire nursing population locally and globally. Nevertheless, the sample size and the diversity of participants' characteristics in both types of studies appeared to encompass a broad range of viewpoints, which could likely reflect the experiences and attitudes present in similar contexts.

Second, this study was conducted in a single hospital in Saudi Arabia, which inherently restricts the conclusions that can be drawn from the research. Although the findings are valuable within the context of the participating hospital, they may not be generalisable to other hospitals or healthcare settings. This limitation makes it essential to exercise caution when interpreting the results and applying them to different contexts. To enhance the generalisability and robustness of the findings, future researchers should consider replicating this study across multiple hospitals and healthcare settings to gain a comprehensive understanding of the relationships between EHR use, nursing burnout, and resilience.

Third, the EHR system included in this investigation was advanced (HIMSS level 7). Hence, there might be different results for other less advanced EHRs or lower HIMSS levels. More importantly, the EHR investigated in this study was fully integrated with the medical devices wirelessly. This integration demonstrated the efficiency of the EHR system by streamlining workflow, updating patient data in real time, minimising manual data entry,

identifying mismatches in patient data early, and enhancing the accuracy of care, which reduced the documentation load and enhanced safer practice for nurses. Therefore, this level of integration between devices and the EHR system might have created a biased result compared to the literature. Thus, it is important to consider the level of EHR integration in further studies for comparable results. This could be assessed through specific criteria, such as the range of functionalities offered by the system. By considering this aspect, future studies could accurately compare and contrast the impact of different EHR systems on nursing burnout, and therefore generate a nuanced understanding. Still, while this digitally mature hospital setting does not reflect most hospitals in Saudi Arabia or other countries, it offers unique insights. This research uncovers how EHR functions at peak digital integration, highlighting challenges and efficiencies experienced. Although it is not directly equated to best practices, such insights can guide other institutions in navigating their EHR integration journey and understanding potential outcomes based on varying levels of digital maturity.

Fourth, the generalisability of the EHR outcome of the participating hospital is limited to the nursing population. In other words, it cannot be assumed that all clinicians at the given hospital will find the same level of usability and acceptability in the EHR that nurses experienced. This is due to the fact that nurses, doctors, pharmacists, and other disciplinary teams are all distinct types of EHR users with varying degrees of EHR documentation load and, as a result, possibly different perspectives on the EHR. In particular, the literature on this topic was more prominent among physicians, where EHR was viewed as a contributor to burnout (Chapter 2). Besides, my systematic review aligns with the existing literature in concluding that nurses experienced less EHR-related stress levels and tended to have more positive perceptions of the EHR compared to physicians (Lee et al., 1996, Weiner et al., 1999, Poissant et al., 2005, Ghahramani et al., 2009, Gardner et al., 2018, Harris et al., 2018b,

Almulhem et al., 2021). Therefore, this study needs to be replicated with other types of clinicians within the same hospital to compare and verify the results.

The fifth limitation is that the majority of the participants were from Asia and the Middle East, which means that nurses' adaptability and resilience could be influenced by ethnicity. In alignment with this assumption, researchers have demonstrated that ethnic backgrounds play a role in building resilience, especially cultural norms and values, individuals' upbringing, and life experiences (Clauss-Ehlers, 2008, Ungar, 2013, Castro and Murray, 2010, Fish et al., 2022). For example, nurses from the United States or Europe might have different perceptions or acceptance of the EHR. A study compared nurses' burnout in Australia and China and found that Chinese nurses presented lower burnout and higher resilience levels than Australian nurses (Fish et al., 2022). However, participants in this study were open in their criticism of other organisational factors (other than the EHR) that contributed to their burnout, as discussed above, which may have mitigated this risk of bias.

Sixth, with the progress of my study, I recognised that I included five items from the Mini-Z survey related to workplace factors contributing to clinicians' burnout but were not directly related to EHR use (e.g., teamwork and leadership), which were perhaps unnecessary for the specific examination of the direct impact of EHR use on nurses' burnout. Although these factors might be correlated with EHR use, their connection is indirect, and the survey does not explicitly illustrate how these workplace factors and EHR use are interconnected. These factors, such as the role of EHR-related leadership, policies, and support, became evident in the qualitative findings. Understanding the impact of various workplace factors on EHR use and burnout was captured through the qualitative exploration in this study, which provided deeper insights and context. Davies (2020) stated that including irrelevant or peripherally related questions in a survey may not impact the reliability of the data collected, but it can still be a problem because it stresses respondents and makes them less likely to

carefully consider and answer every question in a lengthy survey. Although my survey was not long, this is an important consideration for survey work because including only the most necessary and relevant questions may increase the response rate and data quality, reduce participant burden, and ensure a clear focus on the research objectives.

Finally, historically in Saudi Arabia, it has been observed that physicians used to rely on nurses for help with completing some paperwork, enabling them to concentrate more on the direct physical care of patients. However, the introduction of EHR has changed this dynamic, as it requires physicians to complete data entry and documentation on their own. Consequently, nurses could now focus solely on their own tasks. One aspect that could have been explored in the study is whether the implementation of EHR has altered the traditional reliance of physicians on nurses, potentially reducing the burden on nurses to some extent. This might contribute to the differences in EHR acceptance, stress, and burnout experienced by nurses compared to physicians. It is important to note that this specific point of interest emerged anecdotally in a post-data collection discussion at a conference and was not identified in the initial literature review conducted for this study. As such, it was not included in the interview questions. This aspect may provide an interesting direction for future research to comprehensively understand the different effects of EHR implementation on nurses and physicians.

5.7: Implications of the study

To the best of the researcher's knowledge, this study is one of the first studies that provided a rich understanding of EHR-related nurses' burnout in a hospital setting in Saudi Arabia using a carefully considered mixed-methods approach. According to the study findings, nurses had a high level of acceptability for the EHR despite the identified organisational and technological stressors associated with its use. The organisational culture in this study appeared to help foster a supportive environment that contributed to nurses'

resilience, protecting them from EHR-related burnout. Future directions for policy, practice, and research that may be informed by the findings of this study will be discussed in the following section.

5.7.1: Implications for policy

The findings of this study have several implications for policy development related to the implementation and use of EHRs in hospital settings. First, given the challenges with EHR use and useful strategies identified in this study, it is important to re-evaluate implementation strategies. Implementers should consider a user-centred approach to the system design, focusing on reducing the disruptions to workflow and the additional workload introduced by EHR use. Policymakers too should ensure that guidelines and strategic planning take these lived experiences into account, fostering an environment that promotes continuous learning, and encourages feedback from end-users to iteratively improve EHR systems. By adopting this collaborative and iterative approach, the longstanding issues related to EHR usability may be effectively addressed.

Second, the results suggest that organisational and technological stressors, such as EHR documentation policies and poor usability, can impact the effectiveness and acceptance of the EHR. In light of these findings, policymakers should prioritise initiatives that directly address these stressors. For instance, targeted investments and improvements could be made to address specific areas of EHR usability that clinicians find most challenging. This could be informed by regular feedback sessions with EHR users to understand their pain points and needs. Furthermore, the development of EHR documentation policies should consider the lived experiences of nurses, acknowledging the additional workload that EHR use can introduce. Policymakers could advocate for policies that allocate dedicated time for EHR-related tasks or promote realistic expectations of documentation workload in relation to other clinical duties. Addressing these challenges is a complex task, and it is unlikely there will be

a one-size-fits-all solution. Policymakers, hospital administrators, and EHR vendors should foster a culture of continuous learning and iterative improvement, adopting innovative strategies tailored to their specific contexts to overcome these hurdles.

In addition, the study highlights the role that organisational resilience plays in alleviating the negative consequences of stress and burnout associated with EHR use among nurses. Implementers should consider executing strategies to promote resilience among nurses, such as promoting work–life balance, fully integrating the EHR system into medical devices, providing opportunities for continuing education and professional development, and supporting nurses' physical and mental wellbeing. Furthermore, the findings of this study can provide insights specifically for Saudi Arabian healthcare policymakers. With the digital transformation of the healthcare sector in Saudi Arabia, it is essential for policymakers to take the findings of this study into account when formulating policies concerning the implementation and usability strategies of EHRs in hospital settings. For instance, given the expressed concerns regarding data privacy and unauthorised access to EHR, it is crucial to strengthen data protection with rigorous access control and regular audits. In addition to implementing security policies and procedures, staff training and education in security and privacy were proposed as an effective solution for security compliance in medical practice (Fernández-Alemán et al., 2013). Moreover, the quest for a harmonious balance between EHR standardisation and customisation ensuring it does not compromise interoperability, the evolving workflows and needs of diverse users underlines the complex dynamics of usability and efficiency. Cresswell and Sheikh (2013) identified crucial factors that should be considered for EHR implementation and adoption that may account for this issue. These include early and continuous user participation, relative benefits and initial demonstrable usefulness of the technology, a strong alignment with organisational priorities and processes, availability of training and support, along with effective leadership and change management

(Cresswell and Sheikh, 2013). Furthermore, there is a need for a comprehensive approach to exchanging knowledge and experiences to ensure preparedness for unexpected issues related to EHR use (Cresswell et al., 2013a). These are necessary to ensure that the benefits of EHRs are fully realised while simultaneously minimising any adverse effects on clinicians' burnout and the quality of care delivered.

5.7.2: Implications for practice

The findings of this study have several implications for nursing practice related to the use of the EHR in hospital settings. First, the study highlights the importance of addressing negative attitudes and stress related to EHR use among nurses, which stem from a variety of factors. For instance, a high EHR documentation workload placed nurses under competing pressures between meeting organisational requirements and providing patient care. Additionally, technological challenges and system usability issues contributed to nurses' stress and disturbances in their workflow. Nurses should proactively seek continuous learning and support to help them understand and use the EHR. They should also advocate for any necessary resources or modifications to the EHR system to enhance its effectiveness and usability. However, it is crucial to consider that extensive customisation can compromise system interoperability when advocating for the improvement of the EHR system. Therefore, any proposed modifications should aim to enhance its effectiveness and usability without sacrificing its ability to exchange information with other systems. In addition, nurses should prioritise self-care and seek support from their colleagues and management when experiencing EHR-related stress or burnout. Second, my results suggest that nurses can play a key role in promoting the successful implementation and use of the EHR in their workplace. Nurses should be involved in the decision-making process related to the EHR implementation and should actively participate in training and rollout efforts. They should also be proactive

in identifying and addressing any issues or challenges related to EHR use and seek opportunities to share best practices and lessons learnt with their colleagues.

The results of this study also emphasise the importance of resilience in mitigating the negative effects of EHR-related stress and burnout among nurses. It is important for organisations to implement strategies to promote a culture of resilience, as demonstrated in this study. This includes providing ongoing learning and support for EHR use, improving system usability, promoting work–life balance, and investing in the integration of the EHR system. In addition, organisations should emphasise the leadership's role in promoting a positive work environment, listening to nurses' feedback, and involving them in the EHR development processes. This aligns with the principles of digital clinical safety, which emphasise collaboration, openness, iterative change, proportionality, and inclusion, all crucial in tailoring health technologies like EHRs to meet the needs of patients, frontline staff, and the public (Flott et al., 2021). Nurses should also seek opportunities to build resilience through continuing education, professional development, surrounding support and self-care practices. They should also be supportive of their colleagues and seek out opportunities to foster a positive and supportive work environment. It is important for nurses to be proactive in addressing the challenges and opportunities related to EHR use with their managers and other stakeholders. Nurses should always prioritise their own wellbeing and resilience to provide the best possible care to their patients.

Finally, participants in this study identified areas for improvement in the EHR that have direct implications for the practice and serve as recommendations for this study. The organisation should create multifaceted strategies to improve nurses' experience with the EHR and eliminate stressors associated with organisational and technological factors identified in this study such as documentation requirements demands and EHR usability issues. These strategies, as recommended by the study's nurses, include direct feedback

channels for bedside nurses, simplified design of patients' assessment forms to improve EHR usability, improved wireless connection for faster data transfer between devices, improved privacy and confidentiality of patients' data, replacing malfunctioning EHR devices (laptops), customised documentation requirements that fit a unit need and a patient's need, and extra education resources for using the EHR such as specialised training and online user-manual.

Addressing these practical suggestions directly from the nurses' perspective may optimise EHR use, enhance nurses' satisfaction, and ultimately contribute to improved patient care and health outcomes. However, the potentially conflicting demands and needs of other stakeholders, such as administrators, physicians, and other health professionals, need to be considered when implementing these recommendations. Each of these recommendations needs to be evaluated for its potential impact on nurses' experiences and how it might affect other system users. Addressing these suggestions from the nurses' perspective and considering the broader healthcare team may optimise EHR use, enhance overall user satisfaction, and contribute to improved patient care and health outcomes.

5.7.3: Implications for research

The findings of this study have several implications for future research related to the use of the EHR in hospital settings. To enhance the generalisability and robustness of the findings, future research should consider validating this study across different hospitals and healthcare settings in Saudi Arabia, allowing for a comprehensive understanding of the relationships between EHR use, nursing burnout, and resilience. My results emphasise the significance of conducting a similar study with a different group of clinicians in the same hospital in Saudi Arabia, such as physicians, to compare the findings. This could help identify whether different roles in healthcare have varying perspectives and challenges regarding EHR use, thereby allowing for a nuanced understanding of EHR acceptability and

usability of different groups of clinicians. Additionally, given the considerable impact of billing requirements on healthcare in the United States, it would be informative to determine whether this factor contributes to EHR-related burnout among physicians in Saudi Arabia.

As a further step, it would be beneficial for upcoming research to employ a more focused measure of EHR-related burnout, in addition to the Mini-Z survey tool. One example of such a tool can be borrowed from Tajirian et al. (2020), where clinicians were asked to rate the contribution of EHR towards their burnout symptoms on a four-point scale. It is important to note that this specific measure was not available at the time of my study's data collection. This measure can provide a nuanced understanding of the extent to which EHR use is explicitly associated with burnout among clinicians or not. In addition, research should examine the effectiveness of interventions intended to mitigate EHR-related stress and burnout among nurses and other health professionals. Understanding what works best in easing stressors associated with EHR use can provide evidence-based strategies that healthcare institutions can adopt to enhance the wellbeing of their staff. However, the implementation of these strategies should align with the broader organisational goals and culture to ensure that these interventions enhance the wellbeing and productivity of the staff and contribute to the overall organisational objectives and enhance patient care outcomes.

Additional insight into the organisational and technological stressors impacting EHR use, as identified in this study, could lead to precisely tailored strategies for improving EHR implementation and acceptance among nurses. Future research should delve into the specific challenges that nurses encounter when using EHR, with the aim of formulating strategies to address these issues, thereby improving EHR effectiveness and acceptance in hospital settings. Research could also involve working closely with nurses during their interactions with the EHR, to identify real-time issues and devise potential solutions. My results also emphasise the role of resilience in mitigating the negative effects of EHR-related stress and

burnout among nurses. Future researchers should examine the factors that contribute to resilience among nurses as well as the impact of interventions intended to promote resilience against EHR-related burnout. For instance, the findings pointed to the benefits of a comprehensive and integrated EHR system in fostering resilience among nurses. The perceived usefulness and usability of the EHR, coupled with effective organisational support and resources, contributed to the overall resilience of the nursing staff in dealing with EHR-induced stress. By examining the effectiveness of resilience-promoting interventions, we can improve our understanding of how to mitigate EHR-related burnout, improve job satisfaction among nurses, and ultimately, enhance patient care.

Generally, it is important for future research to continue to explore the challenges and opportunities related to EHR use in hospital settings to inform the development of policies and practices that support the successful implementation and use of EHRs and improve the productivity and wellbeing of clinicians. Finally, the cultural setting of Saudi Arabia might be influential in shaping clinicians' perceptions and reactions to EHR use. Factors like interpersonal dynamics, ways of communication, power hierarchies at work, and societal views on technology and change could potentially impact how healthcare professionals adjust to the EHR. Therefore, there is a need for in-depth exploration to understand the influence of these unique cultural and organisational factors in Saudi Arabia on EHR adoption and resilience.

5.7.4 Implications for nurse education

The implications for nurse education drawn from the challenges identified in my study as well as from the literature emphasise the imperative need to reform nursing education to cater to the digital era. While a majority of participants in my study reported proficiency in EHR use, the challenges faced by the minority contributing to their stress and potential burnout highlight an educational urgency. There is a need to introduce educational

programs at both undergraduate and graduate levels that encompass subjects like informatics, digital health, co-design, and data science (Booth et al., 2021). This should include collaboration with professionals from computing and engineering disciplines. Ensuring that all nursing professionals are competent and comfortable with health technologies is vital for mitigating stress and frustration associated with their use, which is increasingly becoming an integral part of healthcare delivery. It is crucial for nursing education to proactively update its competencies and curricula, given the escalating integration of health technologies in every practice facet (Booth et al., 2021).

The findings of my study highlighted the pivotal role of resilience in mitigating nurses' stress related to EHR use and the potential for burnout. Manomenidis et al. (2019) discussed the value of continuous educational endeavours in mitigating burnout and bolstering resilience among nurses. They recommended that nurse managers are encouraged to introduce ongoing educational initiatives designed to boost nurses' self-efficacy, self-esteem, and a positive work disposition. Moreover, offering economic incentives for continuous education can serve a dual purpose: enticing participation in these programs and reinforcing nurses' resilience through enriched knowledge (Manomenidis et al., 2019). Building on this, the importance of supportive interpersonal relationships and a positive organisational culture, as evidenced in my study's findings, aligns with Hart et al. (2014), who advocated for education that enables nurses to seek administrative support and apply academic knowledge to clinical practice through critical reflection. Work-based educational programs like those described by McDonald et al. (2012) could directly foster the kind of individual resilience my study indicated is necessary, concentrating on mentoring, hardiness, emotional intelligence, and reflective participatory learning. These programs should incorporate elements that reinforce the supportive environments needed for effective EHR

use and health technologies, such as teamwork, peer support, and open communication, which my study identified as vital for resilience and stress management among nurses.

5.8: Conclusions

The overall study aim was to examine the association between nursing burnout and EHR use and to explore the contributing factors to nursing burnout related to EHR use in a hospital setting in Saudi Arabia.

This study contributes to the growing body of knowledge surrounding EHR use, nursing burnout, and resilience by providing insights into how these elements interact in a Saudi Arabian healthcare context. Specifically, it offers detailed insights from a new geographical context, Saudi Arabia, using a mixed-methods approach, which has not been frequently utilised in existing studies in this area. This study provides crucial insights into two primary areas: firstly, the specific organisational and technological stressors associated with EHR use among nurses, and secondly, the significant role of resilience in mitigating the negative impacts of these stressors.

Firstly, the results of this study identified specific organisational and technological stressors associated with EHR use among nurses in the hospital. These stressors include a high workload due to EHR documentation requirements leading to a conflict between organisational demands and the provision of direct patient care and technological difficulties such as usability issues that caused disruptions to workflow, and concerns about data privacy by unauthorised access. The findings added depth to the existing literature by revealing that, although these EHR-related stressors contributed to nurses' stress, they did not appear to reach the point of burnout in this context. This observation may seem to contrast with prevalent literature, where EHR-related stress is often associated with burnout. This suggests that the relationship between EHR use and nursing burnout is nuanced and context-dependent, highlighting the importance of context-specific factors in shaping this

relationship. This might refer to a range of elements such as organisational culture, support systems in place, individual resilience, workflow design, and training, along with factors specific to the Saudi Arabian cultural context not explored in the study that may influence attitudes towards the adoption of technology and change.

Secondly, I identified the significant role of resilience in mitigating the adverse effects of EHR-related stress and potential burnout among nurses. It demonstrates that resilience is an individual capacity and can be fostered at the organisational level. The study underscores the importance of supportive interpersonal relationships and organisational culture in fostering resilience among nurses, thus mitigating technology-induced stressors in healthcare settings. This finding could inform the development of organisational policies and practices intended to create a supportive work environment for EHR users. For example, organisations could facilitate teamwork and peer support, provide adequate training and resources for EHR use, promote work–life balance, and create a culture that values open communication and feedback. This supportive environment could potentially enhance resilience among nurses and help them manage the challenges and stressors associated with EHR use, thereby reducing the risk of burnout. Prior studies have primarily focused on individual or organisational strategies for reducing EHR-related stress, with limited attention given to resilience. The study contributions extend the understanding of EHR-related stress and burnout, emphasise the essential role of resilience, and offer practical suggestions for improving EHR implementation and usability in similar contexts. This lays a robust foundation for policy, practice, and future research outlined in the study implications. By examining the experiences within a diverse nursing workforce, it is essential to emphasise the relevance of this study's findings to both non-Western and Western contexts. This highlights its potential applicability across the global nursing workforce. The new conceptual model, as a distinct contribution to knowledge, holds significant potential as a practical tool for

understanding the interplay between EHR use and nursing burnout. This new perspective underscores the importance of resilience at individual and organisational levels in countering EHR-related burnout among nurses. The model offers possibilities for future refinement and wider application, both in local and global healthcare contexts.

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APPENDICES

Appendix 1: Ovid Databases (Embase, Psychinfo, Ovid Medline)

Ovid Research Databases Embase, PsycINFO, Ovid MEDLINE		
#	Search terms	Results
1	(Nurs* or physician* or doctor* or clinician* or "health practitioner*" or "clinicians*" or "healthcare provider*" or "health care provider*" or "health personnel*" or "allied health" or pharmacist* or "occupational therapist*" or physiotherapist* or midwi*).mp.	3,805,649
2	(Electronic document* or "electronic nursing record" or "nursing information system" or "electronic medical record" or "EMR" or "electronic health record" or EHR or "health information technology" or "HIT" or "patient care information system" or "PCIS" or "computeri?ed Provider Order Entry" or "CPOE" or "Clinical decision support system" or "CDSS" or "Decision support system" or "Electronic prescribing" or "e-Prescribing" or "ePrescribing" or "eHealth" or "e-Health" or "digital health").mp.	223,101
3	(Burnout or "burn-out" or "burn* out" or stress* or exhaust* or burden* or frustrat* or distress* or cynic* or depersonali?ation).mp.	3,719,299
4	1 and 2 and 3	4,422
5	(Conference or note or letter or review or editorial).pt.	12,946,760
6	4 not 5	2,521
7	limit 6 to English language	2,456
8	limit 7 to yr="2000 -Current"	2,390
9	remove duplicates from 8	1,624

*(.mp)= Multi-purpose of the keyword search, which includes Title, Original Title, Abstract, and Subject Heading.
*(.pt.) = Publication type.

Appendix 2: CINAHL Database

EBSCOhost Research Databases Database - CINAHL Plus			
#	Query	Limiters/Expanders	Results
S1	Nurs* or physician* or doctor* or clinician* or "health practitioner*" or "clinicians*" or "healthcare provider*" or "health care provider*" or "health personnel*" or "allied health" or pharmacist* or "occupational therapist*" or physiotherapist* or midwi*	Search modes - Find all my search terms	1,236,481
S2	Electronic document* or "electronic nursing record" or "nursing information system" or "electronic medical record" or "EMR" or "electronic health record" or EHR or "health information technology" or "HIT" or "patient care information system" or "PCIS" or "computeri?ed Provider Order Entry" or "CPOE" or "Clinical decision support system" or "CDSS" or "Decision support system" or "Electronic prescribing" or "e-Prescribing" or "ePrescribing" or "eHealth" or "e-Health" or "digital health"	Search modes - Find all my search terms	33,427
S3	Burnout or "burn-out" or "burn* out" or stress* or exhaust* or burden* or frustrat* or distress* or cynic* or depersonali?ation	Search modes - Find all my search terms	329,498
S4	S1 AND S2 AND S3	Search modes - Find all my search terms	679
S5	S1 AND S2 AND S3	Limiters - Publication Year: 2000-2023; English Language Search modes - Find all my search terms	655
	– 133 Duplicates removed manually and by Endnote when combined with Ovid results		522

Appendix 3: MMAT for Mixed Methods

Category of study designs	**Methodological quality criteria Responses**	**Author and Date**		
		Califf, 2015	Hennington, 2008	Mazur et al., 2023
Screening questions (for all types)	S1. Are there clear research questions?	Yes	Yes	Yes
	S2. Do the collected data allow to address the research questions?	Yes	Yes	Can't tell
Qualitative	1.1. Is the qualitative approach appropriate to answer the research question?	Yes	Yes	Yes
	1.2. Are the qualitative data collection methods adequate to address the research question?	Yes	Yes	Yes
	1.3. Are the findings adequately derived from the data?	Yes	Yes	Yes
	1.4. Is the interpretation of results sufficiently substantiated by data?	Yes	Yes	Yes
	1.5. Is there coherence between qualitative data sources, collection, analysis and interpretation	Can't tell	Yes	Can't tell
Quantitative descriptive	4.1. Is the sampling strategy relevant to address the research question?	Yes	Yes	Yes
	4.2. Is the sample representative of the target population?	Yes	No	Yes
	4.3. Are the measurements appropriate?	Can't tell	Can't tell	Yes
	4.4. Is the risk of nonresponse bias low?	Yes	No	Yes
	4.5. Is the statistical analysis appropriate to answer the research question?	Yes	Yes	Can't tell
Mixed methods	1. Is there an adequate rationale for using a mixed methods design to address the research question?	Yes	Yes	Yes
	2. Are the different components of the study effectively integrated to answer the research question?	Yes	Yes	Yes
	3. Are the outputs of the integration of qualitative and quantitative components adequately interpreted?	Can't tell	Can't tell	Can't tell
	4. Are divergences and inconsistencies between quantitative and qualitative results adequately addressed?	Can't tell	Can't tell	Can't tell
	5. Do the different components of the study adhere to the quality criteria of each tradition of the methods involved?	Yes	Yes	Yes
Total score		13/17	12/17	12/17

Appendix 4: CASP for Qualitative studies

Author and Date	Q1 – Was there a clear statement of the research aim?	Q2 – Is a qualitative methodology appropriate?	Q3 – Was the research design appropriate to address the aims of the research?	Q4 – Was the recruitment strategy appropriate to the aims of the research?	Q5 – Was the data collected in a way that addressed the research issue?	Q6 – Has the relationship between researcher and participants been adequately considered?	Q7 – Have ethical issues been taken into consideration?	Q8 – Was the data analysis sufficiently rigorous?	Q9 – Is there a clear statement of findings?	Q10 – Will the results help locally?	**Total score**
Skeff et al, 2022	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Can't tell	8/10

Appendix 5: CASP for Survey Designs

Author and Date	Q1 – clearly focused issue	Q2 – recruitment was acceptable	Q3 – the exposure was accurately measured	Q4 – the outcome was accurately measured	Q5 – confounding factors have been accounted for	Q6 – follow up of the subjects	Q7 – the results of the study were appropriate	Q8 – the results of the study were precise	Q9 – Do you believe the results?	Q10 – Can results be applied to the local population?	Q11 – the study results fit with other available evidence	Q12 – significance implications for practice	**Total score**
AlQahtani et al, 2020	Yes	UC	No	No	Yes	NA	No	UC	No	Yes	No	Yes	4/12

Author and Date	Q1 – clearly focused issue	Q2 – recruitment was acceptable	Q3 – the exposure was accurately measured	Q4 – the outcome was accurately measured	Q5 – confounding factors have been accounted for	Q6 – follow up of the subjects	Q7 – the results of the study were appropriate	Q8 – the results of the study were precise	Q9 – Do you believe the results?	Q10 – Can results be applied to the local population?	Q11 – the study results fit with other available evidence	Q12 – significance implications for practice	**Total score**
Almulhem et al., 2021	Yes	Yes	Yes	Yes	Yes	NA	UC	Yes	Yes	Yes	Yes	Yes	10/12
Anderson et al., 2022	Yes	Yes	Yes	Yes	UC	NA	Yes	UC	Yes	Yes	Yes	Yes	9/12
Chen et al., 2021	Yes	Yes	Yes	Yes	No	NA	UC	UC	UC	Yes	Yes	Yes	7/12
Elliot et al, 2022	Yes	Yes	Yes	Yes	No	NA	Yes	Yes	Yes	Yes	Yes	Yes	10/12
Eschenroeder et al., 2021	Yes	Yes	Yes	Yes	Yes	NA	Yes	Yes	Yes	Yes	Yes	Yes	11/12
Gardner et al, 2019	Yes	No	UC	Yes	Yes	NA	Yes	Yes	Yes	Yes	Yes	Yes	9/12
Gesner et al., 2022	Yes	Yes	Yes	Yes	UC	NA	Yes	Yes	Yes	Yes	Yes	Yes	10/12
Ghahramani et al, 2009	Yes	Yes	UC	Yes	Yes	NA	No	UC	UC	Yes	Yes	Yes	7/12
Harris et al,	Yes	No	UC	Yes	Yes	NA	Yes	Yes	Yes	Yes	Yes	Yes	9/12

Author and Date	Q1 – clearly focused issue	Q2 – recruitment was acceptable	Q3 – the exposure was accurately measured	Q4 – the outcome was accurately measured	Q5 – confounding factors have been accounted for	Q6 – follow up of the subjects	Q7 – the results of the study were appropriate	Q8 – the results of the study were precise	Q9 – Do you believe the results?	Q10 – Can results be applied to the local population?	Q11 – the study results fit with other available evidence	Q12 – significance implications for practice	**Total score**
2018													
Hauer et al, 2018	Yes	UC	UC	UC	Yes	NA	UC	UC	UC	Yes	Yes	Yes	5/12
Heponiemi et al, 2017	Yes	Yes	Yes	UC	Yes	Yes	Yes	UC	Yes	Yes	Yes	Yes	10/12
Jackson, 2020	Yes	No	UC	UC	Yes	NA	Yes	UC	Yes	Yes	Yes	Yes	7/12
Kaihlanen et al., 2021	Yes	Yes	Yes	Yes	Yes	NA	Yes	Yes	Yes	Yes	UC	Yes	10/12
Kutney-Lee et al, 2021	Yes	Yes	Yes	Yes	Yes	NA	Yes	UC	Yes	Yes	Yes	Yes	10/12
Marckini et al, 2019	Yes	Yes	UC	UC	Yes	NA	UC	UC	UC	No	Yes	Yes	5/12
Melnick, Dyrbye et al, 2020	Yes	Yes	Yes	Yes	Yes	Yes	Yes	UC	Yes	Yes	Yes	Yes	11/12
Melnick, Harry, et al, 2020	Yes	Yes	Yes	Yes	Yes	NA	Yes	UC	Yes	Yes	Yes	Yes	10/12

Author and Date	Q1 – clearly focused issue	Q2 – recruitment was acceptable	Q3 – the exposure was accurately measured	Q4 – the outcome was accurately measured	Q5 – confounding factors have been accounted for	Q6 – follow up of the subjects	Q7 – the results of the study were appropriate	Q8 – the results of the study were precise	Q9 – Do you believe the results?	Q10 – Can results be applied to the local population?	Q11 – the study results fit with other available evidence	Q12 – significance implications for practice	**Total score**
Melnick, West, et al, 2021	Yes	Yes	Yes	Yes	Yes	Yes	Yes	UC	Yes	Yes	Yes	Yes	11/12
Olson et al, 2018	Yes	Yes	UC	Yes	Yes	NA	Yes	Yes	Yes	Yes	Yes	Yes	10/12
Peccoralo et al., 2021	Yes	Yes	Yes	Yes	Yes	NA	Yes	Yes	Yes	Yes	UC	Yes	10/12
Shanafelt et al, 2016	Yes	Yes	Yes	Yes	Yes	NA	Yes	Yes	Yes	Yes	Yes	Yes	11/12
Tajirian et al, 2020	Yes	Yes	Yes	Yes	Yes	NA	Yes	Yes	Yes	Yes	Yes	Yes	11/12
Tawfik et al, 2017	Yes	Yes	Yes	Yes	Yes	NA	Yes	Yes	Yes	Yes	Yes	Yes	11/12
Vehko et al, 2019	Yes	Yes	UC	Yes	Yes	NA	UC	UC	Yes	Yes	Yes	Yes	8/12

*UC: unclear, *NA: not applicable.

Appendix 6: Study characteristics

No	Author, Year, Country	Research Aims, Theory, Setting & Quality	Methods	Population	Practice setting	Limitation	Findings
1	AlQahtani et al, 2020, Saudi Arabia STRESS STUDY –	Aims: Perceived prevalence of EHR-related stress among nurses and evaluated the determinants of this stress; Setting: Eye Specialist Hospital in Saudi Arabia; Theory: none reported; Quality: Weak.	Ethics: ethical approval granted; Design: cross-sectional survey; Data collection: validated questionnaire from Kroth et al. (2019); Analysis: regression analysis: Kruskal–Wallis test and Mann–Whitney U test.	Nurses (n=212, response rate 84.8%), mostly females from international countries, who were not trained in the EHR.	Inpatient (recovery room and operation theatre).	The validated instrument the authors used is not the same instrument that has been used by Kroth et al. (2019).	Half of the nurses working at the hospital perceived stress related to the EHR, with some grading it as severe. Senior nurses and those in the emergency department reported significantly higher EHR related stress. Stress mainly due to incomplete data entry by other colleagues, difficulty searching records, and inability to change data at a later date.
2	Almulhem et al, 2021, Saudi Arabia STRESS & BURNOUT STUDY –	Aim: to assess stress and burnout related to the use of EHRs and other HIT tools among HCPs during COVID-19 in Saudi Arabia; Setting: not specified; Theory: none reported; Quality: High	Ethics: ethical approval obtained; Design: cross-sectional survey; Data collection: self-developed survey comprising of 35 items. Mini-Z and HIT-related stress; Analysis: Univariate, bivariate, and multivariate analyses were performed to measure the association between burnout and EHR variables.	182 participants Physicians 63% Nurse 24% Pharmacist 5% Others 8%	Governmental and private healthcare organisations: Primary (19%) Secondary (25%) Tertiary (56%)	Relied on only one distribution method, SCFHS's email database, responses to survey were low, distributing the survey was at the peak of the pandemic in Saudi Arabia with a long data collection period, which may also be related to inadequate responses among HCPs	50.5% of participants reported a presence of HIT-related stress, and 40.1% reported a presence of burnout. The variables independently associated with burnout were providing tertiary level of care, working with COVID-19 suspected cases, dissatisfaction with EHRs, and agreement with the statement that using EHRs added frustration to the workday.
3	Anderson et al, 2022, USA BURNOUT STUDY –	Aim: to examine the prevalence of burnout and identified the contributing factors in gastroenterologists and fellows in training; Setting: not specified;	Ethics: ethical approval obtained; Design: cross-sectional survey; Data collection: three surveys for three groups of GI physicians; Analysis: Univariable analysis; Kruskal-Wallis tests were used for continuous factors and Pearson $\chi 2$ tests were used for categorical variables.	1,021 participants responded (9.2% response rate) to the first survey, including 756 individuals who completed the MBI survey.	GI physicians in rural, urban, suburban settings in the United States.	The first survey was conducted in 2015 before the COVID-19 pandemic. Hence, the findings represent pre-COVID burnout rates, which may underestimate the	High burnout rate of 49.3%. Factors associated with high burnout were female sex, younger age, shorter duration in practice, considering the EHR non–user-friendly, and increased clinical workload both at work and at home. The

No	Author, Year, Country	Research Aims, Theory, Setting & Quality	Methods	Population	Practice setting	Limitation	Findings
		Theory: none reported; Quality: Moderate		GI physicians and fellows.		current prevalence of burnout.	level of burnout for fellows was observed to be high (42.7% in survey 2 and 35.3% in survey 3).
4	Callif et al, 2020, USA STRESS STUDY –	Aims: test the effects of challenge or hindrance techno-stressors in healthcare; Setting: four hospitals in the U.S.; Theory: Holistic Stress Model; Quality: Moderate.	Ethics: approved by the Research Committee; Design: mixed-methods design; Data collection: interviews with nurses about how they interact with HIT at work, followed by refining the Holistic Stress Model for techno-stressors and testing this new model using online survey data (several existing scales were adapted) from hospital nurses; Analysis: qualitative data analysis, followed by confirmatory factor analysis, common methods bias, and structural equation modelling.	Interviews: 32 practicing nurses and nurse managers from the US. Surveys: 402 nurses from the US, then 120 nurses from India and 67 nurses from Germany.	Inpatient (acute care).	There was no clear summary of the main findings of the interviews.	The study found a number of factors prevented technostress including the usefulness of HIT, technical support, and managerial involvement. However, several aspects emerged that contributed to technostress such as the unreliability of HIT, its complexity within a busy and complex environment, changes to HIT (hardware, software and networks), which impacted job satisfaction and turnover intention.
5	Chen et al, 2021, China STRESS STUDY –	Aim: to extend the existing body of knowledge on HIT by assessing the effects of basic (data-related) and advanced (clinical) HIT features on physician empowerment, stress, and ultimately, job satisfaction; Setting: Chinese hospitals; Theory: none reported; Quality: Moderate	Ethics: ethical approval obtained; Design: cross-sectional survey; Data Collection: questionnaire was administered to measure basic and advanced technologies and physicians' outcomes; Analysis: used partial least squares a component-based structural equation modelling technique.	367 physicians completed the survey	Hospitals in China are organised in a 3-tier system (primary, secondary, and tertiary care).	The study did not measure the confounding factors (demographic and organisational) in relation to the study outcomes.	Physicians who used advanced features experienced improvement in all dimensions of physician empowerment and significant reduction in stress. Physicians who used basic technology, however, experienced improvement in fewer dimensions of physician empowerment and no significant change in stress. Except for efficacy, all dimensions of physician empowerment and stress predicted job satisfaction.

No	Author, Year, Country	Research Aims, Theory, Setting & Quality	Methods	Population	Practice setting	Limitation	Findings
6	Elliot et al, 2022 USA STRESS STUDY –	Aim: to assess direct and indirect associations between problems with electronic health records (EHRs) and physician distress via problems encountered during the day-to-day practice of medicine and access to social support; Setting: not specified; Theory: none reported; Quality: High	Ethics: ethical approval obtained; Design: cross-sectional survey; Data Collection: 10-item version of the CES-D depression scale, and series of questions about EHR-related problems; Analysis: regression analysis.	190 physicians (18%) completed the survey.	Physicians across the state of Nevada, who were affiliated with the University of Nevada School of Medicine.	EHR problems were measured as one construct (not segregated). Also, other factors (e.g., demographic or type of work setting) were not measured.	Frequency of EHR problems was positively associated with problems with the day-to-day practice of medicine, and negatively associated with access to social support. Mediation analyses suggest that EHR problems indirectly affect physician distress via problems encountered during the practice of medicine and social support.
7	Eschenroeder et al, 2021 USA BURNOUT STUDY –	Aim: to know more about how modifiable dimensions of EHR use relate to burnout and how these associations vary by medical specialty; Setting: not specified; Theory: none reported; Quality: High	Ethics: ethical approval obtained; Design: cross-sectional survey; Data collection: KLAS Arch Collaborative survey to measure the EHR end-user experience, and a single-item from Mini-Z for burnout. Analysis: ordinal logistic regression.	Physicians from all 50 states	Different healthcare organisations.	The response rate for some of the participating organisations is not known, which precludes reporting the overall response rate. Inability to control for sociodemographic variables such as sex, race, and age because they were not included in data collection.	Physicians reporting 5 hours weekly of after-hours charting were twice as likely to report lower burnout scores compared to those charting 6 hours. Physicians who agree that their organisation has done a great job with EHR implementation, training, and support were also twice as likely to report lower scores on the burnout survey question compared to those who disagree
8	Gardner et al, 2019, USA BURNOUT STUDY –	Aims: 1) determine the prevalence of burnout symptoms and HIT-related stress and 2) quantify the association of HIT-related stress with burnout among physicians; Setting: general healthcare in Rhode Island; Theory:	Ethics: deemed exempt by ethics board; Design: cross-sectional; Data collection: online survey in 2017 of all physicians in one U.S. state; Burnout measured using a single item from the Mini-Z a 10-item instrument developed from the Physician Work Life Study; Analysis: Univariable statistics, bivariable chi-square tests,	Licensed physicians (n=1792, response rate 42.7%) in Rhode Island.	Mixed settings Inpatient: 32.3% Outpatient: 67.6%	Responses were not anonymous. Also, authors measured the association between EHR vendors and burnout and found no association, but they didn't provide any statistical data related	Among those who used the EHR (91%), 70% reported HIT-related stress. The highest prevalence was in primary care specialties. Factors contributing to burnout included: 1) poor/marginal time for documentation, 2) excessive time on EHRs at home, and 3)

No	Author, Year, Country	Research Aims, Theory, Setting & Quality	Methods	Population	Practice setting	Limitation	Findings
		none reported; Quality: High.	multivariable logistic regression, ordered logit model with sensitivity analysis.			to vendors in the study.	those who agreed that EHRs add to their daily frustration.
9	Gesner et al, 2022, USA BURNOUT STUDY –	Aim: to understand the relationship between documentation burden and clinician burnout syndrome in nurses working in direct patient care; Setting: not specified; Theory: Roy's adoption model; Quality: High	Ethics: IRB approval obtained Design: cross sectional survey; Data collection: 22-item MBI, and SUS survey tools; Analysis: A Pearson correlation test to test the association between two variables.	69 nurses included. Registered nurses who work in a direct patient care role and document in the EHR with at least1year of experience were included.	Different settings, and the majority was inpatient settings.	Low number of the study participants. The demographic factors were not correlated with burnout.	Documentation burden has a weak to moderate correlation to clinician burnout syndrome. Furthermore, poor usability of the EHR is also associated with documentation burden and clinician burnout syndrome.
10	Ghahramani et al, 2009, USA STRESS STUDY –	Aims: evaluate perception of attending physicians, house staff, nurses, and senior medical students regarding efficiency and ease of CPOE, stress in work place, system training, and user satisfaction; Setting: Milton S. Hershey Medical Center; Theory: none reported; Quality: Moderate.	Ethics: ethical approval granted; Design: not reported; Data collection: online survey with 110 questions on CPOE use, Perceived Stress Scale (Cohen et al., 1983), job performance and satisfaction including a Generic User Interface Question (Sittig et al., 1999); Analysis: Total scores, Cronbach's Alpha, One-Way ANOVA with Tukey's Studentized test, t-tests, Pearson's correlation Coefficient performed via SPSS.	862 regular users of the CPOE system - 209 nurses, 178 attending physicians, 78 fellows, 179 upper-level residents, 83 interns, and 135 medical students.	Hospital/inpatient	The survey was long (110 Qs), which might have affected the quality of the responses.	413 respondents (47.9 % response rate). Those younger in age were more familiar with the CPOE system, used it more often, and were more satisfied with it. Interns and residents were the most satisfied groups with the CPOE, while attending physicians expressed the least satisfaction. Attending physicians and fellows found the CPOE least user friendly compared with other groups, and also tended to express more stress and frustration with it.
11	Harris et al, 2018, USA BURNOUT STUDY –	Aims: estimate the association between EHR-related stress and burnout among APRNs and describe their perceptions about HIT; Setting: Healthcare in Rhode	Ethics: deemed exempt by ethics review board; Design: cross-sectional; Data collection: electronic survey on HIT use, Burnout measured using single Mini-Z item a 10-item instrument developed from the Physician Work Life Study;	Advanced practice registered nurses (APRNs) in one U.S. state, n=371 (response rate 31%).	Mixed setting Inpatient: 67.6% Outpatient: 32.4%	Survey was not anonymous, which might have contributed to underreporting of the prevalence of burnout among respondents.	73 APRNs reported at least one symptom of burnout. Of these, 34 (46.6%) were Family/Individual APRNs and 16 (21.9%) were Adult/Gerontology APRNs.

No	Author, Year, Country	Research Aims, Theory, Setting & Quality	Methods	Population	Practice setting	Limitation	Findings
		Island; Theory: none reported; Quality: High.	Analysis: Bivariable chi-square and Fisher's exact tests, logistic regression and multivariable logistic regression via SPSS.				Those who use EHRs, 64 (19.3%) reported spending a moderately high to excessive amount of time on their EHR at home, 165 (50.1%) agreed or strongly agreed EHRs add to their daily frustration, and 97 (32.8%) reported insufficient time for documentation.
12	Hauer et al, 2018, USA BURNOUT STUDY –	Aims: assess current levels of physician satisfaction and burnout; Setting: multiple medical specialities; Theory: none reported; Quality: Weak.	Ethics: not reported; Design: cross-sectional; Data collection: online survey using the full Mini-Z questionnaire (48 questions), administered to American Medical Association (AMA) members in one U.S. state; Analysis: not reported.	1,165 physicians across multiple specialities (8.86% response rate).	Mixed settings Not specified	Methods were not explained in detail. Statistical analysis was not reported. Ethical approval was not reported. References provided for the survey links can't be accessed.	One of the three categories of physician burnout was EHR / documentation time. 65% of clinicians agreed or strongly agreed that using an EHR adds frustration to their day. 42% who spent 0-2 hours working at home on the EHR report being frustrated with it, which is almost half the frustration level reported by physicians who spend >8 hours on the EHR outside of work.
13	Hennington, 2008, USA BURNOUT STUDY –	Aims: develop an understanding of nurses lived experiences using an electronic medical record (EMR); Setting: large urban hospital; Theory: Unified Theory of Acceptance and Use of Technology (UTAUT); Quality: Moderate	Ethics: institutional review board approval; Design: mixed methods; Data collection: interviews with nurses (questions based on UTAUT) and direct non-participant observation of nurses using EMRs followed by an electronic survey (burnout measured using Maslach's Burnout Inventory), followed by a qualitative case study; Analysis: inductive and deductive analysis followed by partial least squares for structural equation modelling.	23 nurses and 4 nurse managers were interviewed, 65 nurses completed the survey.	Hospital/inpatient	Small sample size in the survey (n-65). No descriptive tables or graphs of the survey. The interpretation of the survey results was not clear.	Some predictors of EMR usage included performance expectancy, effort expectancy, social influences, facilitating conditions and caseloads. Outcome usage included role conflict and role overload.

No	Author, Year, Country	Research Aims, Theory, Setting & Quality	Methods	Population	Practice setting	Limitation	Findings
14	Heponiemi et al, 2017, Finland STRESS STUDY –	Aims: examine the 9-year longitudinal development of stress levels related to information systems (SRIS) among Finnish physicians; Setting: not specified; Theory: none reported; Quality: High	Ethics: ethical approval obtained; Design: longitudinal survey in 2006, 2010 and 2015; Data collection: wave 1, 2 and 3 used a mix of web-based and postal questionnaires; Analysis: GLM repeated measures analysis.	2841 physicians responded in wave 1, 1705 responded in wave 2, 1462 physicians responded in wave 3.	Mixed Inpatient: 32% Outpatient: 15% Private sectors: 9.5% Others: NR		SRIS increased during the study period. The increase was most pronounced in primary care, whereas in hospitals SRIS did not increase between 2010 and 2015. SRIS increased more among those in a leadership position. On-call duties and high time-pressures were associated with higher SRIS levels during all waves.
15	Jackson, 2020, USA STRESS STUDY –	Aims: determine the prevalence of technostress in among hospital nurses and examine the relationship between technostress and nurses personality traits; Setting: 14 hospitals under one system in Florida; Theory: Transactional Model of Stress and Coping; Quality: Moderate	Ethics: ethical approval granted; Design: non-experimental; Data collection: a convenience sample of surveys from nursing working with EHR on a daily basis.; Analysis: bivariate and multivariate regression analysis.	Hospital nurses n=157 (2.7% response rate)	Inpatient (acute and critical care units).	Small sample size n=157 of 5,788 from 14 hospitals.	Nurses experience technostress at a very high level within the hospital setting. The highest rate of technostress was within job insecurity 31%, followed by techno-invasion 22.9%, techno-complexity 13.4%, techno-uncertainty 3.2%, and techno-overload 1.9%.
16	Kaihlanen et al, 2021, Finland STRESS STUDY –	Aim: to examine whether SRIS and nursing informatics competence are associated with stress and psychological distress in newly graduated nurses (NGNs) and experienced nurses; Setting: not specified; Theory: none reported; Quality: High	Ethics: ethical approval obtained; Design: cross-sectional survey; Data collection: survey tools measuring stress, psychological distress, SRIS, nursing informatics competence; Analysis: multiple linear regression analysis.	NGNs (n = 712) with less than two years of work experience and experienced nurses (n = 1226) with more than two years of work experience	Mixed types of settings inpatients and outpatients.	SRIS was measured with only two items with a Cronbach's alpha value that was low.	SRIS was associated with stress/psychological distress for both NGNs and experienced nurses. Higher nursing informatics competence was associated with lower stress and psychological distress in NGNs, but not among experienced nurses
17	Kutney-Lee et al, 2021, USA	Aims: examine the associations between EHR usability and nurse job	Ethics: ethical approval granted; Design: retrospective, cross-sectional study; Data collection: secondary	12,004 RNs and 1,281,848	Inpatient (acute and critical care units).		Nurses who worked in hospitals with poorer EHR usability had significantly higher odds of

No	Author, Year, Country	Research Aims, Theory, Setting & Quality	Methods	Population	Practice setting	Limitation	Findings
	BURNOUT STUDY –	(burnout, job dissatisfaction, and intention to leave) and surgical patient (inpatient mortality and 30-day readmission) outcomes; Setting: hospitals in 4 US states; Theory: none reported; Quality: High	data sources collected between 2015 and 2016, including: (1) the American Hospital Association (AHA) Annual Survey of Hospitals, (2) the AHA Healthcare Information Technology (IT) database, (3) patient discharge abstracts obtained from state agencies, and (4) the RN4CAST-US nurse survey; Analysis: logistic regression models	patients embedded in 343 hospitals across the 4 states.			burnout, job dissatisfaction and intention to leave compared with nurses working in hospitals with better usability. Surgical patients treated in hospitals with poorer EHR usability had significantly higher odds of inpatient mortality and 30-day readmission compared with patients in hospitals with better usability. Comprehensive EHR adoption was associated with higher odds of nurse burnout.
18	Marckini et al, 2019, Canada and United States BURNOUT STUDY –	Aims: To determine burnout in adult congenital heart disease (ACHD) specialists by assessing stress associated with EHRs; Setting: a variety of practice settings and environments; Theory: none reported; Quality: Weak	Ethics: ethical approval granted; Design: Electronic survey study of ACHD providers; Data collection: Burnout was measured using the Maslach Burnout Inventory (MBI); Analysis: Chi square and Wilcoxon Rank Sum tests	110 ACHD specialists responded to the survey (28.7% response rate). The majority worked in an academic medical center (n=88, 80.7%).	Mixed Not specified, but the majority (80.7%) worked in hospital/inpatient.	Llimited responses from ACHD providers in Canada (n = 5). Shortage of data provision and interpretation (no tables too).	40% (n = 44) ACHD specialists met the criteria for burnout, and they strongly disagreed that a reasonable amount of time is spent on clerical tasks related to direct or indirect patient care. Female physicians were found to have higher incidence of emotional exhaustion than male physicians. There was strong disagreement that EHRs improved efficiency or that the patient portal improved patient care. Physicians >55 years old had a higher perception of personal accomplishment than their younger peers.
19	Mazur et al, 2023, USA BURNOUT STUDY –	Aim: to understand the key factors contributing to hospitalists' burnout and identify key priorities for improving hospitalists'	Ethics: ethical approval obtained; Design: mixed-method methodology; Data collection: Quan: 22-item Maslach Burnout Inventory, and ST workplace factors including EHR.	58 hospitalists with a response rate of 68%.	Inpatient hospital setting	Sample selected by the hospitalist leadership.	76% of hospitalists reported elevated levels on at least one sub-scale of the MBI. During CIs, key breakdowns were reported in relationships,

No	Author, Year, Country	Research Aims, Theory, Setting & Quality	Methods	Population	Practice setting	Limitation	Findings
		workplace; Setting: academic medical centre and a community hospital; Theory: socio-technical model; Quality: Moderate	Qual: contextual inquiry-data-collection (field observation) and modelling activities, and focus-group led validation and prioritisation of ST factors to be addressed through system-wide improvements; Analysis: t-test (two-tailed) for the quantitative, and an Affinity Model for the qualitative analysis.				communication, coordination of care, work processes in EHR, and physical space. Using data from CIs, an affinity diagram was developed.
20	Melnick, Dyrbye et al, 2020, USA BURNOUT STUDY –	Aims: to describe and benchmark physician-perceived electronic health record (EHR) usability and evaluate the association with professional burnout among physicians; Setting: not specified; Theory: none reported; Quality: High	Ethics: ethical approval granted; Design: secondary analysis; Data collection: cross-sectional survey of US physicians from all specialties from October 2017 to March 2018, Burnout was measured using the Maslach Burnout Inventory; Analysis: Kruskal-Wallis or X^2 tests, and multivariable analysis using linear and logistic regression.	870 physicians (69.6%) completed a sub-survey of EHR usability. 74.4% were non-primary care physicians.	Mixed Not specified, but the majority worked in hospitals/inpatients.		397 of 864 (45.9%) had at least 1 symptom of burnout. Mean SD SUS score was 45.9+/-21.9. A score of 45.9 is in the bottom 9% of scores across previous studies and categorized in the "not acceptable" range or with a grade of F. EHR usability scores were independently associated with the odds of burnout with each 1 point more favorable SUS score associated with a 3% lower odds of burnout.
21	Melnick, Harry, et al, 2020, USA BURNOUT STUDY –	Aims: determine the relationship between physician perceived EHR usability and workload by specialty and evaluate for associations with professional burnout; Setting: not specified; Theory: none reported; Quality: High	Ethics: ethical approval granted; Design: cross-sectional survey; Data collection: survey of US physicians from October 2017 to March 2018, Burnout was measured using the Maslach Burnout Inventory; Analysis: Wilcoxon rank sum test or X^2 test, univariable and multivariable analysis using linear and logistic regression.	5197 physicians n=848 (67.8%) completed a sub-survey of EHR usability.	Mixed Not specified, but the majority worked in hospitals/inpatients		A strong association was observed between EHR usability and workload among US physicians, with more favorable usability associated with less workload. Both outcomes were associated with the odds of burnout, with task load acting as a mediator between EHR usability and burnout.

No	Author, Year, Country	Research Aims, Theory, Setting & Quality	Methods	Population	Practice setting	Limitation	Findings
22	Melnick, West, et al, 2021, USA BURNOUT STUDY –	Aims: to measure nurse-perceived electronic health records (EHR) usability with a standardized metric of technology usability and evaluate its association with professional burnout; Setting: not specified; Theory: none reported; Quality: High	Ethics: ethical approval granted; Design: cross-sectional survey; Data collection: random sample of US nurses was conducted in November 2017, Burnout was measured using the Maslach Burnout Inventory; Analysis: Kruskal-Wallis or X^2 tests, and multivariable analysis using linear and logistic regression.	8,638 nurses (9.9%) completed the survey.	Mixed Inpatient: 78% Outpatient: 22%		42.0% were determined to be burnt out. Nurses rated the usability of their current EHR in the low marginal range of acceptability using a standardized metric of technology usability. EHR usability scores were associated with burnout with each 1 point more favorable SUS score and associated with a 2% lower odds of burnout.
23	Olson et al, 2018, USA STRESS & BURNOUT STUDY –	Aims: identify remediable stressors associated with burnout and to compare performance of the Mini-Z's single-item burnout metric against the 22-item MBI; Setting: academic medical centre; Theory: none reported; Quality: High	Ethics: exempted from IRB review under federal regulation; Design: cross-sectional study; Data collection: prevalence of burnout was determined with the MBI and the Mini-Z survey; Analysis: chi-square test, one-way ANOVA, and multivariate logistic regressions.	557 responded anonymously (44% completion rate). 475 were included; academic faculty (372), hospital employed (52), and private practitioners (81).	Mixed Not specified	The majority of the respondents are academic, in which bias affected the results.	Prevalence of burnout via the MBI was 56.6%. Predictors of burnout were poor control over workload, inefficient teamwork, insufficient documentation time, hectic-chaotic work atmosphere, lack of value-alignment with leadership, and excessive electronic medical record time at home. Academic faculty experienced more burnout than private practitioners. Odds of burnout associated with stressors were generally concordant via Mini-Z's burnout metric versus the MBI.
24	Peccoralo et al, 2021, USA BURNOUT STUDY –	Aim: To identify specific thresholds of daily electronic health record (EHR) time after work and daily clerical time burden associated with burnout in clinical faculty; Setting: Mount Sinai Health	Ethics: ethical approval obtained; Design: cross-sectional survey; Data collection: 2 validated instruments to measure burnout; Well-Being Index (WBI) and the Maslach Burnout Inventory (2 subscales). EHR and clerical work items were modified from the Mini-Z; Analysis:	1781(42.9%) participated in the survey. The study focused on 1346 (75.6%) faculty who spent some time on patient care duties.	Mixed inpatient and outpatient settings.	Three departments used different EHRs, some of which have integrated dictation systems, which could have affected their EHR and clerical burden	EHR frustration, spending >90 minutes on EHR-outside the workday by self-report and >1 hour of self-reported clerical work/day were associated with burnout. Reporting that one's practice unloads clerical burden and higher resilience scores

No	Author, Year, Country	Research Aims, Theory, Setting & Quality	Methods	Population	Practice setting	Limitation	Findings
		System, a large academic medical centre with 7 hospital sites in New York City; Theory: none reported; Quality: High	multivariable logistic and linear regression models.			and ultimately impacted their level of burnout.	were negatively associated with burnout.
25	Shanafelt et al, 2016, USA BURNOUT STUDY –	Aims: evaluate the relationship between the electronic environment, clerical burden, and burnout in US physicians; Setting: physicians across all specialties in the US; Theory: none reported; Quality: High	Ethics: not reported; Design: a cross-sectional; Data collection: Burnout measured using the Maslach Burnout Inventory; Analysis: Kruskal-Wallis or X^2 tests, and multivariable regression analysis.	Of 6375 responding physicians in active practice, 5389 (84.5%) used EHRs, and 82.5% reported using CPOE. 76.6% were non-primary care physicians.	Mixed Not specified, but the majority worked in hospitals/inpatients	Gender factor showed significant association to burnout (table 4) but not explained in the paper.	Physicians who used EHRs and CPOE had lower satisfaction with the amount of time spent on clerical tasks and higher rates of burnout. Physicians who used EHRs or CPOE were less likely to be satisfied with the amount of time spent on clerical tasks after adjusting for age, sex, specialty, practice setting, and hours worked per week. Use of CPOE was also associated with a higher risk of burnout after adjusting for these same factors.
26	Skeff et al, 2022, USA STRESS STUDY –	Aim: to assess how the EHR induces distress in physicians and its impact on their professional behaviours; Setting: two healthcare organisations in Northern California; Theory: action research; Quality: High	Ethics: ethical approval obtained; Design: qualitative design; Data collection: semi-structured interviews; Analysis: grounded theory approaches	50 physicians and graduate medical trainees	Mixed		EHR-related distress affecting professional activities. Five main themes emerged from our analysis: system blocks to patient care; poor implementation, design, and functionality of the EHR; billing priorities conflicting with ideal workflow and best-practice care; lack of efficiency; and poor teamwork function
27	Tajirian et al, 2020, Canada	Aims: (1) identify the extent of burnout and the perceived contribution of	Ethics: ethical approval obtained; Design: cross-sectional survey design; Data collection: electronic	176 physicians and 32 learners (fellows	Mixed settings Not specified		A total of 25.6% (45/176) of practicing physicians and 19% (6/32) of learners reported

No	Author, Year, Country	Research Aims, Theory, Setting & Quality	Methods	Population	Practice setting	Limitation	Findings
	BURNOUT STUDY –	the EHR toward it; (2) identify significant contributors of burnout and EHR-related burnout; (3) explore differences between physicians and learners among factors previously identified as contributing to EHR-related burnout; and (4) compare self-reported perceptions on EHR usage metrics using log data; Setting: academic mental health hospital; Theory: none reported; Quality: High	survey, Burnout measured using Mini-Z survey, contribution of EHRs toward burnout was measured by a single question on a 4-point scale, and open-ended survey responses about the experience with the EHR; Analysis: Chi-square and Fisher exact tests.	and residents) responded. The response rates were 43.2% for physicians (full-time: 75% and part-time: 10%) and 47.7% for learners (fellows: 86% and residents: 40%).			having one or more symptoms of burnout, and 74.5% (155/208) of all respondents who reported burnout symptoms identified the EHR as a contributor. Lower satisfaction and higher frustration with the EHRs were significantly associated with perceptions of EHR contributing toward burnout. Physicians' and learners' experiences with the EHR, gathered through open-ended survey responses, identified challenges around the intuitiveness and usability of the technology as well as workflow issues. Metrics gathered from back-end usage logs demonstrated a 13.6-min overestimation in time spent on EHRs per patient and a 5.63-hour overestimation of after-hours EHR time, when compared with self-reported survey data.
28	Tawfik et al, 2017, USA BURNOUT STUDY –	Aims: test the relation between provider burnout prevalence and organisational factors; Setting: 41 NICUs in California; Theory: none reported; Quality: High	Ethics: ethical approval obtained; Design: cross-sectional survey; Data collection: Burnout measured using a 4-item questionnaire based on the Maslach Burnout Inventory; Analysis: 2-tailed t-test, pearson's correlation coefficients, univariable regressions, sensitivity analysis.	1934 respondents (70% response rate), physicians, nurse practitioners, registered nurses, and respiratory therapists. Most respondents were nurses (75%), and 84.8% were females.	Inpatients (NICUs)		Overall burnout prevalence was 26.7% ± 9.8%. Burnout was most prevalent in NICUs with high patient volume and electronic health records. Nursing burnout was more sensitive to organizational differences than physician.

No	Author, Year, Country	Research Aims, Theory, Setting & Quality	Methods	Population	Practice setting	Limitation	Findings
29	Vehko et al, 2019, Finland STRESS STUDY –	Aims: explores the associations of EHR usability factors and nurses' informatics competence factors with self-reported time pressure and psychological distress among registered nurses; Setting: not specified; Theory: none reported; Quality: Moderate	Ethics: ethical approval obtained; Design: nationwide survey conducted in 2017; Data collection: stress measured via the Harris stress index and psychological distress via four items from the General Health Questionnaire (GHQ) and a four-factor model of EHR-related usability factors; Analysis: Analyses of covariance (ANCOVA) were conducted in three steps.	3607 nurses responded (5% men) — a response rate of 12%	Mixed Not specified, but half (54%) of the RNs worked in hospitals/inpatients	Result section is brief, not described in detail.	Unreliability and poor user-friendliness of EHRs seem to be prominent sources of time pressure and psychological distress among registered nurses.

Appendix 7: Survey questions

1. Demographic information	
For the following, please tell us about yourself and your practice.	
- Age	__ 24-34 __ 35-44 __ 45-54 __ 56-65 __ >65
- Gender	__ Female __ Male
- Nationality	Dropdown list (all nationalities)
- Level of education	__ Diploma's degree or equivalent __ Bachelor's degree __ Master's degree or higher
- Job title/current position	__ Staff nurse I __ Nurse manager __ Staff nurse II __ Clinical resource manager __ Nurse coordinator __ Assistant nurse manager __ Nurse supervisor __ Other: please specify_____
- Working area in the hospital	__ Critical __ Emergency care __ Medical __ Ambulatory care __ Surgical __ Obstetric and gynecology __ Paediatric __ Other: please specify_____
- Working experience as a nurse	__ Less than 1 year __ Less than 20 years __ Less than 5 years __ Less than 25 years __ Less than 10 years __ Less than 30 years __ Less than 15 years __ More than 30 years
- Nursing experience at this hospital	__ Less than 1 year __ Less than 20 years __ Less than 5 years __ Less than 25 years __ Less than 10 years __ Less than 30 years __ Less than 15 years __ More than 30 years
- Have you received prior training on the electronic health records (EHR)	__ Yes __ No

Answer the following questions as truthfully as possible to determine your workplace stress levels.

Please choose the answer that best describes your experience.

1. Overall, I am satisfied with my current job:	1 Strongly disagree	2 Disagree	3 Neutral	4 Agree	5 Strongly Agree
2. I feel a great deal of stress because of my job:	1 Strongly disagree	2 Disagree	3 Neutral	4 Agree	5 Strongly Agree
3. Using your own definition of "burnout," please choose one of the answers below:	a. I enjoy my work. I have no symptoms of burnout. b. I am under stress, and don't always have as much energy as I did, but I don't feel burned out. c. I am definitely burning out and have one or more symptoms of burnout, e.g., emotional exhaustion. d. The symptoms of burnout that I am experiencing won't go away. I think about work frustrations a lot. e. I feel completely burned out. I am at the point where I may need to seek help.				
4. My control over my workload is:	1 Poor	2 Marginal	3 Satisfactory	4 Good	5 Optimal
5. Sufficiency of time for documentation is:	1 Poor	2 Marginal	3 Satisfactory	4 Good	5 Optimal
6. Which number best describes the atmosphere in your primary work area?	1 Calm	2	3 Busy, but reasonable	4	5 Hectic, chaotic
7. My professional values are well aligned with those of my department leaders:	1 Strongly disagree	2 Disagree	3 Neutral	4 Agree	5 Strongly Agree
8. The degree to which my care team works efficiently together is:	1 Poor	2 Marginal	3 Satisfactory	4 Good	5 Optimal
9. The amount of time I spend on the electronic health record (EHR) at home is:	1 Excessive	2 Moderately high	3 Satisfactory	4 Modest	5 Minimal/none
10. My proficiency with EHR use is:	1 Poor	2 Marginal	3 Satisfactory	4 Good	5 Optimal
11. EHR adds to the frustration of my day	1 Strongly disagree	2 Disagree	3 Neutral	4 Agree	5 Strongly Agree

**The Mini Z was developed by Dr. Mark Linzer and team at Hennepin Healthcare, Minneapolis MN. The mini Z survey tools can be used for research, program evaluation and education capacities without restriction. Permission for commercial or revenue-generating applications of the mini Z must be obtained from Mark Linzer, MD or the Hennepin Healthcare Institute for Professional Worklife prior to use: www.professionalworklife.com. Questions drawn mainly from the Physician Worklife Study, MEMO study, and Healthy Workplace study.*

For the following, please choose the answer that best describes you.					
12. EHR improves my clinical workflow	1 Strongly disagree	2 Disagree	3 Neutral	4 Agree	5 Strongly Agree
13. EHR improves patient care	1 Strongly disagree	2 Disagree	3 Neutral	4 Agree	5 Strongly Agree
14. EHR improves my job satisfaction	1 Strongly disagree	2 Disagree	3 Neutral	4 Agree	5 Strongly Agree
15. EHR improves communication among the providers and staff in my unit or practice	1 Strongly disagree	2 Disagree	3 Neutral	4 Agree	5 Strongly Agree
16. Remote EHR use	1 No, I do not have remote access		2 No, I have remote access, but do not use it		3 Yes, I use remote EHR access
17. Reason for remote EHR use	a. Unable to complete work during regular work hours		b. Have the opportunity to work from home (e.g., to achieve work/life balance)		

**These additional questions were developed by the Rhode Island Department of Health* (Baier et al., 2012).

Appendix 8: Interview questions

Introduction

Hello. My name is Fatimah Alobayli, I am a PhD student at the University of Edinburgh. How are you? [Icebreaker]. I am conducting this interview expanding on the online survey you might have participated in, which was about the impact of Electronic Health Records (EHR) on nursing burnout in hospitals.

I appreciate your time and respect your privacy; your answers are completely confidential. More importantly, your name will not be used when we use the data we collect. I do want to let you know that I am recording our conversation so that I don't miss any of your responses, is this okay with you? I also want to reassure you that there is no right or wrong answer to any question.

I will be asking you a series of questions about your experiences and opinions about EHR and its impact on you. The interview has four parts; 1) your experiences with EHRs, 2) training and accessing the EHR, 3) use and impact of the EHR, and lastly 4) burnout experience related to EHR. I will tell you when we're finished with one part and moving on to the next part of the questions.

The main goal of the interview is to see things the way you see them, more like a conversation with a focus on your experience, your opinions and what you think or feel about the topic covered. The length of this conversation shouldn't exceed 60 minutes.

مقدمه:

إسمي/ فاطمة العبيلي. طالبة دكتوراة بجامعة إدنبره، كيف حالك؟ هذه المقابلة هي امتداداً على الاستبيان عبر الإنترنت الذي شاركتـ/ي فيه، والذي كان حول تأثير السجلات الصحية الإلكترونية على الإنهاك النفسي المهني لطاقم التمريض في المستشفيات.

مع تقديري لوقتك واحترامي لخصوصياتك فإني أؤكد لك السرية التامة لإجاباتك. والأهم من ذلك، أن اسمك لن يرد أبداً ضمن البيانات التي أقوم بجمعها. كما أود إفادتك بأني سوف أقوم بتسجيل هذه المحادثة التي أجريها معك لضمان استيفائها كاملة، آمل ألا يكون في ذلك أي مانع. كذلك أؤكد الحرية الكاملة في الإجابات فلا توجد إجابة صحيحة أو خاطئة على أية سؤال.

سأقوم بتوجيه عدد من الأسئلة إليك عن تجربتك وآراءك عن نظام السجلات الطبية الإلكترونية ومدى تأثيرها عليك.

تتكون المقابلة من أربعة أجزاء: ١) تجاربك مع السجلات الطبية الإلكترونية، ٢) التدريب ومنفذ الوصول إلى السجلات الطبية الإلكترونية، ٣) استخدام السجلات الطبية الإلكترونية ومدى تأثيرها، ٤) الإنهاك النفسي المتعلق بنظم السجلات الطبية الإلكترونية. سأشير عليك عندما ننتهي من جزء وننتقل إلى الجزء التالي من الأسئلة.

أود أن أوضح أن الهدف الرئيسي للمقابلة هو رؤية الأمور بالطريقة التي أنت تراها، هي أشبه بالحديث المعتاد بالتركيز على تجاربك وآرائك وما تعتقده أو تشعر به حيال الموضوع المطروح. يفضل ألا تتجاوز هذه المحادثة ٦٠ دقيقة.

Demographic questions for the interview

- Age
- Gender
- Nationality
- Level of education
- Working area in the hospital
- Professional experience:
    - How many years have you been a nurse?
    - How many years have you worked at this hospital?
- Job title/current position

Semi-structured interview

Part 1: Experiences with EHRs تجاربك مع السجلات الطبية الإلكترونية

1. What kind of EHR the hospital uses?
2. What do you think about the EHR system?
   Benefits, risks, limitations (probes)
3. What device do you typically use to access the EHR? *[Desktop, Tablet, COW (computer on wheels)]* Why is that?
4. Have you used an EHR in the past? (if yes) how does that compare to this system?
5. Do you still use paper documentation? In what situations?
6. How does the EHR compare to paper documentation?
   Benefits, risks, limitations (probes)

مانوع نظام السجلات الصحية الإلكترونية الذي يستخدم في المستشفى؟
مارأيك في نظام السجلات الصحية الإلكترونية؟ (من ناحية المميزات، العيوب، المخاطر والقصور..)
ماهو الجهاز الذي تستخدمه غالباً للوصول إلى نظام السجلات الصحية الإلكترونية؟ [الجهاز المكتبي، الجهاز اللوحي، الحاسب المتنقل] ولماذا؟
هل سبق لك استخدام السجلات الصحية الإلكترونية في الماضي؟ (إذا نعم) كيف تقارن هذا النظام بما سبق؟
هل مازلت تستعمل السجلات الورقية؟ في أي الحالات؟
كيف تقارن السجلات الصحية الإلكترونية بالسجلات الورقية؟ (أذكر المميزات، العيوب، المخاطر، القصور..)

Part 2: Training and accessing the EHRs التدريب ومنفذ الوصول إلى السجلات الطبية الإلكترونية

7. Did your organisation provide training on using the EHR?
   a. How was the training delivered? (face-to-face (onsite/offsite), online, blended)
   b. What did the training consist of? (knowledge, skills, curriculum content)
   c. Who delivered the EHR training?
   d. How long was the training and how often did it occur (initial, ongoing)?
   e. What do you think about the training your hospital provides? OR How helpful was the training?

هل المؤسسة التي تعمل بها قدمت لك تدريب على انظام السجلات الطبية الإلكترونية؟
كيف كان التدريب المقدم؟ (وجهاً لوجه، داخل أو خارج المؤسسة، أونلاين، متنوع)
ماهي مكونات التدريب؟ (معلومات، مهارات، مناهج)
من الذي دربك على استخدام السجلات الصحية الإلكترونية؟
كم كانت مدة التدريب؟ وكم مرة أعطيت؟ (مره في البداية، باستمرار)
مارأيك حول التدريب المقدم؟ ما مدى الفائدة من التدريب؟

8. Do you have access to the EHR from home? (if Yes)
   a. How much time do you spend on the EHR while at home?
   b. Why do you think you need it outside working hours?
   c. How does this impact your life outside of work?

هل تستطيع الوصول إلى نظام السجلات الطبية الإلكترونية من المنزل؟ (إذا الإجابة نعم)
كم تستغرق من الوقت في استخدامه في المنزل؟
ماهو سبب استخدامك للنظام خارج أوقات العمل؟
كيف يؤثر ذلك على حياتك خارج الدوام؟

Part 3: Use and impact of the EHR استخدام السجلات الطبية الإلكترونية ومدى تأثيرها

9. With a given patient, what do you use the EHR for?
    a. When?
    b. Where?
    c. How often?

ماهي استخداماتك للنظام المتعلقة بالمريض الذي تقدم له الرعاية الكاملة؟ متى؟ وأين؟ وتكرار الاستخدام؟

10. What features of the EHR do you like? (Probes)
11. What features of the EHR you do not like? (Probes)
12. What are the problems you encounter with the EHR?
    a. Are these problems new or ongoing?
    b. Do you think organisational requirements contribute to these issues? *Such as fulfilling requirements of nursing administration, quality and accreditation, billing, etc* (probe)
    c. What do you think it can be done about these problems?

ماهي الخصائص أو الوظائف التي تعجبك في النظام؟
ماهي الخصائص/الوظائف التي لاتعجبك في النظام؟
ماهي المشاكل التي تواجهك مع نظام السجلات الطبية الإلكترونية؟
هل هذه المشاكل جديدة أو مستمرة؟
هل تعتقد أن متطلبات المنظمة الصحية تساهم في هذه المشاكل؟ مثل: استيفاء متطلبات إدارة التمريض، إدارة الجودة، الإعتماد، الفواتير..

13. Can you get help/assistance whenever you need when using the EHR? How? (probes)

14. How does the EHR affect (ask each time);
    a. your performance/efficiency at work,
    b. nursing care,
    c. clinical workflow,
    d. communications among staff and multidisciplinary teams,
    e. job satisfaction?

هل تتمكن من الحصول على المساعدة عندما تحتاجها في استخدام النظام؟ كيف؟
مامدى تأثير نظام السجلات الطبية الإلكترونية على:
آداؤك/فعالية عملك، الرعاية التمريضية، سير العمل، التواصل بين الموظفين والفرق متعددة التخصصات، والرضى الوظيفي

Part 4: Burnout experience related to EHR الإنهاك النفسي المتعلق بنظم السجلات الطبية الإلكترونية

15. I would like to ask you first, what is your understanding of burnout?

في البداية أود أن اسألك، ماذا تفهم عن [يستخدم المصطلح الإنجليزي]؟

16. Have you experienced burnout at work due to the EHR? (if not, ask Q17)
    a. How often does it occur?
    b. How long does it last?
    c. Does it impact your physical or mental health? If yes, how?
    d. Does this impact patient care? If yes, how?
    e. How do you manage to overcome such difficulties/stressful situation (that others might not use or can benefit from you)?
    f. What do you think should be changed to reduce the burnout you experience from EHRs?

هل حدث أن قد عانيت من إنهاك نفسي في العمل بسبب نظام السجلات الصحية الإلكترونية؟
كم مره حدث لك؟
كم استمرت المعاناة معاك؟
كيف كان تأثير ذلك على صحتك الجسدية والعقلية؟
كيف أثر ذلك على رعاية المرضى؟
كيف تتعامل بالعادة للتغلب على مثل هذه الصعوبات والضغوط؟ (كي يستفيد منك الغير)
برأيك مالذي يجب تغييره للتخفيف من الإنهاك النفسي الذي تعانيه المتعلق باستخدام نظام السجلات الصحية الإلكترونية؟

17. In your opinion, what do you think are the reasons that lead nurses to experience burnout related to the EHR system? (probes)
    a. How does it impact their physical or mental health?
    b. How does it impact patient care?
    c. How do they manage to overcome such difficulties/stressful experience?
    d. What do you think it can be done to minimise such EHR stressful experience?

برأيك ماهي الأسباب التي تجعل الممرضين/الممرضات يعانوا من الإنهاك النفسي المتعلق باستخدام نظام السجلات الصحية الإلكترونية؟
مامدى تأثير ذلك على صحتهم الجسدية والعقلية؟
ماهي الآثار المترتبة على رعاية المرضى؟
كيف يتعاملوا بالعادة للتغلب على هذه الصعوبات والضغوط؟
برأيك مالذي يجب عمله للتقليل من هذه الضغوط المرتبطة باستخدام نظام السجلات الصحية الإلكترونية؟

Finishing questions: أسئلة ختامية:

18. Is there anything you would like to elaborate on? هل هناك أي شيء تود التوضيح عليه؟

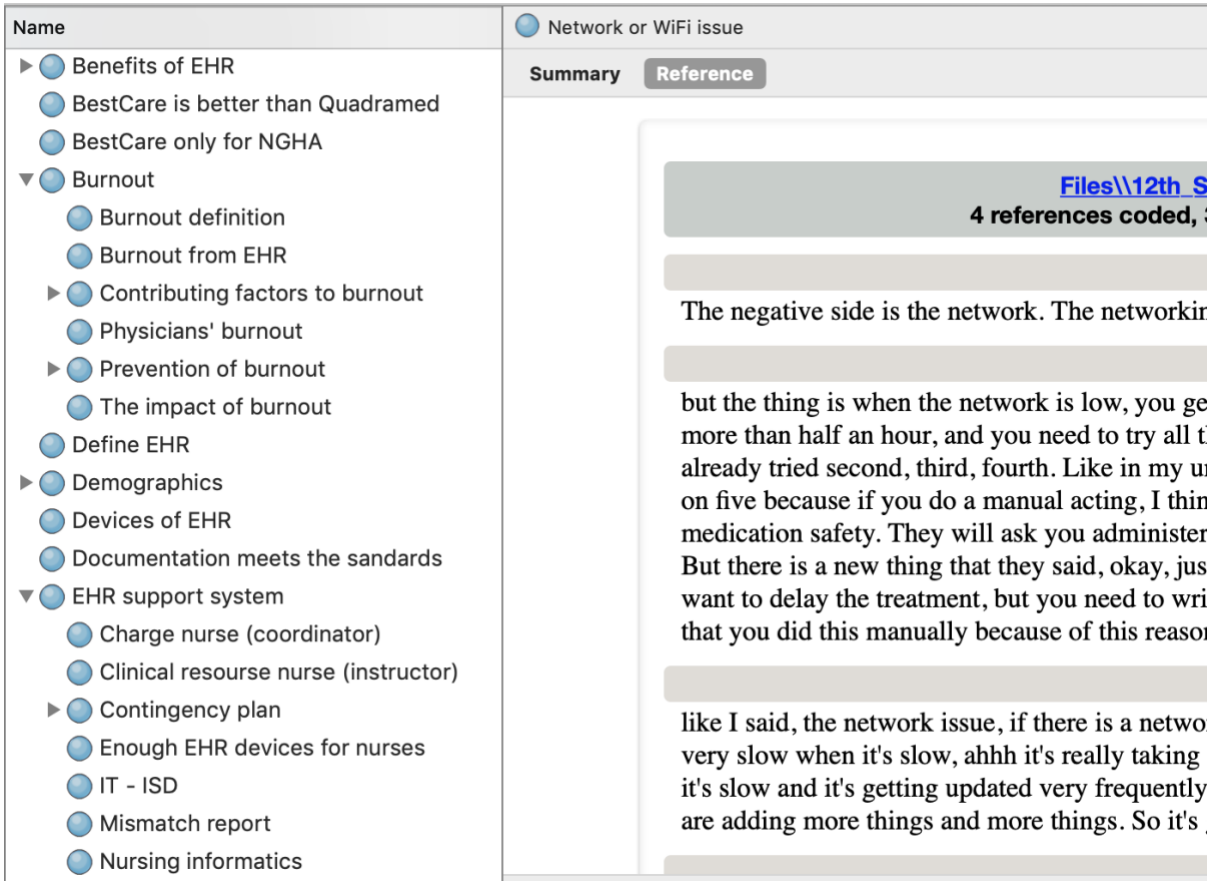
19. Is there anything you would like to add? هل لديك شيء آخر تود أن تضيفه؟

Concluding remarks, thank you and close.

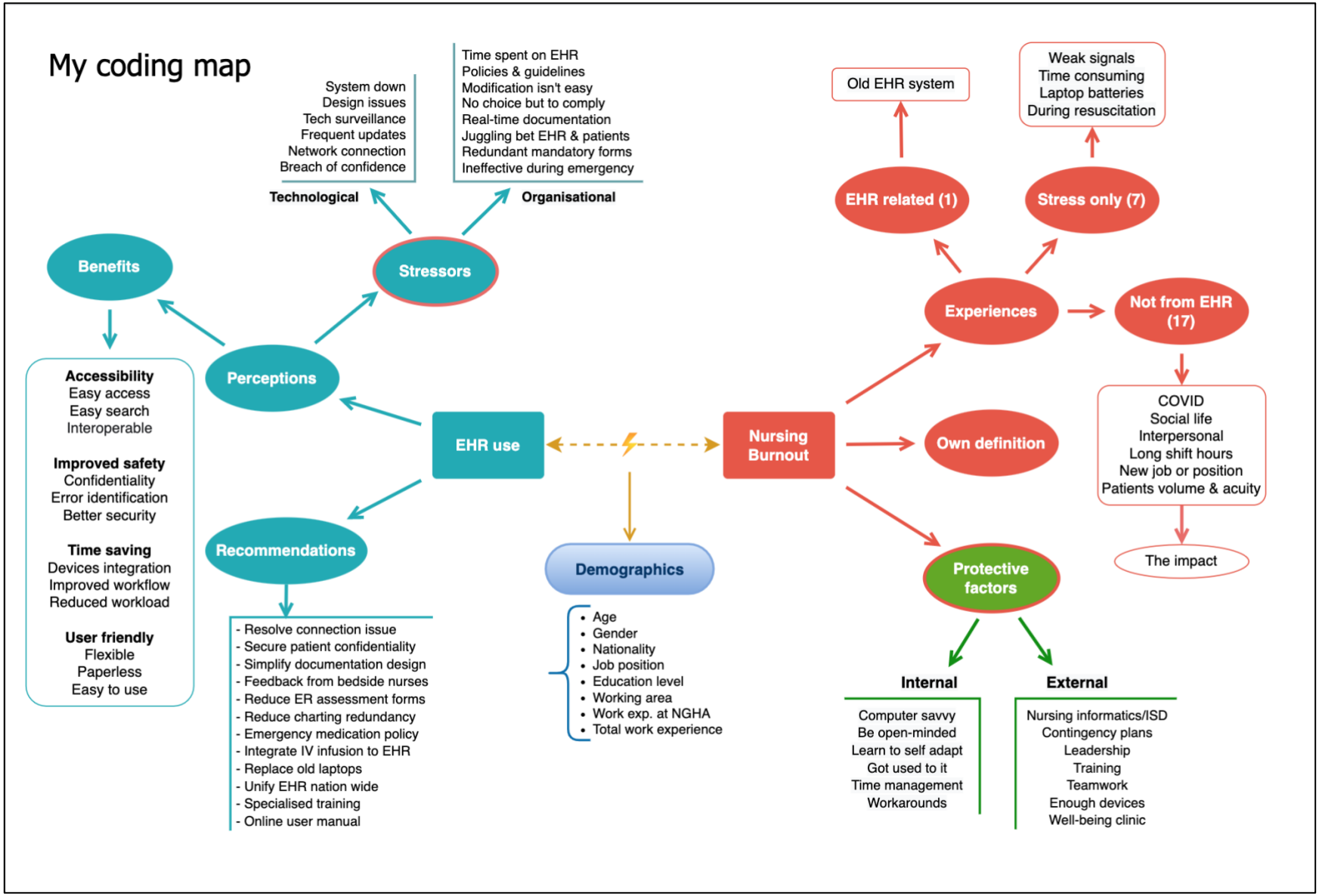
Probes: أسئلة استكشافية

- Why is that? لماذا؟
- What makes you say that? ما الذي يجعلك تقولي ذلك؟
- Could you tell me more? هل يمكن أن تخبرني أكثر؟
- Can you provide specific examples? هل يمكن تعطيني أمثلة محددة؟
- Can you elaborate on this point? هل يمكن أن توضح هذه النقطة؟

Appendix 9: Coding in Nvivo



Appendix 10: The thematic map of the findings



Appendix 11: Ethics approval from UoE

Ref: NURS043

Fatimah Alobayli
PhD Researcher
University of Edinburgh
Medical School
Teviot Place
Edinburgh
EH8 9AG

SCHOOL OF HEALTH IN SOCIAL SCIENCE
The University of Edinburgh
Doorway 6
Medical Quad
Teviot Place
Edinburgh
EH8 9AG

E-mail: steph.grohmann@ed.ac.uk

04/12/2019

Dear Fatimah,

APPLICATION FOR LEVEL 2 APPROVAL

PROJECT TITLE: THE IMPACT OF ELECTRONIC HEALTH RECORDS ON NURSING BURNOUT IN HOSPITAL SETTINGS: MIXED METHODS STUDY

Thank you for submitting the above research project for review by the Section of Nursing Studies Ethics Research Panel.

I can confirm that the submission has been independently reviewed and was approved on 3 December 2019.

Should there be any change to the research protocol, it is important that you alert us to this as this may necessitate further review.

Yours sincerely

Dr Steph Grohmann
Leverhulme Early Career Fellow
Nursing Studies

Appendix 12: Ethics approval from NGHA

Kingdom of Saudi Arabia
Ministry of National Guard - Health Affairs

المملكة العربية السعودية
وزارة الحرس الوطني - الشؤون الصحية

King Abdullah International Medical Research Center
(KAIMRC)

IRB NCBE Registration No.: H-01-R-005

(84) 94456 1515 94466 irb@ngha.med.sa

IRB Office

Memo Ref.No. IRBC/2221/19 E-CTS Ref. No. RYD-19-419812-191617

Study Number: **SP19/537/R**
Study Title: **The Impact of Electronic Health Records on Nursing Burnout in Hospital Settings: a Mixed Methods Study".**
Study Sponsor **non grant**
IRB Review Type: ■ **Expedited Review** ☐ **Full Board**
IRB Approval Date: **15 December 2019**
Study site(s): **Central Region**

Dear **Dr. Najla Barnawi**
Chairperson of Community Service Unit- Assistant Professor; Community Health and Health Education, KSAU-HS.
Ministry of National Guard – Health Affairs

Sub-investigator: Fatimah Yahya Alobayli.

After reviewing your submitted research proposal/protocol and related documents, the IRB has APPROVED the submission.
The approval includes the following related documents:

Document/Title	Version	Date
Research Proposal	01	15 December 2019
Data Collection	01	15 December 2019
Informed Consent Form	01	15 December 2019

The approval of the research study is valid for **one year** from the above approval to expiration date.

Terms of Approval:

- **Annual Reports:** An Annual report must be submitted for approval to avoid termination/suspension of your research.
- **Financial report:** If your study is funded project, details financial report should be submitted with the scientific report.
- **Final Report:** After completion of the study, a final report must be forwarded to the IRB.
- **Retention of original data:** The PI is responsible for the storage and retention of original data pertaining to the project for a minimum of five years.
- **Reporting of adverse events or unanticipated problems:** The PI is responsible to report any serious or unexpected adverse events or unanticipated problems, which could involve a risk to participants or others.
- **Biological samples:** No biological samples to be shipped out of the Kingdom of Saudi Arabia without prior IRB approval.
- **Participant incentives:** No financial compensation or gifts to be given to participants without prior IRB approval.
- **Storage of biological samples:** All biological samples collected for the purpose of this research must be stored in the KAIMRC related repository.

Prof. Abdullah Al Sayyari
Chairman, Institutional Review Board (IRB)
Ministry of National Guard - Health Affairs

AA/AG/Areej

P.O. Box 22490, Riyadh 11426

Appendix 13: Electronic information sheet and consent for survey

ELECTRONIC INFORMATION SHEET AND CONSENT - SURVEY

You are being invited to take part in research on The Impact of Electronic Health Records (EHR) on Nursing Burnout in Hospital Settings: Mixed Methods Study. Fatimah Alobayli, PhD student at the University of Edinburgh is leading this research. Before you decide to take part it is important you understand why the research is being conducted and what it will involve. Please take time to read the following information carefully.

WHAT IS THE PURPOSE OF THE STUDY?

The purpose of the study is to explore factors that contribute to nursing burnout related to EHR use in hospital settings.

WHY HAVE I BEEN INVITED TO TAKE PART?

You are invited to participate in this study because you meet the inclusion criteria that will serve the purpose of the study, which is clinical nurses working full-time in inpatient departments with at least one year working experience, having immediate responsibilities on patient care and patient units and using EHR on a daily basis.

DO I HAVE TO TAKE PART?

No – it is entirely up to you. If you do decide to take part, please read the Information Sheet and complete the Informed Consent Form to show that you understand your rights in relation to the research, and that you are happy to participate. If you do decide to take part you are still free to withdraw at any time and without giving a reason. Deciding not to take part or withdrawing from the study will not affect your employment or legal rights.

WHAT WILL HAPPEN IF I DECIDE TO TAKE PART?

You will be asked to fill in an online survey which will take approximately 5-10 minutes to complete. The survey assesses nurses' attitude towards workplace stress levels and burnout, and your perceptions of EHR.

At the end of the survey you will be asked if you would like to receive a summary of the study findings, which can be sent to you if you want once it has been finalised. Also, you will be asked if you are interested in participating in an additional interview [in person or via Skype]. The second phase of the research is to interview 15-20 participants for more detailed study at a later time. If you are willing to take part, you may be contacted by the researcher for the interview via email.

WHAT ARE THE POSSIBLE BENEFITS OF TAKING PART?

By sharing your experiences with us, you will be helping Fatimah Alobayli and the University to better understand the impact of EHR on nursing and reasons that contribute to nursing burnout in hospital settings. Findings of the study will add new knowledge on and enhance our understanding of nursing burnout related to EHRs in hospitals. This could be used to propose changes to professional practice and EHRs to reduce stress associated with health information technology at an individual or organisational level.

ARE THERE ANY RISKS ASSOCIATED WITH TAKING PART?

The possible risks or discomforts of the study are minimal. Be assured that your participation in this survey is voluntary. You may refuse to take part in the research or exit the survey at any time without penalty.

WHAT IF I WANT TO WITHDRAW FROM THE STUDY?

Agreeing to participate in this project does not oblige you to remain in the study nor have any further obligation to this study. If, at any stage, you no longer want to be part of the study, please inform the project administrator Fatimah Alobayli via email . You should note that your data may be used in the production of formal research outputs (e.g. journal articles, conference papers, theses and reports) prior to your withdrawal and so you are advised to contact the research team at the earliest opportunity should you wish to withdraw from the study. On specific request we will destroy all your identifiable answers, but we will need to use the data collected prior to your withdrawal, and to maintain our records of your consenting participation.

DATA PROTECTION AND CONFIDENTIALITY

Your data will be processed in accordance with Data Protection Law. All information collected about you will be kept strictly confidential and anonymised. Your data will only be viewed by the researcher/research team. All electronic data will be stored on a password-protected computer file, separating any identifying information from participants responses to maintain anonymity.

WHAT WILL HAPPEN WITH THE RESULTS OF THIS STUDY?

The results of this study may be summarised in published articles, reports and presentations. Key findings will always be made anonymous in any formal outputs unless we have your prior and explicit written permission to attribute them to you by name. Information may also be kept for future research.

WHO CAN I CONTACT?

If you have any further questions about the study, please contact the lead researcher, Fatimah Alobayli via email

If you wish to make a complaint about the study, please contact:

Prof Aisha Holloway
Head of Nursing Studies, University of Edinburgh

Prof Ruth Jepson
Director of Research, School of Health in Social Science, University of Edinburgh

In your communication, please provide the study title and detail the nature of your complaint.

For general information about how we use your data go to:

https://www.ed.ac.uk/records-management/privacy-notice-research

SURVEY ELECTRONIC CONSENT

Before starting the survey, please complete the consent form below to indicate you agree to take part in this study.

	Please tick the box
1. I confirm that I have read and understood the Participant Information Sheet for the above study.	☐
2. I have been given the opportunity to consider the information provided, ask questions and have had these questions answered to my satisfaction.	☐
3. I understand that my participation is voluntary and that I can ask to withdraw at any time without giving a reason and without my employment or legal rights being affected.	☐
4. I understand that my anonymised data will be stored for a minimum of 5 years and may be used in future ethically approved research.	☐
5. I agree to take part in this study.	☐

Survey URL:
https://edinburgh.eu.qualtrics.com/jfe/form/SV_e2pbFh7KBThDCRL

Appendix 14: Participant information sheet for interviews

PARTICIPANT INFORMATION SHEET - INTERVIEW

You are being invited to take part in research on The Impact of Electronic Health Records (EHR) on Nursing Burnout in Hospital Settings: Mixed Methods Study. Fatimah Alobayli, PhD student at the University of Edinburgh is leading this research. Before you decide to take part it is important you understand why the research is being conducted and what it will involve. Please take time to read the following information carefully.

WHAT IS THE PURPOSE OF THE STUDY?

The purpose of the study is to explore factors that contribute to nursing burnout related to EHR use in hospital settings, and to examine the association between nursing burnout and EHR.

WHY HAVE I BEEN INVITED TO TAKE PART?

You are invited to participate in this study because you meet the inclusion criteria that will serve the purpose of the study, which is clinical nurses working full-time in inpatient departments with at least one year working experience, having immediate responsibilities on patient care and patient units and using EHR on a daily basis.

DO I HAVE TO TAKE PART?

No – it is entirely up to you. If you do decide to take part, please keep this Information Sheet and complete the Informed Consent Form to show that you understand your rights in relation to the research, and that you are happy to participate. If you do decide to take part you are still free to withdraw at any time and without giving a reason. Please note down your participant number (which is on the Consent Form) and provide this to the lead researcher if you seek to withdraw from the study at a later date. Deciding not to take part or withdrawing from the study will not affect your employment or legal rights.

WHAT WILL HAPPEN IF I DECIDE TO TAKE PART?

You will be asked a number of questions regarding your experience and opinions about EHR use and its impact on nursing burnout. The interview will take place in a safe environment at a time that is convenient to you. Ideally, we would like to audio record your responses (and will require your consent for this), so the location should be in a fairly quiet area. The interview

should take around 20 to 60 minutes to complete. A Skype and phone interviews are another option for you at a place and time that are convenient to you.

WHAT ARE THE POSSIBLE BENEFITS OF TAKING PART?

By sharing your experiences with us, you will be helping Fatimah Alobayli and the University to better understand the impact of EHR on nursing and factors that contribute to nursing burnout in hospital settings. Findings of the study will add new knowledge on and enhance our understanding of nursing burnout related to EHRs in hospitals. This could be used to propose changes to professional practice and EHRs to reduce stress associated with health information technology at an individual or organisational level.

ARE THERE ANY RISKS ASSOCIATED WITH TAKING PART?

There could be a risk of inducing stress or discomfort due to the nurture of the study that looks at burnout within the workplace. Be assured that your participation is voluntary, and you may refuse to take part in the research at any time without penalty. You are free to decline to answer any particular question you do not feel comfortable to answer for any reason.

WHAT IF I WANT TO WITHDRAW FROM THE STUDY?

Agreeing to participate in this project does not oblige you to remain in the study nor have any further obligation to this study. If, at any stage, you no longer want to be part of the study, please inform the project administrator Fatimah Alobayli via email . You should note that your data may be used in the production of formal research outputs (e.g. journal articles, conference papers, theses and reports) prior to your withdrawal and so you are advised to contact the research team at the earliest opportunity should you wish to withdraw from the study. On specific request we will destroy all your identifiable answers, but we will need to use the data collected prior to your withdrawal, and to maintain our records of your consenting participation.

DATA PROTECTION AND CONFIDENTIALITY

Your data will be processed in accordance with Data Protection Law. All information collected about you will be kept strictly confidential. Unless they are anonymised in our records, your data will be referred to by a unique participant number rather than by name. If you consent to being audio recorded, all recordings will be destroyed once they have been transcribed. Your data will only be viewed by the researcher/research team. All electronic data will be stored on a password-protected computer file and all paper forms will be scanned and stored electronically on a password-protected file, and papers will be destroyed. Your consent and any identifying information will be kept separately from your responses in order to minimise risk.

WHAT WILL HAPPEN WITH THE RESULTS OF THIS STUDY?

The results of this study may be summarised in published articles, reports and presentations. Quotes or key findings will always be made anonymous in any formal outputs unless we have your prior and explicit written permission to attribute them to you by name. Information may also be kept for future research.

WHO CAN I CONTACT?

If you have any further questions about the study, please contact the lead researcher, Fatimah Alobayli via email

If you wish to make a complaint about the study, please contact:

Prof Aisha Holloway
Head of Nursing Studies, University of Edinburgh

Prof Ruth Jepson
Director of Research, School of Health in Social Science, University of Edinburgh

In your communication, please provide the study title and detail the nature of your complaint.

For general information about how we use your data go to:

https://www.ed.ac.uk/records-management/privacy-notice-research

Appendix 15: Participant consent form for interviews

PARTICIPANT CONSENT FORM

Study Title: The Impact of Electronic Health Records on Nursing Burnout in Hospital Settings: Mixed Methods Study

Please initial box

6. I confirm that I have read and understood the Participant Information Sheet for the above study. ☐

7. I have been given the opportunity to consider the information provided, ask questions and have had these questions answered to my satisfaction. ☐

8. I understand that my participation is voluntary and that I can ask to withdraw at any time without giving a reason and without my employment or legal rights being affected. ☐

9. I understand that my anonymised data will be stored for a minimum of 5 years and may be used in future ethically approved research. ☐

10. I agree to take part in this study. ☐

Name of person giving consent	Date	Signature
_____	_____	_____

Name of person taking consent	Date	Signature
_____	_____	_____

Appendix 16: A summary of interviewees' responses about their burnout experience and protective factors from EHR-related burnout, with some quotes about the EHR acceptance.

P	Burnout experience	Protective factors (EHR-related)	Quotes about nurses' acceptance of EHR
1	Burnout: system down in the old EHR (no contingency plan), not anymore with the current EHR system.	The contingency plan, fast modification during COVID, enough EHR devices, ISD, nursing informatics, super-users, training, CRNs, well-being clinic.	"I am a computer person, so I prefer the computer anyway, I don't like the paper work". "Overall, I like the system. It's user friendly and it saves time".
2	Burnout: when having bulk of patients. Not from EHR EHR stressors: system down, unnecessary forms in ER.	ISD, informatics' support, enough EHR devices for nurses (1:1), training, super users.	"EHR is very helpful, it's very easy access using EHR". "EHR for me is good. I cannot think any disadvantage". "there's an improvement on the flow of the patients with this EHR".
3	No burnout. EHR stressors: system down and poor wi-fi	Super-users, informatics' department support, teamwork, CRN, workarounds.	"of course, I prefer EHR" "they were really struggling initially in the beginning because they were not used to this system. But once adapted already everything is fine…I still remember February, 2016 was very challenging".
4	Burnout: lack of support and disrespect from leaders. Not from EHR EHR stressors: downtime, network connection	Informatics support, own duties as NM, leadership, feedback from nurses, super-users, fast processes during COVID.	"The best thing about the BestCare is that it's very flexible. whatever kind of technology/machine can be linked to BESTCare and can transfer the information from that thing to the BESTCare". "using this system, it is much easier". "it saved time. It is more accurate. More efficient. BESTCare is very flexible to adapt and any modification you want to do is now possible".
5	Burnout from colleague's conflicts/teamwork (in the past). Not from EHR EHR stressor: Network connections.	Help from nursing colleagues, ISD & nursing informatics, super-users, CRNs.	"BestCare is good. It's a bit confusing at times, but it's, very helpful for me" "once you get used to the system and you use it every day, like what I do now, so it's easier for me" "So using a laptop or computer in handling patients, it's really a big help for me…that would mean less paper work and more patient care". "for me, I love computers"
6	Burnout: Long work hours that affected social life. Moderate level of distress from EHR. EHR stressors: confidentiality, more time spent on the EHR than on bedside.	Training, CRNs, NM, super-users, nursing informatics support, and they work on nurses feedback and update them.	"maybe 80% it's efficient for us, I consider". "with our existing EHR is, it's not flexible. You know, there's a lot of things that you need to enter in the flow sheet, in the nursing notes. It's not really a flexible system". "I think I just have some issues perhaps with the adaptability of the system, but I think it's somehow efficient at work".
7	Burnout: moving from one job position to another. Not from EHR. EHR stress: staff feel that they're being watched all the time (technology), and ER documentation load.	Nursing informatics, training, CRNs, ISD, preceptorship, nursing management support, well-being clinic.	"I think it's a good system in general". It's helped really, for the benefit of the patients, "the system is really smart. It will tell you that this is the wrong patient immediately".
8	Burnout: as a new staff in ER resuscitation during winter. Stressful experience with EHR: when EHR froze and a doctor	Nursing informatics, Nursing orientation, (training), CRNs, teamwork, debriefing (problem solving), and NM.	"In general, it's quite helpful. In the start, it will be difficult if you don't know how to use like the smartphone"

P	Burnout experience	Protective factors (EHR-related)	Quotes about nurses' acceptance of EHR
	shouted at her needed an urgent info from it.		"it's really time saving, … saves your effort and also friendly use, and comprehensive".
9	Burnout: when started as a new grad in ER. Not mainly EHR. EHR stress: Frequent updates, too many forms to document	CRNs, orientation program, nursing informatics, and nursing managers.	"In general, actually, it's good to move from paper-based documentation to electronic based documentation". "it makes somehow the nurses' life much easy"
10	Burnout: patient volume in ER & COVID Stress from EHR is linked with high volume of patients that increases load of documentation.	Training, preceptorship, ISD, nursing informatics, nurses help each other, understanding managers during busy times.	"For me initially it was difficult, but with time of course, we're getting used to it. So it's becoming easier and easier. Although, there will always be challenges".
11	Burnout: when EHR first introduced with high demand to use it. Not anymore. EHR stressor: weak connection.	Super users, nursing informatics, own duty as a CRN, & nurses feedback about the system.	"I think the current system is more, much more advanced and it's much more standardised and systematic and then a more user friendly and more time saving". "I see in a way that actually helps me a lot in terms of my nursing care"
12	No burnout. EHR stressors: frequent issues with the network, repetition of documentation due to separate forms design, old laptops need replacement.	CRNs, NMs, ISD, nursing informatics department, good, workarounds, & super users.	"for me, it's very helpful. I like it better than the system that we had before". "BestCare is really helpful. You know, you don't have a redundancy of doing a lot of things".
13	No burnout. Satisfied with the EHR EHR issues addressed and manageable.	Guidelines, teamwork, NM & CRN, improvement plans, informatics support, super users, education & training.	"me personally, I find it very easy it's much, much easier compared to when I had the paperwork". "it is very convenient for me, so I have zero complaints about it".
14	Burnout: 12 hours shift in ICU. Not from EHR. Addressed some technical issues but quickly get resolved.	NM & CRN duties. Good support from ISD & nursing informatics, eased documentation load during COVID.	"This system is better as you know the new generation loves working with the computer…I got used to it anyways… I don't have any complains". "Best-care is very helpful and I'm sure it helps the other units, not just ICU"
15	Burnout: from busy environment, COVID, & staff. Not from EHR. EHR stressors: time consuming, technical issues, infusion pump not integrated.	CRN and nursing informatics.	"The BestCare is good, but still have a lot to be improved". "I don't have much problem with the system actually ... I'm used to it already"
16	Burnout from COVID, not from EHR. EHR is irritating. Not easy like papers.	Nurses help each other, CRN, and good IT support & ISD.	"I'm not a fan of the computer system. I come from a hospital where we have big flow sheets and paper charts for our patients in ICU. And I feel like it works much better". "It gets me, it irritates me. I get a bit stressed about it, but not burnout because of it."
17	Burnout from COVID, not from EHR. Stressors: network issue (signal) and slowness of the EHR.	Understanding managers. NM & CRN help. ISD & nursing informatics' support.	"I prefer this one (BestCare) because it's really of great help". "if only this signal is good, the network is good. This BestCare is a good thing".
18	No burnout, but severe stress from people around & shortage of staff. EHR issues are manageable	CRN, super users, orientation to new staff, training, good ISD & nursing informatics support. Supportive NM.	Before we were doing it manually and it was really difficult. Now it's easier. It's faster". "for me, I really prefer the system" … I cannot imagine going back to the paper I cannot".

P	Burnout experience	Protective factors (EHR-related)	Quotes about nurses' acceptance of EHR
19	Burnout from disrespect. EHR stressors are adaptable.	Good informatics' support, training, preceptorship program, understanding managers.	"In general, the system is proficient in terms of efficacy and well-planned program". "The system for me looks perfect because everything is there".
20	Burnout from COVID. EHR stressors are adaptable.	Time management, and supportive ISD & nursing informatics.	"I think we have one of the best comparing to any other else". "rather than to fight on the system, we adapt ourselves to the changes...So, day by day, they manage to adjust on it and accept".
21	Burnout; past experiences. EHR issues are manageable.	Good support from nursing informatics & ISD. Training, and preceptorship.	"Overall I think it's a good system, it's good". "to be honest, it's faster, it's easy, not like handwriting, you will write a lot of things". "I think right now, even the doctors, they are happy about the system".

Appendix* 17*: Some quotes from the participants on burnout definition and EHR as a contributor

Definitions of burnout by the participants:
"Burnout when you are already super stressed, you feel that you are not happy anymore with your work or you just want a rest, away of what you're doing" (P10)
"I think like there is no motivations and lack of focusing. Also it's like, I don't find any satisfaction in terms of my job and the things that I'm doing" (P11)
"My understanding of burnout is somebody who's totally exhausted. Who does feel like, too stressed, who cannot function anymore as a nurse, like that. That's what I think is a burnout" (P12)
"To me it means I get enough, I'll leave this job. I cannot tolerate anything, everything around me is provoking me or making me stress or making me irritable" (P18)
"My understanding of burnout is if you have accumulated stress, for example, you have high workload, long hour shift, you have for example, difficult management and, or poor teamwork at workplace, and then you went home late. Sometimes we didn't have the support from the management, then you know, it keeps repeated over and over and over and you don't do anything about it. And then you will find yourself, you cannot really tolerate it anymore. So you're going to reach the point of burning out" (P9)
EHR was not perceived as a contributor to nursing burnout:
"No I wouldn't say that. It gets me, it irritates me. I get a bit stressed about it, but not burnout because of it" (P16)
"EHR no, EHR for me is very small thing" (P2)
"I never encountered one in ER that they said they cannot cope up with EHR, no" (P10)
"I don't expect there is a burnout caused by BESTCare at all" (P4)
"Maybe, not from the system no, I mean from something else (burnout experience)" (P21)
"It's more of the organisations, not the EHR" (P7)