

The Journey of Medical Record Ergonomic Aspects Toward Data Digitalization: A Scoping Review

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ABSTRACT

The transition transition of medical records management from conventional system to electronic medical records (EMR) not only impacts recording technology, but also affects staff working conditions from an ergonomics. Research on ergonomics has been conducted separately at each development stage. This study aims to map the development of ergonomic aspects in medical record management from conventional systems to EMR implementation. The method used in this research is a scoping review with the PRISMA-ScR approach. Literature searches were conducted through several types of national and international scientific databases with keywords ergonomics, digitization, and electronic medical records (EMR). Articles meeting the inclusion criteria were analyzed and grouped based on system development stages and ergonomic dimensions examined. The results showed that in conventional systems, ergonomic issues tend to focus more on physical aspects (35.7%) and environmental aspects (14.3%), such as layout, lighting, ventilation, security systems, and staff work posture. Along with digitalization and EMR implementation, research focus shifted to cognitive ergonomics (21.4%) and organizational ergonomics (28.6%), converging mental workload, user adaptation to system interface design, and management support in managing change. These findings indicate that digitalization does not eliminate ergonomics issue but rather transforms the challenges faced by staff. This research leads to the need for developing an integrated ergonomic framework as a reference for healthcare facilities in implementing EMR. Further research also needs to be developed through a longitudinal and action research approaches to ensure that the transition process runs optimally while maintaining aspects of staff comfort, safety, and well-being.

INTRODUCTION

When humans and their work environment are in proper balance, ideal working conditions are created. This condition is the essence of ergonomics according to the International Ergonomics Association (IEA) (9). Ergonomics is the science that studies how to adjust the relationship between humans, tools, and the work environment to create a safe, comfortable, and efficient work environment through four integrated dimensions: physical ergonomics (workstation design, anthropometry), environmental ergonomics (lighting, temperature, ventilation, security system), cognitive ergonomics (mental load, interface design), and organizational ergonomics (work structure, training, management support). These four aspects have holistic and integrated characteristics, so a comprehensive assessment of each dimension is essential to understand the quality of the work environment as a whole.

The application of ergonomics plays an important role in healthcare services, because high workloads, repetitive activities, and demands for accuracy can cause physical and mental fatigue among staff the work environment is not designed to ergonomic standards (4). Good ergonomic principles can have a significant impact, ranging from increased work comfort, reduce risk of musculoskeletal disorders, to improve staff work efficiency (6).

In healthcare service, medical records have a strategic role as a source of information that supports continuity of patient care. Medical records contain patient identity data, examination results, treatment, and medical procedures that have been provided (2). Based on regulation of the Minister of Health of the Republic Indonesia Number 24 of 2022, medical records have administrative, legal, education, research, and documentation function in healthcare service. The implementation and management of medical records can be done manually or digitally. The conventional medical record system is conducted manually using paper documents stored in a archive room called a filing room, while electronic medical records (EMR) is a digitalization innovation in patient recording that aims to improve efficiency, security, and ease of access to data (5). Nevertheless, the transition process from manual to digital medical records system creates new challenges in terms of spatial layout, work equipment, and staff comfort related to ergonomic aspects.

The conventional system demonstrates obstacles in physical ergonomic aspects, where spatial arrangement, furniture dimensions, and movement space have not fully supported work efficiency (8). Similar problems are also found in environmental ergonomic aspects, where lighting conditions, room temperature, ventilation, and storage room security still do not meet standards (4).

The transition to digital systems not only involves technological updates, but also shifts in user mindsets that have the potential to create additional mental burden for staff if the user interface is not designed by considering staff capabilities and limitations (3). The effectiveness of a work system also greatly depends on organizational support that can adapt to technological changes, such as rearranging task structures and teamwork (1).

International studies show that EMR implementation can cause clinical stress and burnout related to system design and usage factors, although it only explains 12.5% of the variance in stress levels and 6.8% in burnout (11). Other research reveals that increased EMR use causes medical personnel to use computers more frequently, which has the potential to cause physical fatigue and discomfort with musculoskeletal complaints in the neck, shoulders, back, and wrists (7).

From these findings, it can be concluded that the application of ergonomics in medical record management involves four interrelated ergonomic dimensions. However, most research only discusses each ergonomic aspect separately and at different system stages, so it is still unclear how these four aspects interact with and adapt to each other throughout the journey of medical records from conventional systems to EMR. This scoping review research is needed to comprehensively and systematically map how ergonomic principles are applied and contribute to each stage of system development, so as to provide a complete picture as a basis for healthcare facilities in designing an efficient transition to EMR that supports staff comfort.

RESEARCH METHODS

This research uses a scoping review approach in accordance with PRISMA-ScR (Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews) guidelines (13). The literature search was conducted systematically using three main databases, namely PubMed for biomedical literature, Google Scholar which was analyzed with Publish or Perish (PoP) software version 7.0 to analyze trends and citations, and Research Rabbit to search and explore academic journals. The keywords used were "Ergonomi" AND "Digitalisasi" AND "Rekam Medis Elektronik (RME)" in Indonesian, and "Ergonomic" AND "Digitalization" AND "Electronic Medical Record (EMR)" in English, without publication year limitations.

Inclusion and exclusion criteria were determined using a modified PICO framework for scoping review (12). Population includes medical record officers and health workers involved in medical record management. Intervention involves the application of physical, environmental, cognitive, and organizational ergonomic aspects in all stages of medical record management. Outcomes are focused on improving work efficiency, comfort, productivity, data accuracy, and staff workflow smoothness. Included articles are journals in Indonesian and English, accessible in full text, accredited, and relevant to the topic.

The selection process was carried out through three stages: (1) title screening, (2) title and abstract review, (3) full text analysis. Of the 1,037 articles identified (Google Scholar n=1000, PubMed n=14, Research Rabbit n=23), 820 articles were eliminated at the title and abstract screening stage because they were not relevant. Of the remaining 217 articles, 105 articles could not be accessed in full text and 100 articles did not meet the inclusion criteria based on the PICO framework. Manual search (hand search) yielded 2 additional articles, bringing the total to 14 articles selected for analysis.

Data extraction was conducted by identifying key elements such as the ergonomic aspects analyzed, research objectives, methodology, and main findings. The data were then synthesized based on the stage of system development (conventional, digitalization, EMR implementation) and the dominant ergonomic aspects (physical, environmental, cognitive, organizational) to identify research patterns and trends.

Table 1. . Keywords for the scoping review in the national database

Ergonomi	AND	Digitalisasi	AND	Rekam Medis Elektronik (RME)
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Table 2. Keywords for the scoping review in the international database

Ergonomic	AND	Digitalization	AND	Electronic Medical Record (ERM)
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Table 3. Inclusion and exclusion criteria based on the PICO framework

Criteria	Inclusion	Exclusion
Population	Medical record officers who directly experience the impact of workspace layout, both in conventional and digital	Articles focusing on other healthcare professionals who are not directly involved in medical record management.

	systems.	
Intervention	Implementation of ergonomic aspects at every stage of medical record management, ranging from conventional systems and digitalization to the implementation of Electronic Medical Records (EMR).	Articles that focus solely on clinical aspects of patients without addressing ergonomics or workspace layout.
Comparators	-	-
Outcomes	Improvement in work efficiency, comfort, productivity, data accuracy, and workflow continuity across all stages, from conventional systems and digitalization to EMR implementation.	Articles discussing patient clinical outcomes without measuring the impact on healthcare personnel.

Figure 1. Flowchart diagram of the scoping review based on PRISMA

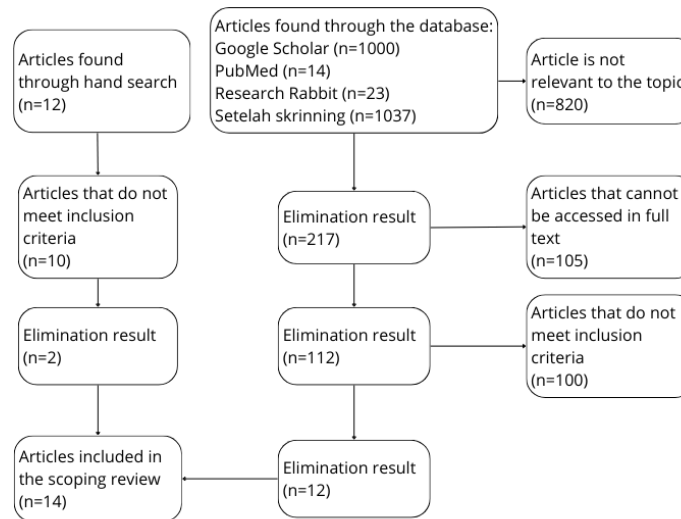


Table 4. Article code and title

Code	Article Title	Article Type	Ergonomic Category
[1]	Realizing quality helath service through ergonomic re-design of the medical records room at the kedungkandang community health center	Conventional	Physical
[2]	Tinjauan aspek ergonomi lingkungan dan keamanan kerja pada ruang rekam medis RS Tiara Bekasi (4)	Conventional	Eviromental
[3]	Faktor-faktor yang mempengaruhi ergonomi ruangan <i>filling</i> terhadap akses petugas rekam medis di RSUD Siak tahun 2018 (8)	Conventional	Physical
[4]	Desain ergonomi ruang <i>filling</i> berkas rekam medis rawat jalan di RSUD Dr. M. M. Dunda Limboto (6)	Conventional	Physical
[5]	Tinjauan tata ruang penyimpanan berkas rekam medis berdasarkan aspek ergonomi guna menunjang kelancaran pelayanan di RSAU Lanud Sulaiman Bandung	Conventional	Eviromental
[6]	Desain unit kerja rekam medis berdasarkan aspek ergonomi di Puskesmas Senduro	Conventional	Physical
[7]	Tinjauan peralihan rekam medis rawat jalan manual ke rekam medis elektronik di rumah sakit MRCCC Siloam Semanggi (5)	Digitalization	Cognitive
[8]	Transformasi pelayanan rekam medis dan dampaknya terhadap kinerja petugas di rumah sakit Pelabuhan Jakarta	Digitalization	Organization
[9]	Kesiapan petugas dalam peralihan dokumen rekam medis manual ke <i>paperless</i> pada unit rekam medis Puskesmas Kedungmundu Kota Semarang	Digitalization	Organization
[10]	Analisis pelaksanaan alih media rekam medis rawat inap konvensional ke rekam medis elektronik di Rumah Sakit Umum Daerah Sanjiwani	Digitalization	Organization

[11]	Implementasi penggunaan rekam medik elektronik rawat jalan di rumah sakit Gotong Royong Surabaya (3)	EMR Implementation	Cognitive
[12]	Implementasi rekam medik elektronik: sebuah studi kualitatif (1)	EMR Implementation	Organization
[13]	Association of electronic health record design and use factors with clinician stress and burnout (11)	EMR Implementation	Cognitive
[14]	Detrimental effects of an electronic health records system on musculoskeletal symptoms among health professionals (7)	EMR Implementation	Physical

Table 5. Clasification of article based on ergonomic aspect

Ergonomic Aspect	Article Code	Research Focus
Physocal Ergonomic	1, 3, 4, 6, 14	Highlights workspace layout, furniture dimensions, shelf spacing, and workstation design based on staff anthropometry. This category also analyzes the risk of musculoskeletal disorders such as repetitive strain injury (RSI), non-ergonomic working postures, and physical fatigue. The main objective is to improve work efficiency, occupational health, and comfort
Eviromental Ergonomic	2, 5	Analyzes physical environmental conditions of the workspace, including lighting intensity, air temperature, ventilation systems, and room cleanliness. It also examines the security of access to document storage areas to prevent data security risks and ensure staff comfort during work activities.
Cognitive Ergonomic	7, 11, 13	Examines mental workload, user adaptation difficulties to digital systems, user interface design quality, and the risk of fatigue associated with the use of electronic medical record systems.
Organization Ergonomic	8, 9, 10, 12	Focuses on management support, task distribution, human resource training, and organizational policies in EMR implementation to maintain efficiency and data security.

RESULTS AND DISCUSSION

Mapping of ergonomic research article on medical recors

The analysis of the 14 selected articles indicates that the distribution of research on medical records ergonomics remains uneven. Physical ergonomics dominates the literature, accounting for 35.7% (5 articles), followed by organizational ergonomics at 28.6% (4 articles), cognitive ergonomics at 21.4% (3 articles), and environmental ergonomics as the least studied aspect at 14.3% (2 articles). This distribution pattern reflects a shift in research focus in line with the development of medical record technologies. Early studies conducted between 2014 and 2020 predominantly examined physical ergonomic issues within conventional systems. Subsequently, research attention increased during the 2021 – 2023 period, coinciding with the enactment of Regulation of the Minister of Health Number 24 of 2022. In the 2024 – 2025 period, research trends appear to stabilize, with a stronger emphasis on the implementation of Electronic Medical Records (EMR).

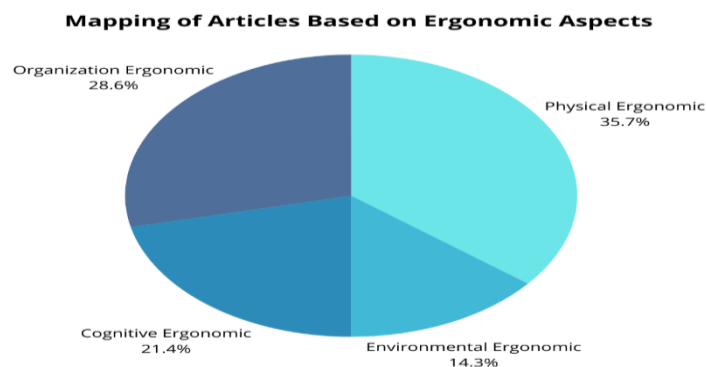
Figure 2. Mapping Of Articles Based On Ergonomics Aspects

Figure 3. Mapping articles by year of publication



Geographically, , 85,7% of the studies were conducted in Indonesia, with 75% concentrated on Java Island, while international studies accounted for only 14.3%. In terms of healthcare facility level, 64.3% of the studies were conducted in hospitals and 21.4% in community health centers. These findings indicate a substantial research bias toward secondary-tertiary healthcare facilities and the Java region. Consequently, the results may not be fully representative of healthcare facilities outside Java Island, which often face different infrastructural, organizational, and technological challenges.

Table 6. Characteristic article

Category	Subcategory	Articles
Year of publication	2014 – 2020	14, 15, 9, 3
	2020 – 2023	12, 7, 6, 11, 5
	2024 – 2025	10, 8, 4, 2, 1
Geographocal location	Indonesian	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12
	International	13, 14
Facility type	Hospital	2, 3, 4, 5, 7, 8, 10, 11, 12
	Community health center	1, 6, 9
	Multi facilities	13, 14
Regional distribution (Indonesia)	Java Island	1, 2, 5, 6, 7, 8, 9, 11, 12
	Outside java island	3, 4, 10

Physical and environment ergonomics in conventional system

In the conventional, ergonomic issues predominantly focused on inadequate physical and environmental working conditions [1][2][3][4][5][6]. Numerous studies indicate that the design of medical record filing rooms has not met ergonomic standards. Article [3] identified problems such as limited workspace, inappropriate spacing between shelves, and the absence of ladders to access high shelves. Meanwhile, Article [4] reported that the filing room area measured only 24.26 m², far below the ideal requirement of 61 m². Shelf spacing was limited to 72 cm, which did not meet the Ministry of Health standard of 90 cm. In addition, room temperature reached 29°C, exceeding the recommended standard of 20–28°C, and lighting intensity was only 37 lux, significantly lower than the required 100 lux.

The consistent findings suggest that physical ergonomics represents a common challenge across various healthcare facilities in Indonesia, leading to staff discomfort, restricted movement, repetitive work activities, and non-ergonomic working postures. Environmental ergonomics has also received attention due to issues reported in Articles [2] and [5]. These studies consistently identified uneven lighting distribution, suboptimal room temperature, inadequate ventilation systems, and the absence of security systems for storage room access, which poses risks to document security.

Improvement efforts began to emerge through studies that proposed ergonomic-based redesigns. Articles [1] and [6] designed a medical records work unit measuring 10 m × 6 m using SketchUp 3D 2020, adjusted to staff anthropometric data, along with improvements to registration counters and ventilation systems. Other studies adopted a different approach by identifying and evaluating existing problems without proposing concrete solutions [3][4][5]. This trend reflects a growing awareness that ergonomics should be considered from the early stages of workspace design.

Although articles [1] and [6] offered advantages by producing ergonomic designs based on anthropometric data, the absence of implementation and post-implementation evaluation stages means that the effectiveness of the proposed solutions remains unverified. Conversely, Articles [3][4][5] provided detailed and systematic documentation of ergonomic problems but did not offer quantitative improvement recommendations, such as calculating the required number of air conditioning units or lighting fixtures based on room size and applicable standards [4]. Furthermore, research on environmental ergonomics remains limited (13.3%), despite its direct impact on staff concentration and productivity.

Cognitive and organization ergonomics during the digitalization phase

The transition from manual medical records to digital systems introduced fundamental changes in ergonomic application, shifting from physical activities to tasks requiring higher mental concentration and system-use competencies [7][8][9][10]. Study [7] documented that the transition process at MRCCC Siloam Semanggi Hospital, initiated in November 2018, continued to face challenges. Approximately 18% of 100 transferred medical records did not meet procedural accuracy, particularly during the data migration stage, which achieved only 82% accuracy due to patient identity verification errors and data input inaccuracies.

The phase highlights new cognitive challenges for staff, as they must adapt to digital workflows, conduct system-based data verification, and ensure accurate data entry. These activities demand a higher level of mental concentration compared to conventional systems. Similar findings were reported in Studies [7] and [11], which emphasized the importance of user interface design and user competence in determining successful system implementation. However, a temporal difference is evident, with Study [7] conducted during the early adaptation phase and Study [11] during the evaluation phase after system implementation. Additionally, the continued use of shared login accounts and resistance to EMR adoption among senior physicians due to age-related factors were reported in Study [7], indicating that cognitive adaptation varies significantly and is strongly influenced by individual characteristics.

Aloside cognitive challenges, organizational ergonomics emerged as a critical factor during digital system implementation [8][9][10]. Study [8] demonstrated that the transformation of medical record services at Pelabuhan Jakarta Hospital affected staff performance, particularly in work pattern adjustments and inter-unit coordination. However, statistical analysis showed no significant performance difference between conventional systems and EMR ($p = 0.19$; $p > 0.05$), suggesting that the transition remained in an adaptation phase where the new system had not yet demonstrated superiority over the old system.

Several studies [8][9][10] identified similar barriers during the transition process, including limited human resources, technical system issues, and suboptimal infrastructure. In primary care facilities such as community health centers [9], challenges were more fundamental, including unstable internet connections and limited staff experience in using applications. In contrast, hospitals [8][10]

faced issues related to system optimization, although problems such as human resource shortages, scanner malfunctions, and incomplete documentation were still reported. These differences indicate uneven digital readiness across healthcare facilities, with most studies emphasizing problem identification rather than providing systematic organizational solutions.

EMR implementation affects not only work systems but also staff ergonomics across multiple dimensions [11][12][13][14]. Digitalization has not eliminated physical ergonomic problems but has transformed the nature of workload experienced by staff. Under conventional systems, staff activities involved frequent movement within storage areas, whereas EMR implementation shifts workload toward prolonged static computer-based tasks. Study [13] reported increased computer usage duration among most staff following EMR implementation, accompanied by musculoskeletal complaints involving the neck, shoulders, back, and wrists. These issues were attributed to prolonged sitting and repetitive hand movements.

This working pattern reflects a transition from dynamic activities such as standing, bending, and lifting to more static tasks associated with non-ergonomic postures. Similar findings were reported in conventional system studies [3][4], which also highlighted a high risk of musculoskeletal complaints, although with different manifestations. These findings indicate that digitalization should not be viewed as a definitive solution to physical ergonomic problems.

Differences in research focus further demonstrate that ergonomic challenges are universal. Studies conducted in countries with more advanced technological infrastructure [13] continued to identify significant ergonomic issues, while studies in Indonesia [1][3][4][6] still reported fundamental challenges such as limited workspace and inadequate equipment. This variation suggests that ergonomic challenges are highly context-dependent, shaped by facility characteristics and implementation readiness.

EMR implementation also influences cognitive workload, as evidenced by Study [14], which reported increased stress and burnout associated with EMR design and usage factors. These included high documentation demands, accumulation of clinical notes, limited cross-institutional information access, administrative-oriented documentation, and disruptions to work-life balance. In addition to cognitive strain, EMR implementation was associated with physical complaints related to posture and prolonged static work. Although the contribution of EMR-related factors to stress and burnout variability was relatively small, the findings indicate that cognitive ergonomics affects not only work efficiency but also staff mental well-being.

Study [11] showed that EMR implementation has the potential to improve work efficiency and space utilization, with outcomes highly influenced by user readiness and system design characteristics. Methodological differences between large-scale quantitative studies [14] and descriptive studies conducted in Indonesia [7][11] suggest that understanding EMR implementation requires broader perspectives that integrate system, organizational, and environmental factors.

As EMR implementation matures, the role of ergonomics becomes increasingly evident. Successful implementation is strongly influenced by organizational readiness, including the availability of competent human resources, infrastructure support, funding, and leadership capable of managing change [12]. However, EMR implementation continues to face challenges such as system instability, limited system design and integration, low computer literacy among users, and technical support disruptions. Although access control and security measures have been implemented, residual risks remain and require ongoing management.

The benefits of EMR implementation are increasingly evident in improved documentation completeness, operational efficiency, and ease of information access. Multiple studies [8][9][10][11][12] emphasize that comprehensive organizational support, including infrastructure, human resources, and management, plays a crucial role in determining the success of digital systems. Differences in research focus indicate that study [12] primarily emphasized problem identification, indirectly highlighting that EMR contributions to service quality improvement depend heavily on collective organizational involvement and leadership capacity in managing technological change.

Integration of ergonomics aspects future research challenges

Based on the reviewed literature, ergonomic research in medical record systems remains insufficiently integrated. Most studies examine ergonomics partially, focusing on only one or two aspects, such as physical ergonomics in conventional systems [1][3][4][6], limited environmental ergonomics [2][5], cognitive ergonomics during digitalization [7][11][14], and organizational ergonomics during EMR implementation [8][9][10][12]. To date, no study has comprehensively integrated all four ergonomic aspects within a single analytical framework to examine their interrelationships and dynamic changes throughout the transition from conventional systems to EMR.

Study Kroth et al. (14) analyzed EMR system factors, working conditions, and individual strategies simultaneously, although the scope remained limited to the EMR implementation phase. Methodologically, most studies employed descriptive-evaluative approaches that focused on problem identification without proposing implementable solutions [3][4][5][7][9][10]. Research focus patterns appear to follow system implementation stages, shifting from physical and environmental ergonomics to cognitive and organizational aspects during digitalization and EMR implementation. Findings must also be interpreted within their implementation contexts. International studies [13][14] were generally conducted in environments with higher technological readiness and focused on optimization, whereas studies in Indonesia [1–12] reflected early-stage challenges related to space, infrastructure, and human resource readiness.

Identified gaps highlight the need for future research adopting integrative, longitudinal, and implementative approaches. First, longitudinal studies should track a single institution throughout the transition from conventional systems to EMR to capture changes and interrelationships among physical, environmental, cognitive, and organizational ergonomics that cannot be observed through cross-sectional designs. Second, future research should adopt broader scopes through multicenter designs with wider geographic coverage, including healthcare facilities outside Java Island and various types of hospitals and community health centers, to enhance representativeness and generalizability. Third, ergonomic research should incorporate action research approaches that not only identify problems and propose recommendations but also test ergonomic interventions and evaluate their impacts on work efficiency, error rates, staff satisfaction, and service quality. This approach enables data-driven decision-making and the development of evidence-based practices. Fourth, economic aspects of ergonomics remain underexplored; therefore, cost–benefit analyses are necessary to assess the balance between investment requirements and operational benefits. Fifth, in-depth qualitative research on user experience using ethnographic approaches is needed to explore staff lived experiences during system transitions, particularly regarding cognitive and emotional dimensions that are difficult to capture through quantitative surveys. Sixth, comparative cross-country studies between Indonesia and countries with more advanced EMR implementation can provide best practices, lessons learned, and strategies applicable to accelerating effective transitions in Indonesia. Seventh, the development and validation of an integrated digital ergonomics framework encompassing physical, environmental, cognitive, and organizational aspects are required as a basis for assessing healthcare facility readiness for EMR implementation. Such a framework should be practical, measurable, and actionable to support system planning and evaluation. Overall, the evolution of medical record ergonomics from conventional systems to digitalization demonstrates that digitalization does not eliminate ergonomic problems but transforms them into new challenges. Physical ergonomics shift from mobility-related issues to static posture concerns, cognitive ergonomics intensify due to increased mental workload associated with digital systems, and organizational ergonomics play a critical role in determining implementation success. Meanwhile, environmental ergonomics remain relatively neglected. Therefore, the transition toward EMR requires adaptive and contextual approaches to ensure that each phase is supported by appropriate ergonomic interventions, ultimately creating efficient, safe, and comfortable working environments for healthcare personnel.

CONCLUSIONS

Based on the analysis of 14 articles, the focus of ergonomic research has shifted in line with the development of medical record technologies. During the conventional phase (2014 – 2020), studies predominantly examined physical ergonomics (35.7%) and environmental ergonomics (14.3%), addressing issues related to filing room space, shelf layout, lighting, ventilation, and security systems. As the transition to digital systems progressed (2021 – 2025), research focus shifted toward cognitive ergonomics (21.4%) and organizational ergonomics (28.6%), emphasizing staff adaptation to new systems, mental workload associated with EMR use, and organizational support in managing change.

These findings indicate that digitalization does not eliminate ergonomic challenges but transforms their nature. Physical workloads involving storage mobility shift toward prolonged static postures at computer workstations, while cognitive workloads increase due to digital data verification demands and adaptation to system interfaces. Most studies continue to address ergonomic aspects partially, providing limited insights into how the four ergonomic dimensions interact throughout the system transition process.

This review highlights opportunities for developing an integrated framework that incorporates physical, environmental, cognitive, and organizational ergonomics as an instrument for assessing healthcare facility readiness for EMR implementation. In addition, future research should adopt longitudinal designs to capture ergonomic dynamics, action research to test intervention effectiveness, and comparative studies with countries that have more advanced EMR implementation. Through more integrative approaches, EMR transitions can be implemented more effectively while maintaining staff comfort, safety, and well-being. This review highlights opportunities for developing an integrated framework that incorporates physical, environmental, cognitive, and organizational ergonomics as an instrument for assessing healthcare facility readiness for EMR implementation. In addition, future research should adopt longitudinal designs to capture ergonomic dynamics, action research to test intervention effectiveness, and comparative studies with countries that have more advanced EMR implementation. Through more integrative approaches, EMR transitions can be implemented more effectively while maintaining staff comfort, safety, and well-being.

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