

Transforming Healthcare Work Systems Through Human-Centred Ergonomic Innovation

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Abstract

Healthcare work systems are becoming increasingly complex due to growing physical demands, cognitive workload, technological development, workforce pressures, and changing organisational requirements. Human centred ergonomic innovation provides an important approach for improving the interaction between healthcare professionals and the systems in which they perform their responsibilities. This article examines the role of human centred ergonomic innovation in transforming healthcare work systems by integrating physical ergonomics, cognitive work design, technology usability, workforce sustainability, and participatory organisational improvement. The analysis identifies several continuing challenges, including fragmented implementation of ergonomic practices, persistent physical and cognitive demands, misalignment between digital technologies and professional workflows, workforce burnout, and limited employee participation in workplace innovation. The discussion demonstrates that effective ergonomic transformation requires a systems perspective that considers the relationships among people, tasks, technologies, physical environments, workload, and organisational structures. Strategic recommendations emphasise integrating ergonomics into organisational planning, improving physical and cognitive work design, strengthening sustainable workload and psychosocial conditions, and establishing participatory approaches to continuous workplace improvement. Overall, human centred ergonomic innovation provides a comprehensive foundation for developing healthcare work systems that support professional wellbeing, operational effectiveness, technological adaptability, and sustainable organisational performance.

Keywords: *Transformation, Worksystems, Digitalisation, Participation, Resilience*

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1. Introduction

Healthcare work systems have become increasingly complex as professionals are required to coordinate patient care, technologies, information, organisational procedures, physical environments, and multidisciplinary relationships within demanding operational settings. This complexity makes conventional approaches to workplace improvement insufficient when they focus on isolated tasks or individual behaviour. Human centred ergonomic innovation offers a broader perspective by designing work around human capabilities, limitations, and interactions with the wider system. Dul et al. (2012) argued that human factors and ergonomics should contribute simultaneously to human wellbeing and system performance, while Carayon et al. (2006) demonstrated through the Systems Engineering Initiative for Patient Safety model that healthcare outcomes emerge from interactions among people, tasks, tools, technologies, organisational factors, and physical environments. Holden et al. (2013) subsequently extended this systems perspective through SEIPS 2.0, emphasising the adaptive and dynamic nature of healthcare work. Gurses et al. (2012) similarly observed that patient safety problems are rarely attributable to a single system component. These perspectives position ergonomic innovation as an organisational approach capable of transforming healthcare work systems by improving the alignment between professional needs, operational processes, technological resources, and workplace conditions.

The transformation of healthcare work requires particular attention to physical ergonomics because many healthcare professionals continue to perform demanding activities involving patient handling, prolonged standing, repetitive movement, equipment manipulation, and constrained postures. Physical workload is especially significant in nursing, where routine care may require lifting, transferring, repositioning, and supporting patients under time pressure. Trinkoff et al. (2003) identified relationships between perceived physical demands and musculoskeletal problems among registered nurses, demonstrating that occupational exposure is closely connected with work design. Hignett (2003) further showed that effective patient handling interventions require comprehensive ergonomic strategies rather than reliance on technique training alone. Davis and Kotowski (2015) later reported a substantial prevalence of musculoskeletal disorders among nurses working across healthcare settings, reinforcing the persistence of physical ergonomic concerns. Tariah et al. (2020) likewise identified lifting, awkward postures, repetitive activities, and prolonged positions as important occupational risks among nurses. These findings indicate that ergonomic innovation should redesign tasks, equipment, workspace arrangements, and organisational support rather than expecting healthcare professionals to compensate continuously for demanding physical conditions. Physical ergonomics therefore remains a fundamental component of transforming healthcare work systems towards safer and more sustainable professional practice.

Cognitive demands have become equally important because healthcare professionals must process large amounts of information while managing interruptions, communicating with colleagues, documenting care, monitoring patients, and making time sensitive decisions. The effectiveness of professional performance therefore depends not only on knowledge and competence but also on whether work systems support attention, information processing, and decision making. Leonard et al. (2004) emphasised the critical role of communication and teamwork in safe healthcare delivery, illustrating how organisational design can influence cognitive performance. Carayon et al. (2014) later identified technology usability, human performance, system resilience, and systems approaches as major human factors domains relevant to patient safety. Workflow fragmentation can further increase mental demands when professionals repeatedly shift between competing activities. Weigl et al. (2012) demonstrated that workflow interruptions were associated with hospital doctors' workload, highlighting the relationship between work organisation and cognitive burden. Wisner et al. (2019) subsequently showed that electronic health records influence nurses' cognitive work in multiple ways. These findings suggest that human centred ergonomic innovation should simplify information flows, reduce avoidable interruptions, improve communication structures, and design work processes that allow healthcare professionals to concentrate their cognitive resources on essential professional responsibilities.

Rapid digitalisation has further changed healthcare work systems by increasing professional dependence on electronic health records, hospital information systems, digital communication, and other information technologies. Although these technologies can improve access to information and coordination, their value depends substantially on usability and compatibility with real work processes. Kroth et al. (2019) found associations between electronic health record design and use factors, clinician stress, and burnout, indicating that poorly aligned technologies can generate additional professional demands. Kutney Lee et al. (2019) similarly demonstrated that hospital work environments influence nurses' perceptions of electronic health record usability

and the quality and safety of care. Melnick et al. (2020) reported a strong association between physicians' perceptions of electronic health record usability and professional burnout. From a human factors perspective, Zayas-Cabán and White (2020) argued that ergonomic methods can improve the design, implementation, and use of health information technology. Zhou et al. (2019) also showed that facilitating conditions and social influences affected nurses' adoption of hospital electronic information management systems. Consequently, digital innovation should be human centred, ensuring that technology supports professional workflows, reduces unnecessary cognitive burden, and strengthens rather than disrupts the wider healthcare work system.

Workload and working time represent another critical dimension because healthcare organisations must maintain continuous service while protecting professionals from excessive and prolonged demands. Staffing shortages, high patient loads, long shifts, overtime, administrative responsibilities, and limited recovery opportunities can create working conditions that are difficult to sustain. Aiken et al. (2002) demonstrated that higher patient workloads were associated with greater nurse burnout and job dissatisfaction as well as poorer patient outcomes. Dall'Ora et al. (2015) later found that nurses working shifts of twelve hours or longer were more likely to experience burnout, job dissatisfaction, and intentions to leave their employment. More recent evidence reinforced the importance of work organisation. Dall'Ora et al. (2020) identified high workload, low staffing, long shifts, limited schedule flexibility, and poor working environments among factors associated with nursing burnout. Woo et al. (2020), through a global systematic review and meta analysis, further demonstrated that burnout symptoms are widespread among nurses. These findings indicate that ergonomic innovation cannot focus only on physical equipment or technology. Transforming healthcare work systems also requires redesigning workload distribution, staffing arrangements, working time, job control, and recovery opportunities so that professional performance can be maintained without progressively weakening workforce wellbeing.

Psychosocial conditions further shape healthcare work because professionals routinely face emotional demands, responsibility for patient outcomes, interpersonal challenges, uncertainty, and organisational pressure. Sustainable transformation therefore requires work systems that provide appropriate social and managerial resources alongside technical and physical improvements. Hall et al. (2016) found that poor healthcare staff wellbeing and burnout were associated with patient safety concerns, demonstrating that workforce wellbeing has implications for wider organisational outcomes. Bodenheimer and Sinsky (2014) similarly argued that healthcare improvement should include the work life of providers as part of the broader objectives of health system performance. Leadership is particularly important because managers influence workload, communication, recognition, professional autonomy, and access to organisational resources. Shanafelt and Noseworthy (2017) identified several organisational strategies for promoting physician engagement and reducing burnout, while Cummings et al. (2018) found that relational leadership styles were associated with more favourable nursing workforce and work environment outcomes. West et al. (2016) additionally demonstrated that interventions can reduce physician burnout. Together, this evidence suggests that human centred ergonomic innovation must incorporate psychosocial work design, ensuring that leadership, communication, organisational support, job resources, and professional relationships contribute to resilient and sustainable healthcare work systems.

Employee participation is central to human centred ergonomic innovation because healthcare professionals possess direct knowledge of how formal procedures operate under real workplace conditions. They experience equipment limitations, workflow barriers, technology problems, communication difficulties, workload fluctuations, and informal adaptations that may not be visible through administrative indicators. Participatory design therefore provides an opportunity to combine professional experience with managerial and technical expertise when work systems are redesigned. Holden et al. (2013) emphasised that healthcare professionals actively adapt to the systems in which they work, while Carayon et al. (2020) extended the SEIPS perspective by highlighting human centred design across complex patient journeys. The latter framework also recognises the challenges of involving multiple stakeholders across interconnected healthcare settings. Paguio et al. (2020) reviewed interventions designed to improve nurses' work environments and found that organisational interventions can influence nurse, patient, and hospital outcomes. Niskala et al. (2020) similarly demonstrated that organisational interventions can improve nurses' job satisfaction. These findings support greater professional participation in ergonomic assessment, technology evaluation, workflow redesign, and organisational improvement. Innovation becomes more meaningful when employees are not merely users of redesigned systems but active contributors whose experiential knowledge helps shape practical, acceptable, and sustainable workplace solutions.

A systems perspective is essential because changes intended to improve one element of healthcare work can create unexpected consequences elsewhere. New technology may improve information availability while increasing documentation burden, additional staffing may have limited impact when workflows remain inefficient, and redesigned spaces may fail to improve performance when communication or role responsibilities remain unclear. Karsh et al. (2010) emphasised the importance of macroergonomic and multilevel perspectives in patient safety research, reinforcing the need to examine interactions across organisational levels. Carayon et al. (2014) similarly argued that human factors approaches should address the broader system rather than individual components in isolation. More recently, Carayon et al. (2020) introduced SEIPS 3.0 to represent healthcare as a series of interconnected work systems across the patient journey. This development broadens the meaning of ergonomic innovation by connecting local workplace design with organisational processes and wider healthcare pathways. Human centred transformation should therefore evaluate how physical environments, digital technologies, professional roles, communication practices, staffing, leadership, and organisational policies influence one another. A coordinated systems approach can reduce fragmented improvement efforts and create stronger alignment between professional wellbeing, operational effectiveness, patient safety, and organisational adaptability.

By 2020, the accumulated evidence provided a strong basis for treating human centred ergonomic innovation as a strategic approach to healthcare transformation rather than a narrow occupational intervention. Healthcare organisations face simultaneous pressures involving workforce wellbeing, digitalisation, patient safety, service quality, workload, staffing, and changing patterns of care. Addressing these pressures independently may produce limited improvement because they emerge from interconnected characteristics of healthcare work systems. Paguio et al. (2020) demonstrated that interventions targeting nurses' work environments can influence outcomes across employees, patients, and hospitals, while Carayon et al. (2020) reinforced the importance of human centred systems design across complex healthcare journeys. Melnick et al. (2020) showed that technology usability can be associated with professional burnout, and Dall'Ora et al. (2020) demonstrated that workload and organisational conditions are important contributors to nursing burnout. Yusof et al., (2020) further connected staff wellbeing with patient safety. Collectively, these findings indicate that meaningful transformation depends on redesigning work around human capabilities while maintaining organisational objectives. Human centred ergonomic innovation can provide this integrative foundation by linking physical work design, cognitive demands, technology, workload, psychosocial conditions, employee participation, and organisational systems within a coherent approach to healthcare improvement.

2. Literature Review

Human centred ergonomic innovation has become increasingly relevant to healthcare because work system performance depends on the interaction between professionals, tasks, technologies, physical environments, organisational processes, and social relationships. Rather than focusing narrowly on individual behaviour or workplace equipment, contemporary ergonomics considers how the complete work system can be designed to accommodate human capabilities while supporting organisational objectives. Dul et al. (2012) positioned human factors and ergonomics as a discipline capable of contributing simultaneously to human wellbeing and system performance, while Carayon et al. (2006) established a healthcare specific systems perspective through the SEIPS framework. Holden et al. (2013) subsequently expanded this approach to recognise the adaptive nature of healthcare work. These developments provide an important theoretical foundation for understanding ergonomic innovation as a mechanism for transforming healthcare work systems. The following review focuses on human centred healthcare systems, physical and cognitive ergonomic transformation, technology supported work design, and workforce sustainability through participatory organisational improvement.

2.1 Human Centred Ergonomic Innovation in Healthcare Work Systems

Human centred ergonomic innovation provides a systems based foundation for understanding how healthcare work can be redesigned around the capabilities, limitations, and needs of professionals. The SEIPS framework developed by Carayon et al. (2006) established that healthcare outcomes are influenced by interactions among people, tasks, tools, technologies, organisational characteristics, and physical environments. Holden et al. (2013) extended this perspective through SEIPS 2.0 by emphasising adaptive work processes and the active role of

professionals within changing healthcare systems. From a broader macroergonomic perspective, Karsh and Brown (2010) argued that patient safety research should recognise relationships across individual, unit, and organisational levels rather than treating workplace factors independently. Gurses et al. (2012) similarly highlighted the need to accelerate the integration of human factors and ergonomics into patient safety because complex system interactions often shape performance problems. These perspectives indicate that ergonomic innovation should not be limited to isolated workplace modifications. Instead, healthcare organisations should redesign work systems by considering how professional capabilities interact with technology, workload, communication, physical environments, and organisational policies. Such an integrated approach can provide a stronger basis for improving system reliability while maintaining human wellbeing.

More recent developments have strengthened the importance of human centred design as healthcare systems become more interconnected and technologically dependent. Carayon et al. (2014) demonstrated that human factors and systems engineering can contribute to healthcare quality by analysing relationships between work system design, professional performance, and patient safety. Carayon et al. (2020) further advanced this perspective through SEIPS 3.0, which placed greater emphasis on human centred design across the patient journey and recognised that healthcare activities extend across multiple work systems. Facility design also forms part of this wider ergonomic perspective. Halawa et al. (2020) found that evidence based healthcare facility design requires alignment among operational, environmental, experiential, clinical, and organisational objectives. Dul et al. (2012) similarly argued that ergonomics should create value by supporting both human wellbeing and system performance rather than treating them as competing priorities. Together, these studies indicate that ergonomic innovation involves more than introducing new equipment or procedures. It requires coordinated redesign of spaces, processes, technologies, and organisational arrangements so that healthcare professionals can work effectively within environments that reflect real human capabilities and changing service demands.

2.2 Physical and Cognitive Ergonomic Transformation in Healthcare

Physical ergonomics remains central to healthcare work system transformation because many professional activities expose employees to repetitive movement, awkward postures, patient handling demands, prolonged standing, and equipment related strain. Trinkoff et al. (2003) identified relationships between perceived physical demands and musculoskeletal problems among registered nurses, demonstrating the importance of job design in occupational health. Hignett (2003) found that interventions focused only on manual lifting techniques were insufficient and that broader ergonomic strategies were required to reduce patient handling injuries. Davis and Kotowski (2015) later reported a substantial prevalence of musculoskeletal disorders among nurses across hospitals, long term care, and home healthcare settings. Tariah et al. (2020) similarly identified lifting, stooping, repetitive activity, and awkward working positions among significant occupational demands experienced by nurses. These findings show that physical strain cannot be addressed effectively by expecting professionals to modify personal behaviour while difficult workplace conditions remain unchanged. Human centred ergonomic innovation should therefore integrate task redesign, suitable equipment, workspace configuration, staffing support, and preventive assessment to reduce unnecessary physical exposure while preserving efficient professional practice. This broader perspective is important for protecting health, preserving work ability, and supporting long term workforce participation.

Cognitive ergonomics is equally important because healthcare professionals must continuously interpret information, prioritise competing demands, coordinate with colleagues, and make decisions under time pressure. Weigl et al. (2012) demonstrated that workflow interruptions were associated with hospital doctors' workload, showing how work organisation can increase cognitive burden. Leonard et al. (2004) emphasised that effective communication and teamwork are critical for safe healthcare delivery, indicating that information exchange must be designed to support rather than complicate professional decision making. Wisner et al. (2019) further showed that electronic health records can influence nurses' cognitive work by affecting information synthesis, shared understanding, and the ability to maintain an overview of patient conditions. These studies suggest that cognitive performance depends partly on how work systems structure information, interruptions, communication, and task sequences. Human centred innovation should therefore reduce unnecessary complexity, improve information visibility, support coordination, and protect attention during demanding activities. Integrating physical and cognitive ergonomics provides a more complete approach because healthcare professionals often experience bodily demands and mental workload simultaneously within the same work process. Such coordination is

particularly important in settings where rapid decisions, complex information, and demanding physical activities occur together.

2.3 Human Centred Technology in Healthcare Work Design

Digital technologies have become a major component of healthcare work systems, making technology usability an important dimension of ergonomic innovation. Kutney-Lee et al. (2019) found that nurses' perceptions of electronic health record usability were related to the wider hospital work environment and reports of care quality. Kroth et al. (2019) similarly identified associations between electronic health record design and use factors with clinician stress and burnout. Melnick et al. (2020) demonstrated that physicians who perceived poorer electronic health record usability had greater odds of professional burnout, reinforcing the importance of technology design for workforce wellbeing. Fraczkowski et al. (2020) found that electronic health record workarounds could arise from technology, task, organisational, patient, environmental, and usability factors, suggesting that system problems often extend beyond software functionality alone. Tolentino and Gephart (2020) further identified functional, physical, perceptual, cognitive, psychological, and social dimensions of nurses' electronic health record experience. Collectively, this evidence indicates that digital transformation should be evaluated according to how technologies fit professional work rather than simply whether systems provide advanced technical capabilities. Human centred technological innovation can therefore strengthen efficiency only when usability, workflow compatibility, and professional experience are treated as core design requirements.

Successful technological innovation also depends on organisational support and professional participation during system adoption and redesign. Zhou et al. (2019) demonstrated that facilitating conditions and social influence contributed to nurses' adoption of hospital electronic information management systems, highlighting the importance of organisational context in technology acceptance. Zayas-Cabán and White (2020) similarly emphasised the role of human factors and ergonomics in improving the design, implementation, and use of health information technology. The literature therefore suggests that technology implementation should include user testing, workflow analysis, usability evaluation, and continuing feedback after deployment. Human centred design is particularly important because professionals may develop informal workarounds when formal technological processes do not correspond with real clinical work. Such workarounds can indicate a mismatch between system design and operational requirements rather than simple resistance to technology. Healthcare organisations should consequently view users as active contributors to technological innovation. Greater involvement of professionals can help identify cognitive burden, unnecessary documentation, fragmented information, and workflow incompatibilities before these problems become embedded in everyday practice, thereby strengthening both technology acceptance and work system effectiveness. This participatory approach can also improve organisational learning by ensuring that emerging technology problems are identified, discussed, and corrected systematically.

2.4 Workforce Sustainability and Participatory Organisational Innovation

Workload and psychosocial conditions are fundamental to ergonomic transformation because sustainable healthcare performance depends on maintaining a reasonable relationship between job demands and available resources. Dall'Ora et al. (2015) found that nurses working shifts of twelve hours or longer were more likely to report burnout, job dissatisfaction, and intentions to leave. Dall'Ora et al. (2020) later identified high workload, inadequate staffing, long shifts, limited schedule flexibility, and poor working environments among important contributors to nursing burnout. Woo et al. (2020) demonstrated through a global systematic review and meta analysis that burnout symptoms were widespread among nurses across countries and specialties. Hall et al. (2016) also identified associations between healthcare staff wellbeing, burnout, and patient safety. These findings indicate that psychosocial strain should not be treated primarily as an individual coping problem. Instead, ergonomic innovation should address how staffing, working time, professional autonomy, leadership, communication, and recovery opportunities are organised. Transforming these conditions can support workforce wellbeing while reducing the risk that persistent organisational pressures undermine professional performance and workforce continuity. A sustainable approach should therefore consider employee wellbeing as an organisational resource that requires deliberate protection through effective work design.

Organisational interventions and employee participation provide practical mechanisms for translating ergonomic principles into sustained workplace improvement. Cummings et al. (2018) found that relational leadership styles were associated with favourable nursing workforce and work environment outcomes, demonstrating that leadership forms part of the wider work system. Niskala et al. (2020) showed that selected organisational interventions can improve nurses' job satisfaction, while Paguio et al. (2020) found that interventions targeting nurses' work environments can influence nurse, patient, and hospital outcomes. Participatory approaches are particularly valuable because healthcare professionals possess detailed knowledge of operational problems that may be difficult to identify through administrative measures alone. Shire et al. (2020) demonstrated that participatory system dynamics modelling can support healthcare workers in understanding relationships among workload, interruptions, fatigue, productivity, and safety within hospital pharmacy systems. These findings suggest that ergonomic innovation should become a continuous organisational process involving employees, managers, technology specialists, and other relevant stakeholders. Participation can strengthen problem identification, organisational learning, implementation quality, and the long term sustainability of redesigned healthcare work systems. Continuous participation also enables organisations to evaluate whether workplace innovations remain appropriate as technologies, service demands, and professional responsibilities change.

3. Key Issues in Transforming Healthcare Work Systems Through Human Centred Ergonomic Innovation

Transforming healthcare work systems through human centred ergonomic innovation remains challenging because healthcare organisations operate within complex environments where physical demands, cognitive workload, digital technologies, workforce pressures, and organisational structures interact continuously. Although ergonomic principles can improve both human wellbeing and system performance, their implementation frequently requires changes extending beyond individual tasks or equipment. Healthcare organisations must consider how technologies fit professional workflows, how physical environments support occupational demands, how workloads influence workforce sustainability, and how employees participate in workplace improvement. Evidence available by 2020 demonstrates persistent concerns involving musculoskeletal disorders, electronic health record usability, professional burnout, workload, and difficulties integrating human factors into healthcare systems (Dall'Ora et al., 2020; Melnick et al., 2020; Tariah et al., 2020). These concerns indicate that ergonomic innovation requires coordinated organisational transformation rather than isolated corrective measures. The following issues correspond with the major themes identified in the literature review involving system integration, physical and cognitive ergonomics, human centred technology, and workforce sustainability through organisational participation.

3.1 Fragmented Integration of Human Centred Ergonomics into Healthcare Systems

One significant challenge concerns the fragmented implementation of human centred ergonomics across healthcare work systems. Organisations commonly address physical safety, technology, staffing, workflow, quality, and employee wellbeing through separate programmes, even though these factors interact during everyday healthcare work. Carayon et al. (2006) demonstrated through the SEIPS framework that healthcare performance is influenced by relationships among people, tasks, technologies, organisational conditions, and physical environments. Holden et al. (2013) subsequently extended this systems perspective by emphasising that healthcare professionals continuously adapt to changing work conditions. When ergonomic improvement is implemented independently within individual departments or functions, organisations may overlook the wider consequences of workplace changes. Gurses et al. (2012) argued that human factors and ergonomics should be integrated more systematically into healthcare because safety and performance problems frequently arise from interactions within complex systems. Carayon et al. (2014) similarly demonstrated that system design, technology usability, human performance, and organisational processes are interconnected dimensions of healthcare quality. Consequently, fragmented ergonomic initiatives may improve a particular task while leaving broader sources of workload, communication difficulty, or system inefficiency unchanged. Effective transformation therefore requires ergonomic principles to become part of organisational planning rather than remaining a specialised response to individual workplace problems.

Another difficulty involves balancing organisational priorities with the principles of human centred design. Healthcare managers frequently face simultaneous pressures involving service capacity, financial resources, staffing availability, technological change, quality requirements, and workforce wellbeing. Under these circumstances, short term operational priorities may receive greater attention than the long term suitability of work systems for healthcare professionals. Dul et al. (2012) argued that ergonomics should create value through the simultaneous improvement of human wellbeing and system performance, suggesting that workforce interests and organisational effectiveness should not be considered competing objectives. Carayon et al. (2020) strengthened this argument through SEIPS 3.0 by positioning human centred design across interconnected healthcare journeys rather than within isolated workplaces. Facility design research provides similar evidence. Halawa et al. (2020) demonstrated that healthcare facility development requires alignment between environmental, operational, clinical, experiential, and organisational objectives. These perspectives indicate that meaningful ergonomic innovation requires stronger coordination between strategic management and workplace design. Without such alignment, organisations may introduce technically effective changes that fail to accommodate professional capabilities, workflow realities, or wider organisational interactions. Human centred transformation therefore depends on management recognising ergonomic design as a strategic organisational capability rather than merely an occupational health responsibility.

3.2 Persistent Physical Demands and Increasing Cognitive Workload

Physical demands remain an important obstacle to healthcare work system transformation because many professionals continue to perform activities involving patient handling, repetitive movement, prolonged standing, awkward postures, and equipment manipulation. These demands become particularly problematic when they occur repeatedly under staffing constraints and time pressure. Hignett (2003) demonstrated that patient handling risks cannot be adequately controlled through lifting instruction alone and require broader ergonomic intervention. Trinkoff et al. (2003) similarly identified relationships between physical job demands and musculoskeletal problems among registered nurses. Later research confirmed the persistence of these concerns. Davis and Kotowski (2015) found a substantial prevalence of musculoskeletal disorders among nurses across hospitals and other healthcare settings, while Tariah et al. (2020) identified lifting, repetitive movements, stooping, and awkward working positions among significant occupational exposures. These findings suggest that knowledge concerning physical ergonomics has not always translated fully into work system transformation. Equipment availability, workplace layout, staffing arrangements, task allocation, and operational pressures may restrict the ability of healthcare professionals to apply safer practices consistently. Physical ergonomic innovation therefore requires organisations to modify the conditions surrounding demanding tasks rather than placing primary responsibility on employees to adapt their individual behaviour.

Cognitive workload creates a parallel challenge as healthcare work increasingly requires simultaneous management of information, communication, technology, documentation, interruptions, and clinical responsibilities. Weigl et al. (2012) found that workflow interruptions were associated with hospital doctors' workload, illustrating how work organisation can contribute to cognitive burden. Wisner et al. (2019) further demonstrated that electronic health records influence nurses' cognitive work, including information processing and maintenance of an overall understanding of patient conditions. Digitalisation can increase these demands when technologies do not correspond with professional workflows. Zayas-Cabán and White (2020) specifically emphasised that human factors and ergonomics methods are needed to improve the design, implementation, and use of health information technology. This issue becomes increasingly important because poorly organised information systems may require professionals to divide attention between clinical responsibilities and technologically imposed tasks. Human centred ergonomic innovation should consequently address cognitive workload alongside physical demands. Treating these areas separately may fail to recognise that healthcare professionals commonly experience both forms of demand simultaneously. Successful transformation therefore requires work systems that reduce unnecessary mental complexity while supporting physical safety, information accessibility, communication, and professional judgement.

3.3 Technology Misalignment and Barriers to Human Centred Digital Innovation

Digital healthcare technologies can improve information availability and coordination, but their introduction can also create new ergonomic problems when systems are poorly aligned with professional work. Electronic health

records may require extensive documentation, repeated navigation, complex data entry, and frequent switching between technological and clinical activities. Kroth et al. (2019) identified relationships between electronic health record design and clinician stress and burnout, while Melnick et al. (2020) demonstrated that poorer perceived electronic health record usability was associated with greater professional burnout. These findings indicate that technological capability alone does not guarantee improved work system performance. Professional experience, usability, cognitive effort, and workflow compatibility must also be considered. Fraczkowski et al. (2020) showed that electronic health record workarounds can emerge from technological, task, environmental, organisational, and usability factors, suggesting that employees may adapt informally when formal systems do not support actual work requirements. Such adaptations can signal fundamental mismatches between technology design and professional practice. Human centred digital innovation therefore requires healthcare organisations to evaluate whether technologies genuinely simplify work or merely transfer additional cognitive and administrative demands to healthcare professionals.

Technology adoption also depends on organisational and social conditions rather than solely on the characteristics of the technology itself. Zhou et al. (2019) examined 660 nurses and found that social influence and facilitating conditions were important in explaining behavioural intentions and use of hospital electronic information management systems. These findings demonstrate that successful technology implementation requires appropriate infrastructure, organisational support, professional acceptance, and conditions that enable healthcare employees to use new systems effectively. Zayas-Cabán and White (2020) similarly concluded that human factors and ergonomics can improve the usefulness of health information technology while noting that further innovative approaches remain necessary. Human centred digital transformation should therefore include professionals during technology selection, testing, workflow analysis, implementation, and evaluation. When employees are excluded from these processes, organisations may implement technically sophisticated systems that create new workflow barriers or cognitive demands. Technology related innovation should consequently be judged not only by system functionality but also by how effectively it supports the people performing healthcare work. Better alignment between technology, organisational conditions, and professional requirements can reduce unnecessary workarounds while strengthening sustainable digital transformation.

3.4 Workforce Burnout and Limited Participatory Organisational Innovation

Workforce sustainability represents another major challenge because healthcare professionals frequently experience demanding workloads, long working hours, staffing limitations, emotional pressures, and limited recovery opportunities. Dall'Ora et al. (2015) demonstrated that longer nursing shifts were associated with burnout, job dissatisfaction, and intentions to leave, while Dall'Ora et al. (2020) identified high workload, inadequate staffing, long shifts, limited scheduling flexibility, and poor working environments among significant contributors to nursing burnout. Burnout therefore reflects broader organisational conditions rather than merely an individual difficulty in managing occupational stress. The scale of the concern is reinforced by international evidence. Zeng et al. (2020) found substantial levels of emotional exhaustion, depersonalisation, and reduced personal accomplishment among mental health nurses in China. Zhang et al. (2020) further reviewed systematic reviews and meta analyses of burnout interventions among physicians and nurses and found that addressing burnout requires combinations of individual and organisational approaches. These findings demonstrate that workforce transformation cannot rely primarily on personal resilience programmes. Sustainable ergonomic innovation must address staffing, workload, working time, leadership, job control, organisational support, and professional resources as interconnected dimensions of healthcare work design.

Limited employee participation can further weaken ergonomic innovation because healthcare professionals possess practical knowledge that is essential for understanding actual workplace conditions. Formal procedures may appear effective from an administrative perspective while creating difficulties when professionals attempt to apply them under real workloads, technological constraints, or patient demands. Holden et al. (2013) demonstrated that healthcare professionals actively adapt within dynamic work systems, making their experience valuable for identifying system limitations. Participatory approaches can therefore help organisations understand operational problems before implementing major workplace changes. Paguio et al. (2020) found that interventions aimed at nurses' work environments can influence outcomes involving healthcare professionals, patients, and organisations, indicating that workplace redesign has broader strategic consequences. Burnout research also supports the importance of organisational participation. Zhang et al. (2020) identified organisational interventions as part of the evidence base for reducing burnout among physicians and nurses. Healthcare organisations should

consequently avoid designing ergonomic innovations exclusively through managerial or technical perspectives. Greater professional participation in problem identification, technology evaluation, workflow redesign, and assessment of workplace changes can improve the practical relevance of interventions. Participatory organisational innovation provides a stronger foundation for developing healthcare work systems that remain responsive to workforce needs while maintaining operational effectiveness.

4. Discussion on Transforming Healthcare Work Systems Through Human Centred Ergonomic Innovation

Transforming healthcare work systems requires a broader understanding of ergonomics that extends beyond physical workplace adjustments towards the coordinated design of people, technologies, tasks, organisational processes, and working environments. The issues identified previously demonstrate that fragmented ergonomic implementation, persistent physical and cognitive demands, technology misalignment, workforce burnout, and limited professional participation can restrict meaningful healthcare transformation. Evidence available by 2020 supports a systems oriented response because healthcare professionals operate within interconnected work environments where changes in one component can influence others. Carayon et al. (2020) emphasised human centred design across complex healthcare journeys, while Dall'Ora et al. (2020) demonstrated that workload, control, social support, and organisational conditions contribute to nursing burnout. Human centred ergonomic innovation should therefore integrate workforce needs with organisational objectives so that healthcare transformation improves professional working conditions while strengthening system effectiveness.

4.1 Integrating Human Centred Ergonomics Across Healthcare Work Systems

Healthcare organisations can achieve more meaningful ergonomic transformation when human centred principles are incorporated across the entire work system rather than applied to isolated workplace problems. Physical environments, professional responsibilities, technologies, communication structures, staffing arrangements, and organisational procedures continuously interact during healthcare delivery. Improvements targeting only one component may consequently produce limited results when other system conditions remain unchanged. Carayon et al. (2006) established this interconnected perspective through the SEIPS model, while Holden et al. (2013) expanded it by recognising the dynamic interactions between healthcare professionals and their work environments. Gurses et al. (2012) similarly argued for stronger integration of human factors and ergonomics into healthcare because system problems frequently emerge from relationships among multiple workplace components. These perspectives indicate that ergonomic innovation should become part of routine organisational decision making concerning workforce planning, facility development, technology, workflow, and quality improvement. Human centred transformation can then move beyond correcting individual ergonomic problems towards identifying how organisational structures generate or intensify those problems. Such integration is particularly important because healthcare systems continually change in response to new technologies, patient requirements, professional responsibilities, and operational pressures.

Strategic integration also requires healthcare management to recognise that workforce wellbeing and system performance are complementary organisational objectives. Dul et al. (2012) argued that human factors and ergonomics can contribute simultaneously to human wellbeing and organisational performance, providing an important rationale for embedding ergonomic principles within management practice. This perspective is reinforced by Paguio et al. (2020), whose systematic review found that interventions targeting nurses' work environments can influence outcomes involving nurses, patients, and hospitals. Organisational transformation should therefore consider whether changes in staffing, workflow, technology, facilities, and professional responsibilities create appropriate conditions for employees to perform effectively. Carayon et al. (2020) further advanced this systems orientation through SEIPS 3.0 by emphasising human centred design across interconnected healthcare journeys. Consequently, healthcare organisations should develop mechanisms for evaluating ergonomic consequences before and after organisational changes are implemented. This approach can help management recognise unintended effects, including additional workload, workflow fragmentation, or cognitive burden. Integrating ergonomic assessment with organisational planning can therefore strengthen adaptability while ensuring that healthcare transformation remains responsive to professional capabilities and actual working conditions.

4.2 Balancing Physical Ergonomics with Cognitive Work Demands

Physical ergonomic innovation remains essential because healthcare professionals continue to experience occupational demands that can affect their capacity to work effectively over time. Patient handling, repetitive movements, prolonged standing, awkward postures, and equipment manipulation are common features of healthcare practice, particularly within nursing. Tariah et al. (2020) found that nurses experienced substantial work related musculoskeletal problems, with lower back discomfort particularly prevalent and occupational activities such as lifting, awkward postures, stooping, and repetitive actions identified as important physical demands. Earlier research by Hignett (2003) demonstrated that patient handling risks require comprehensive ergonomic intervention rather than reliance primarily on lifting instruction, while Davis and Kotowski (2015) confirmed the wider prevalence of musculoskeletal disorders among nurses. These findings suggest that physical ergonomic innovation should focus on modifying the surrounding work system. Healthcare organisations should consider how equipment accessibility, workplace layout, staffing, task allocation, and time pressure influence physical exposure. Ergonomic transformation becomes more effective when physical risk prevention is integrated into everyday work design rather than addressed only after occupational problems develop.

Cognitive ergonomics requires comparable attention because healthcare professionals increasingly work within information intensive environments characterised by documentation, communication, interruptions, decision making, and digital technologies. Technology can strengthen healthcare performance, but poorly aligned systems can increase mental workload. Melnick et al. (2020) found that poorer physician perceptions of electronic health record usability were associated with greater odds of professional burnout, demonstrating that technology design has consequences for workforce experience. Khairat et al. (2020) additionally found an association between electronic health record use and physician fatigue and efficiency, reinforcing the importance of user centred interface design. Zayas-Cabán and White (2020) argued that human factors and ergonomics methods can improve the design, implementation, and use of health information technology. These findings support a more balanced understanding of ergonomic innovation in which physical and cognitive demands are considered together. Healthcare organisations should evaluate whether technologies simplify professional activities, support information processing, and correspond with actual workflows rather than merely introducing additional digital functions.

4.3 Strengthening Workforce Sustainability Through Ergonomic Work Design

Workforce sustainability requires healthcare organisations to address workload as a fundamental characteristic of work system design rather than treating excessive demand as an unavoidable feature of professional practice. Dall'Ora et al. (2020) identified high workload, low job control, limited decision latitude, poor social support, and inadequate rewards among important predictors of nursing burnout. These relationships demonstrate that burnout can develop from the organisation of work itself and should therefore be addressed through organisational redesign alongside individual support. Workload management should consider staffing adequacy, patient demands, working hours, scheduling, professional autonomy, and opportunities for recovery. Yusof et al. (2020) further identified personal and work related factors associated with nurse resilience, demonstrating that the capacity to manage demanding healthcare work is influenced by workplace conditions as well as individual characteristics. Human centred ergonomic innovation should consequently seek to create environments where professional resilience is supported by appropriate resources rather than expected to compensate continuously for excessive demands. This approach can strengthen workforce sustainability by creating a more appropriate relationship between professional responsibilities and the resources available to perform them.

Psychosocial working conditions should also form an integral component of healthcare ergonomic transformation. Leadership, professional relationships, organisational support, job control, recognition, and communication influence how employees experience demanding healthcare environments. Yuan et al. (2020) demonstrated that nursing practice environments were significantly associated with burnout, providing evidence that organisational characteristics influence workforce wellbeing. Yang and Hayes (2020) similarly identified organisational and occupational contributors to burnout among mental health professionals, supporting the need to consider working conditions alongside individual factors. These findings complement Yu et al. (2019), who demonstrated that work related characteristics contribute to nurse resilience. Taken together, Yu et al. (2019), Yuan et al. (2020), and

Yang and Hayes (2020) demonstrate that healthcare workforce sustainability depends substantially on the quality of the work environment. Human centred ergonomic innovation should therefore incorporate psychosocial conditions into work system redesign rather than restricting ergonomics to physical or technological dimensions. Creating supportive work environments can strengthen professional wellbeing while helping healthcare organisations maintain capable and experienced workforces.

4.4 Advancing Participatory Innovation for Sustainable Healthcare Transformation

Meaningful employee participation can strengthen ergonomic innovation because healthcare professionals possess experiential knowledge that is difficult to obtain solely through administrative indicators or technical assessments. Professionals interact directly with technologies, equipment, patients, workflows, communication systems, and organisational procedures and can therefore identify mismatches between formal system design and actual work. Shire et al. (2020) demonstrated the value of participatory system dynamics approaches by examining healthcare workers' perspectives in the design of safer and more efficient hospital pharmacy dispensing systems. Their findings support the usefulness of stakeholder participation when organisations seek to understand complex healthcare systems and evaluate potential changes. Professional participation should consequently extend beyond consultation after major decisions have been made. Healthcare workers can contribute during problem identification, technology evaluation, workflow redesign, workplace planning, and post implementation assessment. Such participation can improve the practical relevance of ergonomic interventions because proposed changes are evaluated against real professional experiences. It can also strengthen organisational learning by revealing informal adaptations and operational difficulties that may otherwise remain invisible to management.

Participatory innovation should ultimately be supported by formal organisational structures that allow employee knowledge to influence continuing workplace development. Healthcare work systems are dynamic, meaning that an intervention that performs effectively under current conditions may become less suitable as technologies, workloads, patient requirements, and professional responsibilities change. Paguio et al. (2020) demonstrated that interventions designed to improve nurses' work environments can influence nurse, patient, and hospital outcomes, reinforcing the organisational importance of sustained workplace improvement. Human centred transformation should therefore include continuing evaluation, structured employee feedback, multidisciplinary collaboration, and opportunities to modify interventions when new difficulties emerge. This process is consistent with the wider human factors perspective advanced by Carayon et al. (2020), which recognises healthcare as a collection of interconnected work systems requiring human centred design. By combining professional participation with systematic organisational evaluation, ergonomic innovation can become an ongoing process rather than a temporary response to workplace problems. This approach provides a stronger foundation for healthcare systems that can adapt to change while preserving professional wellbeing, operational effectiveness, and sustainable organisational performance.

5. Strategic Recommendations for Human Centred Ergonomic Innovation in Healthcare Work Systems

Transforming healthcare work systems requires practical strategies that connect ergonomic principles with organisational planning, workforce management, technology implementation, and continuous workplace improvement. Human centred ergonomic innovation should not be treated as an isolated occupational initiative

because healthcare professionals interact continuously with physical environments, digital technologies, demanding tasks, information systems, and organisational structures. Evidence available by 2020 demonstrates that work environment interventions can influence outcomes involving healthcare professionals, patients, and hospitals, reinforcing the strategic importance of workplace design (Paguio et al., 2020). Healthcare organisations should therefore develop coordinated approaches that strengthen ergonomic integration, balance physical and cognitive demands, support sustainable workforce conditions, and involve healthcare professionals directly in workplace innovation. These priorities correspond with the major concerns discussed previously and provide a practical foundation for transforming healthcare work systems through human centred principles.

5.1 Institutionalise Human Centred Ergonomics in Organisational Planning

Healthcare organisations should institutionalise human centred ergonomics within strategic and operational planning so that workplace design becomes an ongoing management responsibility. Decisions concerning staffing, facilities, technologies, equipment, workflow, and professional responsibilities should be evaluated according to their effects on both employees and organisational performance. Carayon et al. (2006) demonstrated through the SEIPS framework that healthcare outcomes emerge from interactions among people, tasks, technologies, organisational conditions, and physical environments. Holden et al. (2013) subsequently expanded this systems perspective by recognising the adaptive relationships between healthcare professionals and their work systems. These frameworks indicate that ergonomic assessment should occur before major organisational changes are implemented rather than functioning primarily as a corrective response after difficulties emerge. Dul et al. (2012) similarly argued that human factors and ergonomics should contribute simultaneously to human wellbeing and system performance. Healthcare managers should therefore incorporate ergonomic considerations into workplace planning, technology procurement, risk assessment, workflow development, and quality improvement. Establishing multidisciplinary ergonomic teams can further support this process by combining professional, managerial, technical, and organisational perspectives when evaluating proposed changes. Such institutionalisation can reduce fragmented interventions and create stronger alignment between professional capabilities, organisational resources, workplace conditions, and healthcare performance.

Continuous evaluation should complement strategic integration because healthcare work systems change as technologies, patient demands, staffing patterns, and professional responsibilities evolve. An ergonomic solution that performs effectively under existing conditions may become unsuitable when workload or technology changes. Carayon et al. (2014) emphasised that healthcare quality and safety require a systems approach capable of considering interactions among multiple work system components. Carayon et al. (2020) further developed this perspective through SEIPS 3.0, which places human centred design within interconnected healthcare journeys. Healthcare organisations should consequently establish regular assessments of physical environments, workflow efficiency, technology usability, workload, communication, and employee experience. The findings should be incorporated into management decisions so that ergonomic improvement becomes a continuous process rather than a temporary project. Paguio et al. (2020) found that interventions targeting nurses' work environments can influence nurse, patient, and hospital outcomes, supporting the organisational value of sustained workplace improvement. Regular assessment can therefore enable healthcare organisations to identify emerging ergonomic problems, evaluate unintended consequences, and modify work systems before difficulties become established barriers to professional wellbeing and organisational effectiveness.

5.2 Integrate Physical Ergonomics with Cognitive Work Design

Physical ergonomic improvement should focus on redesigning demanding work conditions rather than relying predominantly on healthcare professionals to modify individual working behaviour. Patient handling, repetitive movement, awkward working positions, prolonged standing, and equipment manipulation remain significant occupational demands within healthcare. Hignett (2003) demonstrated that reducing musculoskeletal injuries associated with patient handling requires broader ergonomic interventions rather than dependence on manual handling training alone. Davis and Kotowski (2015) similarly identified substantial levels of musculoskeletal disorders among nurses across different healthcare environments. Tariah et al. (2020) further demonstrated that lifting, repetitive activities, stooping, and awkward postures represent important occupational demands among nurses. These findings indicate that healthcare organisations should regularly identify physically demanding tasks and determine whether workplace design, equipment, staffing, or task organisation can be improved. Appropriate

patient handling equipment should be accessible when required, while workspace layouts should minimise unnecessary movement and difficult postures. Staffing and work scheduling should also be considered because employees may be unable to apply appropriate ergonomic practices consistently when workloads are excessive. Physical ergonomic innovation should consequently combine equipment, environmental design, task modification, and organisational support to reduce unnecessary occupational exposure while maintaining effective professional performance.

Cognitive work design should be developed alongside physical ergonomics because modern healthcare professionals increasingly interact with electronic records, information systems, digital communication, alerts, and complex documentation processes. Technology should support professional judgement rather than create additional cognitive burden. Melnick et al. (2020) found that poorer perceived electronic health record usability was independently associated with physician burnout, demonstrating the importance of technology experience for professional wellbeing. Healthcare organisations should therefore evaluate digital systems according to usability, workflow compatibility, information presentation, navigation requirements, and documentation demands. Zayas-Cabán and White (2020) similarly concluded that human factors and ergonomics approaches can improve the design, implementation, and use of health information technology. Healthcare professionals should participate in usability testing before and after new technologies are introduced because difficulties may become visible only during real workplace use. Organisations should also review unnecessary alerts, repeated documentation, fragmented information channels, and complicated navigation processes. Integrating cognitive and physical ergonomic improvement can produce a more comprehensive work system in which technological innovation supports professional activities without creating avoidable mental or physical demands.

5.3 Strengthen Sustainable Workload and Psychosocial Work Design

Healthcare organisations should strengthen workload management by aligning professional responsibilities with available staffing, working time, resources, and opportunities for recovery. Excessive workload should not be regarded simply as an unavoidable characteristic of healthcare employment because organisational conditions can contribute substantially to professional burnout. Dall'Ora et al. (2015) found associations between longer nursing shifts and burnout, job dissatisfaction, and intentions to leave, while Dall'Ora et al. (2020) identified workload, staffing, working patterns, job control, and organisational support among important factors associated with nursing burnout. The 2020 review specifically demonstrates that burnout is influenced by work related characteristics and can produce consequences for employees, organisations, and patients. Healthcare organisations should consequently monitor staffing adequacy, shift length, overtime, workload distribution, break opportunities, and scheduling arrangements. Workload assessment should also consider differences between departments because professional demands can vary according to patient needs, task complexity, and service requirements. A more responsive approach to workload management can enable organisations to identify excessive demands before they contribute to persistent fatigue, declining job satisfaction, or workforce instability.

Psychosocial work design should complement workload management by strengthening organisational resources that help healthcare professionals perform demanding responsibilities effectively. Supportive leadership, professional autonomy, effective communication, recognition, teamwork, and opportunities for development can influence how employees experience their working environments. Yu et al. (2019) identified both personal and work related factors associated with nurse resilience, suggesting that organisational conditions can influence professionals' ability to function effectively under demanding circumstances. Niskala et al. (2020) reviewed interventions designed to improve nurses' job satisfaction and found evidence that selected interventions produced meaningful improvements. Paguio et al. (2020) likewise demonstrated that workplace interventions can influence multiple levels of healthcare outcomes. Organisations should therefore avoid relying predominantly on individual coping strategies when significant workplace pressures remain unchanged. Management should examine whether employees receive adequate organisational support, reasonable control over their work, effective communication, and opportunities to contribute to decisions affecting professional responsibilities. Combining workload management with psychosocial work design provides a stronger foundation for workforce sustainability because it addresses both occupational demands and the organisational resources required to manage them.

5.4 Establish Participatory Innovation and Continuous Workplace Improvement

Healthcare professionals should become active participants in ergonomic innovation because they possess practical knowledge concerning how technologies, tasks, physical environments, and organisational procedures function during everyday work. Formal work procedures may differ considerably from actual practice when employees must respond to changing patient needs, time constraints, equipment limitations, or technology difficulties. Participatory ergonomic processes can help organisations identify these differences and develop interventions that correspond more closely with operational realities. Holden et al. (2013) emphasised that healthcare professionals interact dynamically with their work systems, suggesting that employees should not be treated merely as passive users of workplace designs. Participation should therefore begin during problem identification and continue through solution development, implementation, and evaluation. Healthcare organisations can establish regular employee consultations, multidisciplinary improvement groups, technology usability assessments, and structured feedback mechanisms. Professional input should be particularly important when organisations introduce technologies or redesign workflows because employees can identify practical consequences that may not be apparent during technical planning. Meaningful participation can improve the relevance and acceptance of ergonomic interventions while allowing organisations to capture professional knowledge that would otherwise remain informal or unrecognised.

Continuous workplace improvement should ensure that employee participation produces measurable organisational action rather than functioning only as consultation. Healthcare organisations should establish mechanisms for recording ergonomic concerns, prioritising improvement opportunities, evaluating implemented changes, and communicating outcomes to employees. Paguio et al. (2020) found that work environment interventions can affect outcomes at nurse, patient, and hospital levels, demonstrating that organisational improvement has consequences beyond individual employee experience. Management should consequently evaluate whether ergonomic interventions actually reduce workload, improve technology usability, strengthen job satisfaction, or resolve workflow difficulties after implementation. Employee feedback can then be used to refine interventions when expected improvements are not achieved. This continuous approach is particularly important because healthcare environments evolve through technological change, workforce movement, changing service demand, and new organisational requirements. Niskala et al. (2020) further demonstrated the value of systematically examining workplace interventions intended to improve nurses' job satisfaction. By connecting employee participation with evaluation and organisational learning, healthcare organisations can transform ergonomic innovation from occasional workplace modification into a sustained management process that supports adaptable, human centred, and effective healthcare work systems.

6. Conclusion

Human centred ergonomic innovation provides an important foundation for transforming healthcare work systems in response to increasing organisational complexity, technological development, workforce demands, and changing professional responsibilities. Healthcare work cannot be understood through individual tasks or workplace conditions alone because professionals operate within interconnected systems involving people, technologies, physical environments, information, organisational procedures, and social relationships. The analysis demonstrates that effective ergonomic transformation requires healthcare organisations to recognise these interactions when designing and managing work. Persistent physical demands, cognitive workload, workflow interruptions, technology usability problems, and demanding working conditions indicate that ergonomic concerns remain important despite continuing advances in healthcare systems. Addressing these challenges requires a broader approach that integrates physical and cognitive ergonomics with organisational and technological considerations rather than relying on isolated workplace interventions.

The discussion further demonstrates that successful transformation depends on creating healthcare work systems that support both professional wellbeing and organisational effectiveness. Physical ergonomic improvements should be accompanied by appropriate cognitive work design, particularly as healthcare professionals increasingly interact with electronic records, digital information systems, and complex communication processes. Workforce sustainability also requires greater attention to workload, staffing, job control, organisational support, and psychosocial working conditions. At the same time, technological innovation should be evaluated according to its compatibility with actual professional workflows and its ability to support rather than complicate healthcare work. Integrating these dimensions provides a stronger basis for reducing unnecessary physical and cognitive demands while improving the capacity of professionals to perform their responsibilities effectively within increasingly complex healthcare environments.

Healthcare organisations should therefore position human centred ergonomics as an ongoing component of organisational planning and workplace improvement. Ergonomic considerations should be incorporated into decisions involving technologies, facilities, staffing, workload, workflow, and professional responsibilities. Equally important is meaningful participation by healthcare professionals in identifying workplace problems, evaluating proposed changes, and assessing whether implemented improvements produce the intended outcomes. Continuous evaluation and employee participation can enable organisations to respond more effectively as healthcare technologies, service requirements, and workforce conditions continue to evolve. The recommendations developed in this article emphasise institutionalising ergonomic principles, integrating physical and cognitive work design, strengthening sustainable workload and psychosocial conditions, and establishing participatory workplace improvement. Through these approaches, human centred ergonomic innovation can contribute to healthcare work systems that are more adaptable, sustainable, supportive of professional wellbeing, and capable of maintaining effective organisational performance.

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