

Advancing Sustainable Healthcare Workplaces Through Human Centred Ergonomic Work Design

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Abstract

Sustainable healthcare workplaces require working conditions that support healthcare professionals while maintaining effective organisational performance and quality service delivery. Human-centred ergonomic work design is an important approach that aligns workplace systems with human capabilities, limitations, and professional requirements. This article explores the role of human-centred ergonomics in developing sustainable healthcare workplaces by integrating physical, cognitive, technological, psychosocial, and organisational dimensions. The analysis identifies several continuing challenges, including physical ergonomic risks, technology-related cognitive demands, excessive workload, psychosocial pressures, fragmented organisational practices, and limited employee participation. These concerns demonstrate that workplace sustainability cannot be achieved through isolated interventions, as healthcare professionals operate within complex, interconnected work systems. Greater integration of ergonomic principles into organisational planning can improve the alignment between professional capabilities and workplace demands. Particular attention should be given to physical workplace design, human-centred technology, workload management, psychosocial support, and meaningful employee participation. The article emphasises that sustainable ergonomic improvement requires continuous evaluation and coordinated organisational action rather than temporary responses to individual workplace problems. Ultimately, human-centred ergonomic work design provides a strategic foundation for creating healthcare workplaces that promote workforce wellbeing, strengthen organisational adaptability, support professional effectiveness, and contribute to sustainable healthcare performance.

Keywords: Ergonomics, Healthcare, Sustainability, Wellbeing, Workforce

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1. Introduction

Healthcare workplaces represent complex social and organisational environments where professionals are expected to deliver reliable services while responding to demanding physical, cognitive, technological, and interpersonal requirements. Changes in healthcare delivery have increased the importance of designing workplaces that support employees without compromising organisational effectiveness. Ergonomics provides an important foundation for achieving this balance because it focuses on adapting work systems to human capabilities, limitations, and needs. Dul et al. (2012) described human factors and ergonomics as a discipline capable of supporting both human wellbeing and system performance. Within healthcare, Carayon et al. (2006) demonstrated through the Systems Engineering Initiative for Patient Safety model that professional work is influenced by interactions among individuals, tasks, tools, technologies, organisational structures, and physical environments. Holden et al. (2013) later expanded this perspective through SEIPS 2.0 by emphasising the dynamic relationships between people and their work systems. These perspectives have strengthened recognition that workplace sustainability cannot be achieved through occupational safety measures alone. Sustainable healthcare workplaces require a broader understanding of how work is structured, how employees interact with their environments, and how organisational decisions influence the ability of healthcare professionals to perform effectively over extended periods.

Physical demands remain among the most visible ergonomic concerns within healthcare workplaces. Professionals involved in direct patient care frequently perform activities requiring lifting, transferring, repositioning, repetitive movement, prolonged standing, awkward postures, and equipment handling. Such demands can become particularly problematic when employees perform them repeatedly under time constraints or without adequate physical support. Trinkoff et al. (2003) identified associations between perceived physical demands and musculoskeletal problems among registered nurses, demonstrating the occupational consequences of demanding work activities. Hignett (2003) similarly established that reducing musculoskeletal risks associated with patient handling requires broader intervention strategies rather than reliance on manual handling instruction alone. Waters (2007) further questioned traditional manual patient lifting practices and emphasised the need for safer approaches to physically demanding care activities. Later evidence continued to demonstrate the persistence of these concerns. Davis and Kotowski (2015) identified a substantial prevalence of musculoskeletal disorders among nurses across different healthcare settings. More recently, Tariah et al. (2020) reported considerable work related musculoskeletal problems among nurses and identified lifting, awkward postures, stooping, and repetitive activities among important occupational demands. Physical ergonomic conditions therefore remain central to the development of healthcare workplaces capable of supporting workforce health and sustainable professional practice.

Beyond physical requirements, healthcare work places considerable cognitive demands on professionals who must continuously process information, communicate with colleagues, monitor changing situations, make decisions, and manage multiple responsibilities. These activities frequently occur in environments characterised by interruptions, competing priorities, and substantial information flows. Weigl et al. (2011) demonstrated that workflow interruptions represent a significant characteristic of hospital physicians' work and can influence the organisation of professional activities. Leonard et al. (2004) also emphasised the importance of effective communication and teamwork for safe healthcare delivery, indicating that cognitive performance depends partly on the quality of organisational interactions. Human factors research has consequently encouraged greater attention to the systems surrounding professional decision making. Gurses et al. (2012) argued that human factors and ergonomics should be more closely integrated into healthcare improvement because performance is influenced by interactions among professionals, technologies, tasks, and organisational conditions. Carayon et al. (2014) similarly demonstrated the importance of a systems approach for improving healthcare quality and patient safety. These perspectives indicate that cognitive demands should not be viewed simply as an unavoidable consequence of professional responsibility. Workplace design can influence how information is presented, how communication occurs, how interruptions are managed, and how effectively healthcare professionals can concentrate on essential responsibilities.

Technological development has added another dimension to ergonomic work design as healthcare organisations increasingly depend on electronic health records, digital communication, information platforms, monitoring systems, and other technologies. Although digital systems can improve information accessibility and coordination, their benefits depend heavily on usability and compatibility with professional work. Poorly designed technologies

may increase documentation requirements, information overload, navigation complexity, and cognitive workload. Kroth et al. (2019) identified associations between electronic health record design and use factors with clinician stress and burnout, highlighting the organisational consequences of technology related demands. Kutney Lee et al. (2019) also demonstrated that electronic health record usability is connected with the broader nursing work environment and healthcare outcomes. Melnick et al. (2020) subsequently found that physicians' perceptions of electronic health record usability were independently associated with professional burnout, strengthening the argument that technology design can influence workforce wellbeing. Human centred ergonomic design therefore requires healthcare technologies to correspond with actual professional activities rather than requiring professionals to continually adapt their working practices to poorly aligned systems. Greater attention to usability, workflow compatibility, information presentation, and employee involvement can help ensure that digital transformation supports rather than complicates healthcare work.

Workload represents an equally significant consideration because healthcare professionals frequently operate under substantial time pressure and demanding staffing conditions. Work intensity can increase when patient requirements, administrative responsibilities, staffing limitations, and unpredictable situations occur simultaneously. Excessive workload can become difficult to sustain when professionals have insufficient time or resources to recover from demanding responsibilities. Aiken et al. (2002) demonstrated that higher patient workloads among nurses were associated with greater burnout and job dissatisfaction as well as poorer patient outcomes. Griffiths et al. (2014) later identified relationships between nurses' shift length, overtime working, perceived quality of care, and patient safety. Dall'Ora et al. (2015) further found that nurses working shifts of twelve hours or longer were more likely to experience burnout, job dissatisfaction, and intentions to leave employment. These relationships were reinforced by Dall'Ora et al. (2020), who identified high workload, low staffing, long shifts, and limited control among important characteristics associated with nursing burnout. Workload should therefore be considered a central element of human centred work design because sustainable healthcare workplaces depend on achieving an appropriate relationship between professional demands, available resources, staffing arrangements, working time, and opportunities for recovery.

Psychosocial conditions also shape the sustainability of healthcare workplaces because professional responsibilities frequently involve emotional demands, interpersonal relationships, uncertainty, accountability, and pressure to maintain high standards. Persistent exposure to demanding conditions may affect psychological wellbeing when organisational resources and workplace support are insufficient. Hall et al. (2016) found associations between healthcare staff wellbeing, burnout, and patient safety, demonstrating that workforce wellbeing can influence outcomes beyond individual employees. West et al. (2016) subsequently showed that interventions can contribute to reductions in physician burnout, while Panagioti et al. (2017) identified the value of both individual and organisational approaches to burnout reduction. Leadership represents another important dimension of the psychosocial work environment. Cummings et al. (2018) demonstrated that relational leadership styles were associated with favourable outcomes for the nursing workforce and work environment. Shanafelt and Noseworthy (2017) similarly identified organisational leadership, workload, efficiency, workplace culture, and professional support as important considerations for physician wellbeing. These findings indicate that psychosocial sustainability depends not only on employees' ability to manage occupational pressure but also on whether organisational conditions provide appropriate resources, leadership, communication, autonomy, and social support.

The concept of a sustainable healthcare workplace extends beyond reducing occupational problems because sustainability also concerns the ability of organisations to maintain a capable and effective workforce over time. Healthcare organisations depend heavily on professional knowledge, experience, commitment, and continuity. Working environments that repeatedly expose employees to excessive physical demands, cognitive burden, fatigue, burnout, or organisational frustration may undermine this capacity. Bodenheimer and Sinsky (2014) argued that healthcare improvement should incorporate the wellbeing of healthcare providers alongside established objectives relating to patient experience, population health, and cost. Hall et al. (2016) similarly demonstrated that healthcare staff wellbeing is associated with patient safety, illustrating the connection between workforce conditions and organisational outcomes. Paguio et al. (2020) further reviewed interventions designed to improve nurses' work environments and demonstrated that workplace interventions can influence outcomes involving nurses, patients, and hospitals. These findings provide an important social and organisational foundation for sustainable workplace development. Protecting workforce wellbeing should therefore not be considered separate from organisational effectiveness because healthier working conditions can support workforce stability,

professional capability, service continuity, and the long term capacity of healthcare organisations to respond to changing demands.

Human centred ergonomic design also places considerable importance on employee participation because healthcare professionals possess practical knowledge of how work is actually performed. Formal procedures may describe how tasks are expected to occur, but employees experience the operational realities of equipment limitations, workflow interruptions, technology difficulties, communication barriers, workload pressures, and environmental constraints. Their involvement can therefore provide valuable information when organisations redesign workplace systems. Carayon et al. (2014) emphasised that healthcare improvement requires attention to interactions among individuals and multiple components of the work system. Holden et al. (2013) similarly demonstrated that work processes emerge from dynamic relationships between people, tasks, technologies, organisations, and environments. Participatory ergonomic approaches are particularly valuable because they recognise employees as contributors to workplace improvement rather than simply recipients of organisational change. Paguio et al. (2020) further demonstrated the potential value of interventions directed towards nurses' work environments. Meaningful employee participation can strengthen problem identification, technology evaluation, task redesign, communication improvement, and workplace planning. Such involvement also enables healthcare organisations to develop solutions that correspond more closely with professional practice and the everyday conditions experienced by their workforce.

Organisational design provides the wider context within which physical, cognitive, technological, and psychosocial factors interact. Improvements in one workplace dimension may have limited value when other components continue to create excessive demands. For example, introducing advanced equipment may reduce physical effort but create additional cognitive demands when technology is difficult to operate. Increasing staffing may improve workload distribution but produce limited benefits when communication systems and task allocation remain poorly organised. Carayon et al. (2006) established the importance of examining healthcare as an interconnected work system, while Holden et al. (2013) extended this understanding by recognising the dynamic nature of healthcare work processes. Carayon et al. (2020) further developed this systems perspective through SEIPS 3.0, which incorporates human centred design into the understanding of increasingly complex healthcare journeys. These developments demonstrate the importance of moving beyond fragmented ergonomic interventions towards coordinated workplace design. Sustainable healthcare environments depend on the alignment of professional capabilities with physical spaces, technologies, work processes, organisational structures, staffing resources, and management practices. A systems perspective therefore provides a stronger foundation for addressing the multiple demands experienced by healthcare professionals within contemporary healthcare organisations.

Greater integration of ergonomics into healthcare management can strengthen the capacity of organisations to develop working environments that remain effective under changing professional and organisational demands. Traditional workplace interventions have often concentrated on specific problems such as musculoskeletal injuries, fatigue, burnout, or technology difficulties. Although these concerns remain important, addressing them separately may overlook the interactions that contribute to their development. Dul et al. (2012) emphasised that ergonomics can create value when human wellbeing and system performance are considered complementary rather than competing objectives. Evidence from healthcare research supports this broader perspective. Tariah et al. (2020) demonstrated the continuing significance of physical occupational risks among nurses, while Melnick et al. (2020) identified the relationship between technology usability and professional burnout. Dall'Orta et al. (2020) further highlighted the influence of workload, staffing, working hours, and job control on nursing burnout, while Paguio et al. (2020) demonstrated the potential contribution of organisational work environment interventions. Collectively, these findings support a more comprehensive approach in which sustainable healthcare workplaces are built around human capabilities, supportive organisational conditions, appropriate technologies, manageable work demands, and meaningful professional participation.

2. Literature Review

Human centred ergonomic work design has gained increasing importance in healthcare because workplace sustainability depends on the interaction between professionals, technologies, tasks, physical environments, organisational structures, and social relationships. Ergonomics is no longer understood solely as the adjustment of equipment or posture but as a systems oriented discipline concerned with improving human wellbeing while maintaining effective system performance (Dul et al., 2012). Within healthcare, the SEIPS model developed by Carayon et al. (2006) established an important foundation for analysing how work system components influence care processes and organisational outcomes. Holden et al. (2013) subsequently extended this perspective through SEIPS 2.0 by recognising the dynamic interaction between healthcare professionals and their work environments. Carayon et al. (2014) further demonstrated that human factors and ergonomics can strengthen healthcare quality and safety through systematic work system design. By 2020, these perspectives had expanded towards more explicitly human centred approaches that considered complex healthcare journeys and organisational sustainability (Carayon et al., 2020). These developments support the examination of sustainable healthcare workplaces through four interconnected areas involving human centred work systems, ergonomic working conditions, workforce wellbeing, and organisational workplace design.

2.1 Human Centred Ergonomics in Healthcare Work Systems

Human centred ergonomics provides a comprehensive approach for understanding healthcare workplaces because professional activities are shaped by multiple interacting components rather than isolated working conditions. Carayon et al. (2006) conceptualised healthcare work through the interaction of people, tasks, technologies, organisational characteristics, and physical environments, demonstrating that workplace outcomes can emerge from relationships across the entire system. Holden et al. (2013) strengthened this perspective by recognising that healthcare professionals continuously adapt their activities to changing demands and work processes. Consequently, effective work design should accommodate human capabilities rather than require employees to continuously compensate for poorly designed systems. Gurses et al. (2012) similarly argued that healthcare improvement requires stronger integration of human factors and ergonomics because safety and performance problems are rarely caused by a single workplace component. Carayon et al. (2014) later identified technology usability, human performance, system resilience, and work system design as important areas where ergonomic approaches can contribute to healthcare improvement. These perspectives demonstrate that human centred ergonomics should be integrated into management decisions involving workplace design, technology, workflow, communication, staffing, and professional responsibilities rather than being restricted to occupational safety interventions.

Growing attention to sustainability has further expanded the importance of human centred design within healthcare organisations. Sustainable workplaces should enable professionals to maintain their capabilities, wellbeing, and effective performance over extended periods while organisations continue responding to changing service requirements. Carayon et al. (2020) advanced the SEIPS perspective through SEIPS 3.0 by placing greater emphasis on human centred design across complex healthcare journeys. This development reinforces the importance of considering work from the perspective of people who interact with healthcare systems rather than designing organisational processes primarily around technical requirements. Halawa et al. (2020) similarly demonstrated that healthcare facility design involves the alignment of environmental, operational, experiential, clinical, and organisational objectives. Their review highlights that the built environment can influence both healthcare processes and staff experiences. Human centred design consequently requires integration between workplace infrastructure and organisational processes. Rather than treating physical spaces, technologies, workflows, and professional roles separately, healthcare organisations should examine how these components collectively influence everyday work. Such integration provides a stronger foundation for workplace sustainability because improvements can simultaneously support professional wellbeing, effective healthcare delivery, and the organisational capacity to adapt to changing demands.

2.2 Physical Ergonomics and Technology Supported Cognitive Work

Physical ergonomics remains fundamental to sustainable healthcare workplaces because many professional responsibilities involve substantial physical exposure. Nurses and other healthcare professionals frequently perform patient handling, repetitive movements, equipment manipulation, prolonged standing, reaching, bending,

and work in constrained postures. Hignett (2003) demonstrated that patient handling risks require comprehensive ergonomic interventions rather than reliance solely on lifting instruction. Trinkoff et al. (2003) similarly identified relationships between perceived physical demands and musculoskeletal problems among registered nurses. The continuing importance of this concern was demonstrated by Davis and Kotowski (2015), who found a substantial prevalence of musculoskeletal disorders among nurses across different healthcare environments. More recent research available in 2020 continued to identify physical occupational demands as an important concern. Tariah et al. (2020) reported work related musculoskeletal disorders among nurses associated with lifting, repetitive activities, awkward working positions, and other occupational demands. Research examining prevention practices also indicates that organisational conditions influence whether healthcare employees can successfully apply ergonomic practices. Consequently, sustainable physical ergonomics requires appropriate equipment, workspace design, task organisation, employee training, managerial support, and organisational conditions that enable safer working practices.

Cognitive ergonomics has become equally significant because digital technologies increasingly shape how healthcare professionals receive information, communicate, document activities, and make decisions. Electronic health records can support information accessibility but may also create additional cognitive demands when usability is poor or systems do not correspond with clinical workflow. Wisner et al. (2019) demonstrated that electronic health records influence nurses' cognitive work, reinforcing the importance of evaluating digital systems beyond their technical capabilities. Kroth et al. (2019) identified associations between electronic health record design and use factors with clinician stress and burnout, including concerns surrounding data entry, information accessibility, and work life interference. Fraczkowski et al. (2020) further found that electronic health record workarounds can emerge from technological, task, organisational, environmental, and usability factors. Tolentino and Gephart (2020) similarly demonstrated that nurses' electronic health record experiences involve functional, physical, cognitive, psychological, and social dimensions. Yusof et al. (2020) found that poorer perceived electronic health record usability was associated with greater physician burnout. Technology sustainability therefore depends on human centred usability, workflow compatibility, information quality, and cognitive demands rather than technological availability alone.

2.3 Workload Psychosocial Wellbeing and Workforce Sustainability

Workload and working arrangements represent major components of ergonomic work design because sustainable professional performance requires an appropriate balance between job demands and available workforce resources. Healthcare organisations frequently operate continuously, creating requirements for shift work, extended working hours, overtime, and demanding staffing arrangements. Dall'Ora et al. (2015) demonstrated that nurses working shifts of twelve hours or longer were more likely to experience burnout, job dissatisfaction, and intentions to leave. Later evidence reinforced the importance of organisational work characteristics. Dall'Ora et al. (2020) identified high workload, low staffing, long working hours, limited schedule flexibility, and poor working environments among important contributors to nursing burnout. Harvey et al. (2020) similarly examined nurses' experiences of workload, care rationing, and working environments, illustrating how workload pressures interact with the wider organisation of professional work. These findings indicate that workload should not be regarded simply as an unavoidable feature of healthcare employment. Human centred work design requires organisations to consider staffing levels, work allocation, shift duration, recovery opportunities, schedule flexibility, and professional control when developing sustainable working arrangements.

Psychosocial wellbeing is closely connected with workload because professional sustainability also depends on leadership, workplace relationships, organisational resources, job satisfaction, and opportunities for recovery. Hall et al. (2016) demonstrated through a systematic review that poorer healthcare staff wellbeing and burnout were associated with patient safety concerns. This relationship suggests that employee wellbeing has implications extending beyond the individual professional. Cummings et al. (2018) found that relational leadership styles were associated with more favourable nursing workforce and work environment outcomes, including job satisfaction and staff wellbeing. The scale of the challenge was further demonstrated by Woo et al. (2020), whose global systematic review and meta analysis examined burnout symptoms among 45,539 nurses across 49 countries. Niskala et al. (2020) additionally found that organisational interventions can contribute to improvements in nurses' job satisfaction. These findings demonstrate that sustainable healthcare workplaces require psychosocial resources alongside appropriate physical and technological conditions. Supportive leadership, reasonable job demands,

professional autonomy, positive workplace relationships, and organisational support can collectively strengthen workforce wellbeing and long term professional sustainability.

2.4 Organisational Ergonomics and Participatory Workplace Design

Organisational ergonomics brings together physical, cognitive, technological, and psychosocial dimensions by examining how work structures and organisational processes influence professional activities. A central principle of this perspective is that healthcare organisations should address workplace problems at the system level rather than expecting individual employees to continually adapt to demanding conditions. Carayon et al. (2006) established that changes in one work system component may influence other parts of the healthcare environment, while Holden et al. (2013) emphasised the dynamic nature of interactions among professionals, tasks, technologies, organisations, and physical settings. Workplace interventions should therefore consider potential relationships across these dimensions. Paguio et al. (2020) systematically reviewed interventions intended to improve nurses' working environments and found evidence of interventions influencing nurse, patient, and hospital outcomes. This finding is particularly relevant to workplace sustainability because it demonstrates that employee working conditions and organisational outcomes are interconnected. Effective organisational ergonomics consequently requires coordination between workforce management, leadership, workplace planning, technology implementation, occupational health, quality improvement, and healthcare service processes rather than separate improvement programmes operating independently.

Employee participation provides an important mechanism for achieving this integration because healthcare professionals possess detailed experiential knowledge about the environments in which work is actually performed. Participatory ergonomics enables employees to contribute to the identification of physical demands, workflow difficulties, technological limitations, communication problems, and organisational barriers. Earlier healthcare research demonstrated that participatory ergonomics teams can identify workplace problems and develop practical solutions, although implementation can be constrained by competing demands and organisational structures. More broadly, human factors approaches emphasise that successful healthcare redesign should be driven by an understanding of professional activities and the conditions surrounding them. Gurses et al. (2012) advocated stronger organisational capacity for applying human factors and ergonomics, while Paguio et al. (2020) demonstrated the potential value of organisational interventions directed towards nurses' working environments. Carayon et al. (2020) further strengthened the human centred orientation of healthcare systems design. Taken together, these perspectives indicate that sustainable healthcare workplaces depend on meaningful employee involvement, coordinated organisational redesign, responsive management systems, and continuous evaluation of how workplace changes affect both professionals and organisational performance.

3. Key Issues in Advancing Sustainable Healthcare Workplaces

Developing sustainable healthcare workplaces remains challenging because healthcare professionals work within systems shaped by physical demands, digital technologies, cognitive requirements, workload pressures, psychosocial conditions, and organisational structures. Human centred ergonomics provides a useful foundation for addressing these concerns, but healthcare organisations frequently face difficulties translating ergonomic principles into everyday work practices. Evidence available up to 2020 demonstrates continuing concerns involving musculoskeletal risks, technology related workload, burnout, staff wellbeing, and organisational work environments (Dall'Ora et al., 2020; Melnick et al., 2020; Paguio et al., 2020). These challenges indicate that sustainable workplace development requires coordinated attention to the complete healthcare work system rather than isolated interventions.

3.1 Limited Integration of Human Centred Ergonomics into Healthcare Work Systems

A major challenge concerns the limited integration of human centred ergonomic principles across healthcare work systems. Healthcare organisations frequently address workplace problems through separate initiatives involving occupational safety, technology, staffing, or quality improvement, although these dimensions are closely interconnected. Carayon et al. (2006) established that healthcare work involves interactions among individuals,

tasks, technologies, organisational characteristics, and physical environments, while Holden et al. (2013) further demonstrated that these relationships continuously shape healthcare processes and outcomes. Nevertheless, fragmented improvement strategies can overlook the consequences that changes in one part of the system create elsewhere. Introducing new technology, for example, may improve information availability while increasing documentation requirements or cognitive demands. Gurses et al. (2012) similarly emphasised the need for stronger integration of human factors and ergonomics into healthcare improvement because performance problems often emerge from system interactions rather than isolated individual failures. Carayon et al. (2020) further strengthened this systems perspective through human centred healthcare design. The continuing challenge is therefore ensuring that ergonomic principles influence organisational planning, technology implementation, workplace design, workflow management, and professional responsibilities simultaneously rather than functioning as a specialised activity applied only after workplace difficulties become apparent.

Organisational priorities can further complicate human centred work design when operational requirements receive greater attention than the capabilities and limitations of healthcare professionals. Hospitals must manage service demand, financial resources, staffing, technology, quality expectations, and patient requirements, creating pressure to maintain productivity even when working conditions become increasingly demanding. Dul et al. (2012) argued that ergonomics should simultaneously contribute to human wellbeing and system performance, suggesting that these objectives should be considered complementary. However, sustainable implementation requires managers to recognise employee wellbeing as a fundamental component of organisational effectiveness rather than an additional occupational concern. Paguio et al. (2020) found that interventions directed towards nurses' work environments can influence outcomes involving nurses, patients, and hospitals, demonstrating that workplace conditions have organisational significance. Similarly, Niskala et al. (2020) demonstrated that organisational interventions can improve nurses' job satisfaction. These findings illustrate why fragmented approaches remain problematic. Without stronger alignment between ergonomic principles and management practices, healthcare organisations may improve individual workplace components while leaving broader systemic pressures unchanged, limiting progress towards genuinely sustainable healthcare workplaces.

3.2 Physical Ergonomic Risks and Technology Related Cognitive Demands

Persistent physical demands continue to create difficulties for sustainable healthcare work despite extensive knowledge concerning occupational ergonomics. Healthcare professionals, particularly nurses, frequently perform patient transfers, lifting, repositioning, repetitive movements, prolonged standing, and activities requiring awkward body positions. Hignett (2003) demonstrated that patient handling risks require comprehensive ergonomic interventions because training employees in manual handling techniques alone provides limited protection. Trinkoff et al. (2003) similarly identified relationships between physical job demands and musculoskeletal problems among registered nurses. Later evidence confirmed that these occupational concerns remain substantial. Davis and Kotowski (2015) reported a high prevalence of musculoskeletal disorders among nurses across multiple healthcare environments, while Tariah et al. (2020) identified lifting, repetitive activities, stooping, and awkward working positions among important occupational demands associated with musculoskeletal problems. The persistence of these conditions suggests that physical ergonomic knowledge is not always translated effectively into workplace design. Equipment availability, workspace limitations, staffing pressures, time constraints, and task organisation can prevent healthcare professionals from consistently applying safer working practices. Consequently, physical ergonomic risks should be understood as organisational design problems rather than solely as consequences of individual working techniques, requiring coordinated changes across workplace environments and operational practices.

Digitalisation creates a different but equally important ergonomic challenge by increasing cognitive interaction between healthcare professionals and information systems. Electronic health records and hospital information technologies can improve information availability, but poorly designed systems may contribute to workload, frustration, inefficient workflows, and professional burnout. Melnick et al. (2020) found that physician perceptions of electronic health record usability were independently associated with burnout, while Khairat et al. (2020) identified an association between electronic health record use, fatigue, and efficiency. Human factors therefore need greater consideration during technology selection and implementation. Zayas-Cabán and White (2020) specifically argued that human factors and ergonomics methods can improve the design, implementation, and use of health information technology. Zhou et al. (2019) further demonstrated that facilitating conditions and social influences affect nurses' adoption of hospital electronic information management systems. These findings

indicate that successful digitalisation depends not only on technological capability but also on usability, organisational support, user participation, workflow compatibility, and the cognitive demands experienced by healthcare professionals.

3.3 Excessive Workload and Threats to Psychosocial Workforce Sustainability

Excessive workload represents a significant barrier to sustainable healthcare workplaces because employees frequently operate under time pressure, staffing limitations, extended working hours, and demanding professional responsibilities. These conditions can become particularly difficult when employees have inadequate recovery time or limited control over their working arrangements. Dall'Ora et al. (2015) demonstrated that nurses working longer shifts were more likely to report burnout, job dissatisfaction, and intentions to leave. More comprehensive evidence presented by Dall'Ora et al. (2020) identified high workload, inadequate staffing, long shifts, low schedule flexibility, time pressure, limited autonomy, and poor leadership support among factors associated with nursing burnout. Such findings demonstrate that burnout should not be interpreted only as an individual inability to manage occupational pressure. Working conditions and organisational design make substantial contributions to the development of psychosocial strain. Healthcare organisations therefore face the difficult task of maintaining continuous service provision while ensuring that staffing, workload distribution, scheduling, professional autonomy, and recovery opportunities remain sustainable. Failure to achieve this balance may weaken workforce wellbeing and make long term professional performance increasingly difficult to maintain.

The scale of psychosocial pressure among healthcare professionals reinforces the need to treat workforce sustainability as an organisational concern. Woo et al. (2020) examined burnout across 45,539 nurses from 49 countries, demonstrating that burnout represents a widespread international workforce issue. Yusof et al. (2020) similarly reported substantial burnout among mental health nurses in China, providing further evidence that the problem extends across different healthcare specialties. Zhang et al. (2020) reviewed interventions designed to reduce burnout among physicians and nurses and identified both individual and organisational approaches, although workplace conditions remain important targets for prevention. Hall et al. (2016) further associated healthcare staff wellbeing and burnout with patient safety outcomes. These findings demonstrate that psychosocial wellbeing cannot be separated from organisational sustainability. Burnout, fatigue, dissatisfaction, and declining wellbeing may influence professional performance, retention, and the ability of healthcare organisations to maintain an experienced workforce. Sustainable workplace strategies must therefore address the organisational causes of excessive demands rather than relying primarily on individual coping programmes or personal resilience.

3.4 Weak Employee Participation and Fragmented Organisational Workplace Design

Limited employee participation represents another important challenge because workplace redesign may fail when healthcare professionals are insufficiently involved in identifying problems or developing solutions. Employees possess practical knowledge concerning physical demands, workflow barriers, technology difficulties, communication problems, and workload pressures encountered during everyday practice. Human centred ergonomics recognises this experience as valuable information for improving workplace systems. However, organisational decisions concerning technology, staffing, workspace configuration, and procedures may be developed primarily through administrative or technical perspectives. This creates the possibility that formally efficient solutions do not correspond with actual professional work. Holden et al. (2013) demonstrated that healthcare work systems are dynamic and influenced by interactions among people, tasks, technologies, organisations, and environments. Carayon et al. (2014) similarly emphasised that understanding professional work is fundamental to effective system redesign. Greater participation can therefore help organisations identify mismatches between formal processes and actual workplace requirements. Without meaningful involvement, healthcare professionals may need to create informal adjustments or workarounds to manage systems that do not adequately support their activities, potentially reducing the effectiveness and sustainability of organisational improvements.

A related concern involves maintaining improvements after workplace interventions have been introduced. Sustainable ergonomic change requires continued evaluation because healthcare technologies, service demands, workforce characteristics, and organisational priorities can change over time. Paguio et al. (2020) identified

participatory approaches among interventions used to improve nurses' work environments and demonstrated that such interventions can influence nurse, patient, and hospital outcomes. Organisational support is therefore essential if employee participation is to become more than occasional consultation. Management should provide opportunities for professionals to contribute to problem identification, technology evaluation, workflow redesign, and assessment of workplace changes. Zayas-Cabán and White (2020) similarly emphasised the need for broader application of human factors and ergonomics principles in healthcare technology development and implementation. Sustainable healthcare workplaces consequently depend on continuous interaction between organisational objectives and professional experience. Weak participation or fragmented management structures may prevent organisations from recognising emerging ergonomic problems, reducing their capacity to develop work systems that remain responsive to workforce needs and changing healthcare demands.

4. Discussion on Human Centred Ergonomic Design for Sustainable Healthcare Workplaces

Human centred ergonomic work design provides a broader foundation for strengthening healthcare workplace sustainability because professional wellbeing and organisational performance are shaped by interconnected physical, cognitive, psychosocial, technological, and organisational conditions. Sustainable improvement therefore requires healthcare organisations to move beyond isolated responses to individual workplace problems and consider how the wider work system influences employees over time. Evidence demonstrates that workload, technology usability, work environments, staffing resources, and organisational support can influence burnout, professional effectiveness, and healthcare outcomes. For example, Farid et al. (2020) demonstrated through systems modelling that nursing workload and working time can influence fatigue, burnout, absenteeism, and quality of care. Paguio et al. (2020) similarly found that interventions designed to improve nurses' work environments can affect nurse, patient, and hospital outcomes. These relationships support the view that sustainable healthcare workplaces depend on organisational conditions that enable professionals to perform demanding responsibilities without continuous exposure to avoidable physical or psychological pressures. Human centred ergonomics therefore offers an appropriate framework for integrating professional needs with organisational objectives while maintaining effective healthcare performance.

4.1 Integrating Human Centred Ergonomics into Healthcare Work Systems

Effective integration of human centred ergonomics requires healthcare organisations to recognise that workplace performance emerges from interactions across the entire work system. Physical environments, employee capabilities, technologies, tasks, organisational structures, staffing arrangements, and communication processes should therefore be considered collectively when workplace improvements are planned. Fragmented interventions may resolve an immediate problem without addressing the conditions that created it or may unintentionally generate new demands elsewhere. For example, introducing sophisticated digital technologies can improve information accessibility but may simultaneously increase documentation responsibilities and cognitive workload when implementation does not correspond with professional workflow. Similarly, physical workplace improvements may provide limited benefits when employees continue to experience excessive workload or inadequate staffing. Human factors research has increasingly emphasised this systems perspective because healthcare problems often emerge from interactions between multiple organisational components rather than from individual employee behaviour. Farid et al. (2020) demonstrated the value of systems modelling for understanding relationships among workload, workforce health, and quality of care. Such evidence indicates that healthcare managers should integrate ergonomic assessment into workforce planning, technology implementation, workplace development, and service improvement rather than treating ergonomics as a separate occupational safety activity.

Organisational commitment is equally important because human centred workplace design requires management priorities to accommodate both professional wellbeing and operational requirements. Healthcare organisations often face pressure to increase productivity, control costs, manage staffing shortages, and maintain service quality, potentially encouraging short term operational solutions that increase workforce demands. Sustainable workplace management requires a different perspective in which employee capabilities and limitations are incorporated into

organisational decision making. Paguio et al. (2020) demonstrated through a systematic review that work environment interventions can influence outcomes involving nurses, patients, and hospitals, indicating that workforce conditions possess strategic organisational significance. Their findings support the argument that workplace improvement should not be viewed merely as an employee welfare initiative. Healthcare managers should consequently assess how staffing decisions, work procedures, technologies, physical environments, and organisational expectations influence professional work. Integrating ergonomic thinking into routine management can enable organisations to identify potential mismatches between employee capabilities and workplace demands before those mismatches contribute to fatigue, dissatisfaction, occupational health difficulties, or declining performance. Such integration provides a more sustainable basis for balancing workforce wellbeing with healthcare service requirements.

4.2 Balancing Physical Ergonomic Demands with Cognitive Technology Requirements

Physical ergonomic improvement remains necessary because healthcare professionals continue to experience substantial occupational exposure associated with patient handling, repetitive movements, prolonged standing, awkward postures, and equipment use. These demands should be addressed through workplace redesign rather than relying primarily on employees to adapt their behaviour to unsuitable conditions. Evidence available in 2020 demonstrated that work related musculoskeletal disorders remained a significant concern among nurses. Tariah et al. (2020) found high levels of musculoskeletal discomfort among nurses and identified lifting, awkward postures, stooping, and repetitive actions as important physical demands. These findings reinforce the importance of incorporating physical ergonomics into task design, equipment selection, workspace configuration, staffing arrangements, and work procedures. Ergonomic interventions should also acknowledge that physical workload does not occur independently from organisational conditions. Time pressure, staffing shortages, equipment accessibility, patient characteristics, and work organisation can influence whether employees can consistently apply safer working practices. Healthcare organisations should therefore adopt a preventive approach that identifies demanding tasks and modifies the surrounding work system before occupational problems become persistent. Such an approach strengthens the relationship between workplace design and sustainable workforce capability rather than placing responsibility for physical safety predominantly on individual healthcare professionals.

At the same time, sustainable healthcare workplaces must respond to increasing cognitive demands created by digitalisation. Electronic health records and other healthcare technologies can support information exchange and professional decision making, but poorly designed systems can increase task complexity and mental workload. Melnick et al. (2020) found a strong association between physicians' perceptions of electronic health record usability and professional burnout, demonstrating that technology experience can influence workforce wellbeing. Human centred technology should therefore be evaluated according to usability, information presentation, workflow compatibility, documentation requirements, and the demands placed on professional attention. Technology implementation should involve healthcare professionals because they possess practical knowledge about how digital systems interact with actual work processes. Furthermore, systems should be reviewed after implementation rather than assuming that technical functionality automatically produces effective professional use. Digital transformation becomes more sustainable when technologies reduce unnecessary cognitive burden instead of adding additional layers of documentation, alerts, or fragmented information. Balancing physical ergonomic requirements with cognitive technology demands enables healthcare organisations to improve work systems more comprehensively while ensuring that technological advancement remains aligned with human capabilities and professional practice.

4.3 Strengthening Workload Management and Psychosocial Workforce Sustainability

Sustainable healthcare workplaces require workload arrangements that enable professionals to maintain performance without continuous exposure to excessive demands. Staffing limitations, long shifts, high patient loads, insufficient recovery opportunities, and limited control can increase psychological and physical strain over time. Farid et al. (2020) demonstrated through system dynamics modelling that longer nursing shifts and working weeks can substantially increase fatigue and burnout while influencing absenteeism and quality of care. Workload should therefore be treated as an organisational design variable rather than an unavoidable characteristic of healthcare practice. Employee resilience may provide some protection against occupational demands, but it should

not become a substitute for appropriate workplace conditions. Yu et al. (2019), through a systematic review, identified both personal and work related factors associated with nurse resilience, reinforcing the importance of organisational conditions in supporting sustainable professional functioning. Healthcare organisations should consequently monitor workload patterns, staffing adequacy, shift arrangements, overtime, job control, and access to workplace resources. Sustainable workload management requires a balance in which service requirements can be maintained without progressively exhausting the professional resources on which healthcare organisations depend.

Psychosocial sustainability also depends heavily on the quality of the professional work environment. Yuan et al. (2020) found that the nursing practice environment was significantly associated with burnout, demonstrating that organisational conditions can influence healthcare professionals' experiences beyond individual characteristics. Similarly, Yang and Hayes (2020), in reviewing burnout among mental health professionals, identified organisational and work related contributors alongside individual factors, reinforcing the need for workplace focused responses. These findings are particularly important for human centred ergonomic design because psychosocial conditions should be considered part of the work system alongside physical and cognitive demands. Leadership support, professional autonomy, communication, team relationships, job resources, and opportunities for recovery can influence whether demanding healthcare work remains sustainable. Interventions focused solely on personal coping may provide limited long term benefits when excessive workload or unsupportive organisational conditions remain unchanged. Healthcare managers should therefore develop workplace strategies that address both demands and resources. The combined evidence from Yu et al. (2019), Yuan et al. (2020), and Yang and Hayes (2020) demonstrates that workforce sustainability requires organisational environments capable of supporting professional resilience while reducing preventable sources of burnout.

4.4 Strengthening Employee Participation through Integrated Workplace Design

Employee participation provides an important mechanism for translating human centred ergonomic principles into practical workplace improvements. Healthcare professionals possess detailed knowledge of how tasks, technologies, communication processes, physical spaces, and organisational procedures operate during everyday practice. Management systems that fail to incorporate this knowledge may introduce workplace changes that appear efficient administratively but create unexpected difficulties during actual use. Participation should therefore occur during problem identification, technology selection, workflow development, workplace redesign, and evaluation of organisational change. Research involving healthcare workers has demonstrated the value of participatory approaches for understanding complex work systems. Shire et al. (2020), for example, examined healthcare workers' perspectives on participatory system dynamics modelling for designing safer and more efficient hospital pharmacy dispensing systems. Their study demonstrates how workforce involvement can contribute practical knowledge to system design and improvement processes. Participation can also strengthen acceptance of change because professionals are more likely to recognise the relevance of interventions when their practical experiences are considered. Human centred workplace design consequently requires employees to be treated as active contributors to organisational improvement rather than passive users of systems developed entirely through managerial or technical perspectives.

Participation alone, however, is insufficient unless healthcare organisations establish mechanisms that translate employee feedback into coordinated workplace change. Sustainable ergonomic design requires continuous evaluation because work demands, technologies, staffing patterns, service requirements, and professional roles can change over time. Organisational structures should therefore provide regular opportunities for healthcare professionals to identify emerging problems and participate in evaluating whether previous interventions remain effective. Paguio et al. (2020) found that interventions targeting nurses' work environments can influence outcomes at employee, patient, and hospital levels, reinforcing the importance of systematic organisational action. Human centred improvement should consequently involve management, healthcare professionals, ergonomic expertise, technology specialists, and other relevant stakeholders where appropriate. Such collaboration can help organisations identify relationships among physical workload, technology usability, psychosocial demands, staffing, and work processes that might be overlooked when these areas are managed separately. Integrated workplace design creates a stronger foundation for organisational learning because ergonomic improvement becomes an ongoing management process. Through meaningful participation and coordinated system redesign, healthcare organisations can develop workplaces that remain responsive to professional needs while supporting long term service effectiveness and workforce sustainability.

5. Strategic Recommendations for Sustainable Healthcare Workplace Development

Creating sustainable healthcare workplaces requires ergonomic principles to be incorporated into organisational decisions concerning people, tasks, technologies, working environments, and management practices. Workplace improvement should move beyond isolated responses to physical discomfort, cognitive workload, burnout, or technology difficulties and adopt a more coordinated approach to work system design. Healthcare organisations should particularly strengthen human centred ergonomic planning, improve physical and technological working conditions, manage workload and psychosocial demands, and encourage meaningful employee participation. These priorities can help organisations establish working environments that accommodate human capabilities while maintaining effective professional practice and long term workforce sustainability.

5.1 Embed Human Centred Ergonomics into Organisational Planning

Healthcare organisations should incorporate human centred ergonomics into strategic and operational planning rather than treating ergonomics primarily as a response to occupational problems. Decisions concerning staffing, workflow, technology, workplace configuration, equipment, and service delivery should be evaluated according to their potential effects on healthcare professionals and the wider work system. Carayon et al. (2006) demonstrated through the SEIPS model that healthcare outcomes emerge from interactions among people, tasks, technologies, organisational conditions, and physical environments. Holden et al. (2013) subsequently expanded this perspective by demonstrating that healthcare work involves dynamic interactions between professionals and their work systems. These frameworks provide a strong foundation for evaluating organisational changes before they create unintended demands. Dul et al. (2012) similarly argued that human factors and ergonomics can contribute simultaneously to employee wellbeing and system performance when integrated into organisational strategy. Management should therefore establish ergonomic considerations as part of routine planning, risk assessment, technology procurement, workplace development, and quality improvement. Such integration can enable organisations to identify potential mismatches between workplace demands and professional capabilities before they contribute to fatigue, inefficiency, dissatisfaction, or occupational health concerns.

A systematic approach should also involve continuous assessment because healthcare workplaces evolve as technologies, professional responsibilities, service demands, and organisational priorities change. Ergonomic interventions that are appropriate under one set of conditions may become less effective when workloads, staffing patterns, technologies, or work processes change. Carayon et al. (2014) emphasised that healthcare quality and safety require a systems approach that considers interactions across multiple workplace components. Carayon et al. (2020) further advanced this perspective through SEIPS 3.0 by incorporating human centred design into complex healthcare journeys. These developments suggest that ergonomic evaluation should become an ongoing management activity rather than a one time workplace exercise. Healthcare organisations should periodically examine physical conditions, technology usability, workload patterns, communication processes, staffing arrangements, and employee experiences to determine whether existing systems remain appropriate. Paguio et al. (2020) demonstrated that interventions targeting nurses' work environments can influence outcomes involving nurses, patients, and hospitals. Consequently, continuous ergonomic assessment can support organisational learning by enabling healthcare managers to recognise emerging workplace problems and make timely adjustments that strengthen workforce sustainability.

5.2 Improve Physical Ergonomics Through Human Centred Technology

Healthcare organisations should strengthen physical ergonomic practices by systematically identifying tasks that expose professionals to unnecessary physical demands. Particular attention should be directed towards patient handling, repetitive activities, prolonged standing, awkward working positions, equipment movement, and tasks requiring excessive physical effort. Hignett (2003) demonstrated that patient handling risks require comprehensive ergonomic interventions rather than dependence on manual handling instruction alone. Trinkoff et al. (2003) similarly identified relationships between physical demands and musculoskeletal problems among registered nurses. These findings indicate that training should be combined with workplace redesign, appropriate equipment, task modification, and sufficient organisational support. Davis and Kotowski (2015) further identified a substantial prevalence of musculoskeletal disorders among nurses across healthcare environments, reinforcing the need for preventive interventions. More recent evidence from Tariah et al. (2020) continued to identify lifting, repetitive activities, awkward postures, and other occupational exposures as important physical concerns among

nurses. Healthcare organisations should consequently conduct regular ergonomic assessments, improve access to appropriate equipment, redesign demanding tasks, and involve employees in identifying practical physical difficulties within their working environments.

Technological improvement should complement physical ergonomic interventions because healthcare professionals increasingly perform their responsibilities through digital work systems. Technology should reduce unnecessary demands rather than introduce additional cognitive workload, documentation requirements, or workflow complexity. Melnick et al. (2020) demonstrated that physician perceptions of electronic health record usability were independently associated with professional burnout, illustrating the relationship between technology design and workforce wellbeing. Healthcare organisations should therefore assess electronic health records and other digital technologies according to usability, information presentation, workflow compatibility, documentation requirements, and professional task demands. Zayas Cabán and White (2020) similarly emphasised the importance of applying human factors and ergonomics principles to health information technology. Zhou et al. (2019) demonstrated that facilitating conditions influence nurses' adoption of hospital electronic information management systems, indicating that successful technology implementation requires appropriate organisational support. Technology users should therefore participate in system selection, testing, implementation, and evaluation. Digital systems that correspond with actual professional work can improve information accessibility and efficiency while reducing unnecessary cognitive demands. Human centred technology should consequently become an integral component of sustainable ergonomic workplace development rather than being managed separately from professional work design.

5.3 Establish Sustainable Workload and Psychosocial Support Practices

Healthcare organisations should develop workload management practices that recognise the relationship between staffing, working time, professional demands, recovery, and employee wellbeing. Workload should be monitored systematically rather than addressed only when staffing difficulties or burnout become severe. Dall'Ora et al. (2015) demonstrated that nurses working shifts of twelve hours or longer were more likely to experience burnout, job dissatisfaction, and intentions to leave. Dall'Ora et al. (2020) subsequently identified high workload, inadequate staffing, long shifts, limited schedule flexibility, and low control among important characteristics associated with nursing burnout. These findings demonstrate that scheduling represents an important ergonomic and organisational consideration. Management should regularly review patient demand, staffing levels, shift duration, overtime, workload distribution, break arrangements, and opportunities for recovery. Where possible, employees should also have reasonable involvement in scheduling arrangements because greater predictability and control may contribute to more sustainable working conditions. Workload management should not simply seek to reduce professional responsibilities but should ensure that responsibilities remain proportionate to the time, staffing, resources, and organisational support available to healthcare professionals.

Psychosocial support should be strengthened simultaneously because sustainable workplaces depend on more than appropriate staffing and working hours. Healthcare professionals require supportive leadership, effective communication, professional autonomy, positive workplace relationships, and sufficient organisational resources to manage demanding responsibilities. Hall et al. (2016) demonstrated associations between healthcare staff wellbeing, burnout, and patient safety, indicating that psychosocial conditions can have wider organisational consequences. Cummings et al. (2018) similarly found that relational leadership styles were associated with favourable nursing workforce and work environment outcomes. Organisational responses should therefore extend beyond programmes that encourage individual employees to cope with difficult working conditions. Panagioti et al. (2017) demonstrated that organisational interventions can contribute to reductions in physician burnout, supporting the importance of addressing workplace conditions themselves. Yu et al. (2019) further identified work related factors associated with nurse resilience, suggesting that organisational resources can influence professionals' capacity to manage demanding environments. Healthcare organisations should consequently strengthen supervisor support, teamwork, communication, job control, recognition, and access to appropriate resources. These measures can create psychosocial environments that support professional wellbeing while strengthening workforce stability and sustainable performance.

5.4 Strengthen Employee Participation in Integrated Workplace Improvement

Healthcare professionals should be actively involved in workplace improvement because they possess direct knowledge of the physical, technological, cognitive, and organisational challenges encountered during everyday work. Employee participation can help management identify differences between formally designed processes and the realities of professional practice. Healthcare professionals may recognise workflow barriers, unnecessary movements, difficult technologies, communication problems, workload pressures, or environmental limitations that are not immediately visible through administrative performance measures. Holden et al. (2013) emphasised that healthcare work systems are dynamic and shaped by interactions between people and multiple workplace components. Carayon et al. (2014) similarly demonstrated that understanding actual work conditions is fundamental to effective healthcare system improvement. Employee participation should therefore occur during ergonomic assessment, technology evaluation, workplace redesign, workflow improvement, and implementation of organisational changes. Participation should not be limited to collecting opinions after decisions have already been made. Instead, healthcare professionals should contribute during problem identification and solution development. Such involvement can improve the practical relevance of workplace interventions while strengthening professional acceptance of organisational change and supporting a more genuinely human centred approach to healthcare work design.

Employee participation should also be supported by formal organisational mechanisms that allow workplace feedback to generate meaningful improvement. Healthcare organisations can establish multidisciplinary ergonomic committees, regular workplace assessments, structured employee feedback processes, and post implementation evaluations to ensure that ergonomic concerns remain visible within management decision making. Paguio et al. (2020) demonstrated through a systematic review that interventions targeting nurses' work environments can influence outcomes at nurse, patient, and hospital levels, highlighting the strategic importance of workplace improvement. Human centred design should therefore connect employee knowledge with organisational resources and managerial authority. Carayon et al. (2020) further emphasised human centred systems design by recognising the importance of understanding healthcare activities across complex journeys. Management should evaluate whether implemented changes actually reduce physical demands, cognitive burden, workflow difficulties, or psychosocial pressures rather than assuming that implementation itself represents success. Continuous feedback can also identify unintended consequences and support timely modification. Through meaningful participation, systematic evaluation, and coordinated organisational action, healthcare workplaces can become more responsive to changing professional needs while maintaining workforce wellbeing, organisational adaptability, and sustainable healthcare performance.

6. Conclusion

Human centred ergonomic work design provides an important foundation for advancing sustainable healthcare workplaces by recognising that professional wellbeing and organisational performance are closely connected to the conditions in which healthcare work is performed. Healthcare professionals operate within complex environments involving physical demands, cognitive responsibilities, digital technologies, workload pressures, psychosocial challenges, and organisational expectations. These dimensions interact continuously and can influence the ability of professionals to perform their responsibilities effectively over time. The analysis demonstrates that sustainable workplace development cannot depend solely on conventional occupational safety practices or isolated interventions. Instead, healthcare organisations need to consider the wider work system and the relationships among employees, tasks, technologies, physical environments, organisational structures, and management practices. A human centred approach provides a more comprehensive basis for ensuring that workplace systems accommodate professional capabilities and limitations while continuing to support healthcare service requirements.

Several important challenges may limit the development of sustainable healthcare workplaces. Persistent physical ergonomic risks remain associated with patient handling, repetitive activities, prolonged standing, awkward working positions, and other demanding professional activities. At the same time, increasing dependence on digital technologies introduces cognitive demands related to usability, information processing, documentation, and workflow compatibility. Excessive workload, staffing pressures, extended working hours, insufficient recovery opportunities, and psychosocial strain create further concerns for workforce sustainability. Limited

employee participation and fragmented organisational workplace design can also reduce the effectiveness of ergonomic improvements because interventions may not adequately reflect the realities of professional practice. These concerns demonstrate that workplace problems should not be considered independently. Physical, cognitive, technological, psychosocial, and organisational conditions are interconnected and require coordinated management attention if healthcare organisations are to create working environments that remain supportive and sustainable.

Strengthening workplace sustainability therefore requires ergonomic principles to become an integral part of organisational planning and continuous workplace improvement. Healthcare organisations should systematically evaluate physical working conditions, technology usability, workload arrangements, psychosocial support, and employee experiences while ensuring that healthcare professionals participate meaningfully in workplace development. Human centred technologies should correspond with actual professional activities, while staffing and scheduling practices should provide an appropriate balance between service requirements and workforce capabilities. Employee participation is equally important because healthcare professionals possess practical knowledge that can assist organisations in identifying emerging workplace difficulties and developing realistic improvements. Continuous evaluation can further ensure that ergonomic interventions remain appropriate as technologies, professional responsibilities, service demands, and organisational priorities change.

Ultimately, sustainable healthcare workplaces depend on the ability of organisations to balance human needs with operational requirements without treating these objectives as competing priorities. Human centred ergonomic work design offers a practical and strategic approach for achieving this balance by placing healthcare professionals within the wider context of workplace systems and organisational development. Greater attention to ergonomic work design can contribute to healthier working conditions, more supportive professional environments, improved organisational adaptability, and stronger workforce sustainability. Rather than responding to workplace difficulties only after they become established, healthcare organisations should adopt a proactive approach that continuously aligns work demands with human capabilities. Such an approach can provide a stronger foundation for maintaining professional wellbeing and effective healthcare performance while supporting the long term sustainability of healthcare organisations.

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