

# Risk Analysis of Patient Transport Personnel Using ISO 45001:2018 in Vajira Hospital, Thailand

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**Purpose:** This study aimed to evaluate occupational health and safety risks among patient transport personnel at Vajira Hospital, Thailand, using the ISO 45001:2018 Occupational Health and Safety Management System (OHSMS). The goal was to identify hazards, quantify risk levels, and propose targeted corrective measures to enhance workplace safety.

**Patients and Methods:** Data were collected from 60 patient transport personnel and their supervisors using in-person, semi-structured interviews. Task-related hazards were identified through standardized checklists aligned with ISO 45001:2018. Descriptive statistics (frequencies, percentages, mean values) were applied to summarize participant characteristics and risk levels.

**Results:** Among 21 assessed work activities: 2 activities were categorized as very high risk (ergonomic hazards). 12 activities as high risk. 6 activities as medium risk. 1 activity as low risk. Key hazards included repetitive lifting, awkward postures, and potential exposure to infectious agents. ISO 45001:2018 clauses 6.1.2 (Hazard Identification and Risk Assessment) and 8.1 (Operational Planning and Control) were most relevant for these high-risk activities.

**Conclusion:** The study identifies urgent needs for ergonomic interventions, staff training, and procedural adjustments to reduce high-risk activities. Implementing ISO 45001:2018 systematically can improve hazard control and promote a safer working environment for patient transport personnel in hospital settings.

**Keywords:** occupational health, patient transport personnel, risk assessment, ISO 45001:2018, ergonomic hazards

## Introduction

Patient transport personnel—commonly referred to as patient transporters, porters, or hospital transport staff—play a critical role in healthcare delivery. Their responsibilities include transferring patients from ambulances or hospital entry points to various clinical departments for diagnostic or therapeutic procedures. This function not only supports operational efficiency but also directly impacts patient safety and continuity of care.<sup>1</sup>

Occupational health data highlight the severe risks faced by frontline hospital personnel globally. For example, the Centers for Disease Control and Prevention (CDC) reported that Emergency Medical Services (EMS) clinicians experienced 16,900 injuries in 2020, including overexertion (31%) and violence (18%).<sup>2</sup> Crucially, similar patterns are observed internationally among hospital transport staff, nursing assistants, and other personnel regularly engaged in manual patient handling, with Musculoskeletal Disorders (MSDs), particularly low back pain, being recognized as a major occupational health crisis in healthcare.<sup>3–7</sup>

In Thailand, centralized data on occupational injuries among hospital personnel are limited. The *Occupational Safety, Health, and Environment Act B.E. 2554 (A.D. 2011)* mandates the implementation of occupational safety measures but does not require formal reporting to the Department of Labor Protection and Welfare.<sup>8</sup> Consequently, hospitals, including Vajira Hospital, implement risk management practices individually, limiting systematic hazard identification and benchmarking. This reporting gap can result in unrecognized hazards, delayed corrective actions, and inconsistent safety outcomes. Adopting the ISO 45001:2018 framework is highly pertinent here, as it offers a globally recognized,

structured, and replicable process for hazard identification, risk assessment, and preventive measures, improving workplace safety beyond current general legislative approaches.<sup>8,9</sup>

Patient transport personnel frequently perform tasks that involve lifting, pushing, and transferring patients using stretchers or wheelchairs. These activities require repetitive bending, twisting, and lifting, which increase the risk of work-related musculoskeletal disorders (WMSDs) and other ergonomic hazards.<sup>3,4,10</sup> Psychosocial factors, such as time pressure, patient aggression, and workload, may further exacerbate occupational risk.<sup>3-7</sup> Evidence from both domestic and international studies highlights low back pain as a prevalent health issue among healthcare personnel regularly engaged in manual patient handling, including nurses, nursing assistants, and patient transport personnel.<sup>3-7,10</sup>

Vajira Hospital is a tertiary care public hospital under the Bangkok Metropolitan Administration (BMA), with over 1000 inpatient beds and a high level of specialized services. In 2022 (B.E. 2565), the hospital recorded 959,265 outpatient visits and 25,058 inpatient admissions.<sup>11</sup> While risk assessment guidelines based on the Hospital and Healthcare Standards are applied, these protocols do not fully capture the actual working conditions and hazards encountered by patient transport personnel.<sup>12</sup>

Accordingly, this study applies a risk assessment approach based on the ISO 45001:2018 Occupational Health and Safety Management System (OHSMS) to identify hazards and evaluate occupational health and safety risks affecting patient transport personnel. Data were collected using in-person, semi-structured interviews with operational staff and supervisors, covering all work areas and task-related activities. The study aims to:

1. Provide a comprehensive evaluation of workplace hazards among patient transport personnel,
2. Quantify risk levels and identify the most hazardous tasks, and
3. Propose detailed, feasible corrective and preventive measures aligned with the ISO 45001:2018 hierarchy of controls, offering actionable value for improving hospital patient transport safety.

This study addresses existing gaps in both local and international literature by combining standardized OHSMS guidelines with practical field assessments, offering a transferable methodological model and actionable insights for improving safety in hospital patient transport operations.<sup>10</sup>

## Materials and Methods

### Study Design, Setting, and Data Collection

The study employed a descriptive, cross-sectional design using mixed methods (qualitative interviews/observation and quantitative risk scoring) structured around the ISO 45001:2018 Occupational Health and Safety Management System (OHSMS) framework.

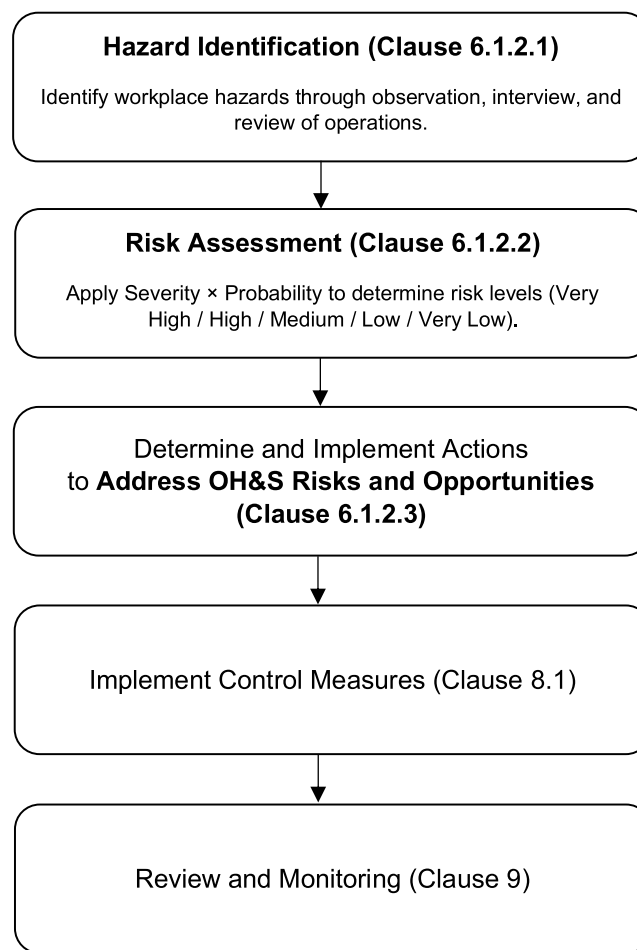
On-site data collection was conducted over a 4-week period at Vajira Hospital, covering three operational areas: Petcharat Building, Mahavajiravudh Building, and Dipangkorn Rasmijoti Building. Data collection covered multiple shifts to capture variations in workload and operational conditions.

### Hazard Identification and Risk Assessment (HIRA) Procedure

Hazard identification and risk assessment were performed in accordance with the Occupational Health and Safety Management System (ISO 45001:2018, Clause 6.1.2 – Hazard identification and assessment of risks and opportunities). The process consisted of three sequential stages:

1. Identifying potential hazards (Clause 6.1.2.1),
2. Evaluating risk levels (Clause 6.1.2.2), and
3. Determining appropriate control measures for each patient transport activity (Clause 6.1.2.3).

The detailed steps of this process are summarized in [Figure 1](#) (HIRA Process Flow).



**Figure 1** Hazard Identification and Risk Assessment (HIRA) process flow based on ISO 45001:2018 (Clause 6.1.2). Image created by the author, adapted from ISO 45001:2018.

## Hazard Identification (Clause 6.1.2.1)

Potential occupational hazards were identified through direct observation, structured interviews with stretcher personnel, and reviews of standard operating procedures (SOPs). The assessment comprehensively addressed six key hazard categories:

- Physical hazards: noise, temperature, inadequate lighting, and confined spaces during patient transport.
- Ergonomic hazards: manual handling of patients, awkward postures, repetitive movements, and forceful exertions during lifting or transferring tasks.
- Biological hazards: exposure to infectious agents, contaminated surfaces, and biofluids encountered during patient handling.
- Chemical hazards: incidental exposure to disinfectants or cleaning agents used within transport zones.
- Psychosocial hazards: work-related stress, fatigue, and time pressure during emergency transfers.
- Safety hazards: slips, trips, and falls during patient movement or equipment handling.

All identified hazards were recorded and classified according to the type of exposure and potential consequence, forming the foundation for subsequent risk assessment.

## Risk Assessment (Clause 6.1.2.2)

1. Severity and Probability: Each identified hazard was assessed using predefined Severity (S) and Probability (P) criteria (see Table 1).
2. Risk Level Evaluation: Risk levels were calculated using the formula Risk Score = S × P and categorized according to the organization's risk management framework (see Table 1).
3. Control Measures: For each risk category, appropriate preventive and corrective measures were proposed (see Table 1).

Risk levels were then organized in descending order from highest to lowest, consistent with the ISO 45001:2018 OHSMS framework.

## Legal and Regulatory Compliance Risk Assessment (Clause 6.1.3)

In accordance with ISO 45001:2018, Clause 6.1.3 (Determination of legal and other requirements), relevant OH&S legislation, regulations, and other compliance obligations were systematically identified and reviewed to ensure conformity with applicable national and institutional standards. These legal and other requirements served as critical inputs to the HIRA process, ensuring that risk control measures were both operationally effective and legally defensible.

## Actions to Address Risks and Opportunities (Clause 6.1.2.3)

Following the quantitative risk assessment (as presented in Table 2), all identified risks were subsequently evaluated to determine potential opportunities for enhancing the OHSMS. The evaluation utilized the specific assessment criteria detailed in Table 3. The OH&S Opportunity Score was calculated as a composite index, representing the total sum of the scores assigned to items A through F in the Opportunity Assessment checklist.

**Table 1** Risk Assessment Criteria and Recommended Control Measures

Severity Level (S)	Description	Probability Level (P)	Description	Risk Score (S×P)	Risk Category	Recommended Control Measures
5	Fatal or permanent disability	5	Very likely (>80% chance)	25	Very High	Immediate corrective actions, stop work, if necessary, implement engineering controls, intensive training
4	Major injury or illness requiring hospitalization	4	Likely (60–80% chance)	16	High	Implement engineering and administrative controls, staff training, monitor regularly
3	Moderate injury requiring medical attention	3	Possible (40–60% chance)	9	Medium	Administrative controls, safe work procedures, periodic training
2	Minor injury not requiring medical attention	2	Unlikely (20–40% chance)	4	Low	Basic preventive measures, awareness training
1	Negligible injury	1	Rare (<20% chance)	1	Very Low	Routine monitoring, maintain existing procedures

**Notes:** Severity (S) evaluates the potential impact of the hazard. Probability (P) estimates the likelihood of the hazard occurring. Risk Score (S×P) is used to classify risk into categories: Very High, High, Medium, Low, Very Low. Control Measures are aligned with ISO 45001:2018 OH&S Management System, including engineering, administrative, and behavioral interventions.

The top three strategic opportunities prioritized for action management are:

1. **Elimination and Substitution:** Implementing engineering solutions (e.g., the procurement of mechanical patient-handling devices) to eliminate very high- and high-risk manual tasks. This approach represents the highest level of control within the Hierarchy of Controls.
2. **Continual Improvement:** Developing and institutionalizing the corrective and preventive actions into the OHSMS to ensure the sustained reduction of risk, directly aligning with the Act phase of the PDCA cycle.
3. **Benchmarking and Transferability:** Utilizing the validated ISO 45001 methodology as a transferable model for benchmarking and policy development across other comparable healthcare settings.

## Data Analysis and Statistics

Descriptive statistics (including frequency, percentage, mean, standard deviation, and minimum–maximum values) were calculated to summarize personal and work-related characteristics of the participants, as well as general risk levels for each work activity.

Inferential analyses were also conducted to compare risk exposure by demographic and operational factors (eg, age, years of service, workload intensity), providing deeper insights into risk variability among stretcher personnel. Findings from both the HIRA and compliance assessments were interpreted in relation to ISO 45001:2018 requirements and institutional OH&S policies to support evidence-based decision-making and continuous improvement.

## Results

### Personal and Work Information

All 60 patient transport personnel who participated in the study were male, with a mean age of 38.0 years (SD = 11.8). The majority of the workforce fell between 21–40 years of age (63.4%). Pertaining to physical health characteristics, the average Body Mass Index (BMI) was 27.1 kg/m<sup>2</sup>, with most participants classified as Obese Level 1 (33.3%). Furthermore, 63.3% reported not engaging in regular exercise. Regarding work characteristics, the participants reported an average duration of experience in patient transport duties of 11.0 years. They performed an average of 8.0 working hours per day and approximately 22.0 patient transfers daily. A high percentage of participants (75.0%) had previously received training on ergonomic patient lifting and transfer techniques. These findings indicate a workforce predominantly composed of middle-aged, long-serving personnel performing highly repetitive manual handling tasks. The combination of high workload frequency, long average service duration, and a high prevalence of high BMI places this occupational group at substantial ergonomic risk—a profile that underscores the need for targeted intervention strategies within the OHSMS.

### Occupational Health and Safety (OH&S) Risk Assessment

Work responsibilities of patient transport personnel were divided into two key roles:

1. **Patient Transport Control Staff:** Responsible for coordinating patient transfers, recording requests, and prioritizing cases (eg, emergency, ICU, CT, or MRI transfers).
2. **Transport Personnel:** Responsible for physical patient movement using stretchers or wheelchairs, often involving manual lifting and prolonged standing.

In accordance with ISO 45001 Clauses 6.1.2.1 (Hazard Identification) and 6.1.2.2 (Risk Assessment), a total of 21 work activities were analyzed.

Results revealed the following risk classification: 2 activities (9.5%) were classified as Very High Risk, 12 (57.1%) as High Risk, 6 (28.6%) as Medium Risk, and 1 (4.8%) as Low Risk (see [Table 2](#)).

**Table 2** Summary of Occupational Health and Safety (OH&S) Risk Assessment Results (n=21 Activities)

Risk Category (ISO 45001 Level)	Number of Activities (n)	Percentage (%)	Predominant Hazard Type	Key Activities & Examples	Required Action Priority (ISO 45001 Clause 8.1.2)
Very High Risk (Unacceptable)	2	9.5%	Ergonomic / Physical	Manual transfer of immobile/ bariatric patients; Manual lifting from floor/confined spaces.	Immediate and Urgent Action: Elimination/Substitution of hazard (eg. mandatory mechanical aids).
High Risk	12	57.1%	Ergonomic / Physical	Pushing heavy equipment over long distances; Tasks requiring sustained awkward postures or repetitive movements.	Prioritized and Aggressive Controls: Implementation of engineering and administrative controls (eg. staff rotation, improved equipment).
Medium Risk	6	28.6%	Physical / Biological	Tasks with moderate exposure (eg. needlestick risk, slips/trips, moderate exertion).	Scheduled Improvement: Manage risk through established procedures and monitoring.
Low Risk	1	4.8%	General Safety	Non-critical tasks requiring minimal exertion or low exposure.	Routine Monitoring: Maintain existing controls and general supervision.
<b>Total</b>	<b>21</b>	<b>100%</b>			

## Analysis of Very High Risk Activities

The two activities categorized as Very High Risk primarily involved manual lifting and transferring of immobile patients, and were specifically identified as:

1. Manual transfer of completely dependent (immobile) or bariatric patients between the stretcher/wheelchair and the bed/examination table.
2. Manual lifting of patients (who are unable to assist themselves) off the floor or out of vehicles in emergency or confined spaces.

These activities were categorized as Very High Risk due to the extreme combination of severity and likelihood scores. The primary causes stem from the excessive biomechanical load required to manually manage weights often exceeding the recommended limits (such as patient weight combined with the weight of the stretcher, which can be up to 60 kg). This process frequently necessitates awkward working postures, including deep forward bending, torso twisting, and forceful exertion (pinch grip force and heavy lifting force) which are sustained for a significant duration under time pressure. The direct and severe impact on stretcher personnel includes a high likelihood of acute or chronic Work-Related Musculoskeletal Disorders (WMSDs), specifically severe injury to the lumbar spine (low back pain) and shoulder joints, leading to increased muscle fatigue, injury severity, and mandatory sick leave.

## Analysis of High Risk Activities

High-risk tasks were linked to factors such as awkward postures, repetitive movements, and pushing heavy equipment over long distances (eg, transporting fully occupied stretchers between distant buildings or departments).

These findings collectively demonstrate the predominance of ergonomic and physical hazards in patient transport work and underscore the urgent need for preventive interventions within the ISO 45001 framework.

## Opportunities for OH&S Improvement

Consistent with ISO 45001:2018 Clause 6.1.2.3, a systematic evaluation was conducted to identify opportunities for enhancing the Occupational Health and Safety Management System (OHSMS), using the criteria detailed in Table 3. The

**Table 3** Criteria for Assessing OH&S Improvement Opportunities

Criteria (Item)	Description of Opportunity Assessment	Scoring Range/Basis
<b>A</b>	Alignment with OHSMS Objectives	Assesses how well the potential improvement aligns with the organization's stated OH&S objectives (eg, reducing MSD incidents by 10%).
<b>B</b>	Compliance Enhancement	Assesses the extent to which the improvement helps the organization meet or exceed legal and other requirements (eg, new national ergonomic standards).
<b>C</b>	Applicability of Hierarchy of Controls (HOC)	Assesses the feasibility of implementing higher-level controls (Elimination, Substitution, Engineering) vs lower-level controls (Admin, PPE).
<b>D</b>	Prevention of Future Incidents	Assesses the potential of the improvement to prevent the recurrence of similar incidents or nonconformities identified in the past.
<b>E</b>	Ease of Implementation / Feasibility	Assesses the relative effort required for implementation, considering factors like complexity, time, and necessary technical resources.
<b>F</b>	Cost-Effectiveness / Resource Requirement	Assesses the cost-benefit ratio and the estimated financial and personnel resources required to implement and sustain the improvement.
<b>OH&amp;S Opportunity Score</b>	<b>Total Sum of Scores (A + B + C + D + E + F)</b>	<b>A composite score used to prioritize the opportunities with the greatest potential benefit and feasibility.</b>

OH&S Opportunity Score, calculated as a composite index of criteria A through F, was used to prioritize actions with the highest strategic value.

The identified opportunities align directly with the primary objective of ISO 45001: to prevent ill health and proactively improve OH&S performance. The evaluation confirmed that the most significant opportunities lie in addressing the Very High and High-Risk ergonomic activities. Table 4 summarizes the strategic opportunities prioritized for management action based on their composite scores.

The top three strategic opportunities are:

**Table 4** Summary of OH&S Improvement Opportunities and Prioritization

Priority Rank	Identified High-Risk Activity	Primary Hazard Type	Strategic Opportunity	Recommended ISO 45001 Control Level	Opportunity Score
1	Manual transfer of completely dependent/ bariatric patients.	Ergonomic (Forceful Exertion, Posture)	Procure and mandate use of mechanical patient handling aids (eg, patient slings, transfer devices).	Elimination/ Substitution	[Highest Score]
2	Manual lifting of patients off the floor/out of confined spaces.	Ergonomic (Awkward Posture, Force)	Establish Structured Staff Rotation to mitigate cumulative fatigue and implement Targeted Ergonomic Training.	Administrative Control	[Second Highest Score]
3	Transporting stretchers/ wheelchairs over long distances/uneven floors.	Ergonomic (Repetitive Pushing/Pulling)	Improve equipment maintenance and modify work procedures to minimize transport distance.	Engineering/ Administrative	[Third Highest Score]
4	High-pressure workloads and patient complaints (leading to stress/fatigue).	Psychosocial	Implement structured debriefing sessions and review staffing ratios during peak hours.	Administrative Control	[Relevant Score]

1. **Elimination and Substitution:** The highest priority is placed on implementing engineering controls, specifically the procurement and mandatory use of mechanical patient handling devices (eg, patient slings, transfer boards). This addresses the root cause of the Very High Risk manual handling tasks, serving as the most effective control measure.
2. **Continual Improvement through Administrative Controls:** A medium-term opportunity involves institutionalizing corrective actions into the OHSMS, focusing on structured staff rotation systems and targeted, recurrent ergonomic training modules. This helps mitigate cumulative physical fatigue and ensures the sustained reduction of risk (aligned with the Act phase of the PDCA cycle).
3. **Benchmarking and Transferability:** Utilizing the validated ISO 45001 methodology as a transferable model for risk evaluation and policy development across other comparable healthcare settings, maximizing the study's impact beyond Vajira Hospital.

These strategic priorities provide actionable value for practitioners by focusing resources on interventions that offer the highest level of risk reduction according to the Hierarchy of Controls.

## Legal and Regulatory Compliance Risk Assessment

In alignment with *ISO 45001:2018*, Clause 6.1.3 (*Legal and other requirements*), a systematic review was conducted to identify work activities associated with potential legal or regulatory compliance risks. The analysis identified six (6) patient transport activities that posed varying degrees of legal and regulatory non-compliance risk.

The assessment results indicated that these risks were significant, with one (1) activity categorized as Very High Risk and five (5) activities classified as High Risk based on severity and probability scores. These findings highlight areas where existing operational practices do not fully align with national occupational health and safety (OH&S) legislation or ISO 45001:2018 requirements.

Accordingly, priority corrective actions were developed, emphasizing both the severity of risk and the urgency of achieving legal compliance. The top three actions are summarized below:

### 1. **Training and Awareness Programs:**

Development and implementation of structured training programs specifically focused on safe patient-handling and ergonomic practices. These initiatives aim to ensure that all stretcher personnel are competent in compliance-related safety procedures. (*Priority Score = 21*)

### 2. **Documentation and Assessment:**

Establishment of comprehensive workplace safety manuals and task-specific hazard assessment protocols for all patient transport activities. This documentation serves as verifiable evidence of compliance with OH&S regulations. (*Priority Score = 19*)

### 3. **Safe Weight Limits:**

Formulation and enforcement of legally compliant safe weight limits for manual patient lifting and transfer operations, ensuring strict adherence to national occupational health and safety standards.

## Preventive and Control Measures

Following ISO 45001 Clause 6.2.2, preventive and control measures were developed based on the risk evaluation results. Recommended actions include:

- Improving environmental conditions (lighting, floor conditions, obstruction-free pathways);
- Developing and disseminating safe-work procedures with regular training refreshers;
- Implementing a formal safety-management system with mechanisms for feedback, complaints, and hazard reporting;
- Regular equipment maintenance (wheelchairs, stretchers, communication devices);
- Enhancing signage and communication on workplace hazards;
- Ensuring provision and regular inspection of personal protective equipment (PPE).

These measures collectively aim to reduce ergonomic and physical hazards, promote a proactive safety culture, and strengthen compliance with ISO 45001 requirements.

## Novelty and Broader Implications

This study is among the first in Thailand to systematically apply ISO 45001:2018 principles to assess occupational health and safety risks among patient transport personnel — a workforce often overlooked in previous hospital safety research. The structured approach enhances transparency and replicability of risk evaluations and provides a scalable framework for other hospitals seeking to implement international safety management standards.

## Discussion

One of the primary health issues among healthcare personnel is exposure to ergonomic hazards. Such hazards can result in chronic pain in the arms, back, or neck and frequently lead to musculoskeletal disorders (MSDs), such as carpal tunnel syndrome. These conditions can significantly impair work performance and productivity and have a detrimental impact on an individual's health-related quality of life.<sup>13,14</sup>

Stretcher personnel are a key group involved in patient transport within hospitals. Based on the risk assessment (Table 2), particularly during patient intake and transport activities—whether the patient is partially able or unable to assist themselves, certain tasks were classified as unacceptable risk and high risk, primarily due to ergonomic factors. These risks stem from inappropriate working postures, such as exerting force to push or lift patients, and from the substantial weight of wheelchairs or stretchers, which can be as heavy as 60 kilograms. As a result, workers are required to exert significant physical effort to move patients, increasing the likelihood of muscle fatigue and leading to MSDs.

The finding that ergonomic hazards are the most critical risk for stretcher personnel at Vajira Hospital aligns with a well-documented global occupational health challenge. This strong correlation reinforces the external validity of the study. International research on occupational health and safety risk assessment has consistently identified similar ergonomic hazards among hospital staff, especially emergency room nurses. To compare relevant findings, studies with similar job functions to stretcher personnel were reviewed. For instance, the study by Hilintang and Kartika,<sup>15</sup> which used Job Safety Analysis (JSA) to evaluate risks among emergency room nurses, identified high ergonomic risks during the transfer of patients from ambulances to stretchers. Hazards in this step included exerting lifting force, which may cause pressure injuries to the hips or hands, and incorrect lifting techniques, such as bending or twisting the torso. Risk control measures proposed in that study focused on administrative controls, such as hazard communication, training, stretching before and after shifts, and regular physical exercise to improve muscle flexibility supporting the spine.

Another relevant study by Koskas and Vignais<sup>16</sup> applied the Rapid Upper Limb Assessment (RULA) tool to assess ergonomic risks among hospital staff. Their findings showed that tasks with the highest ergonomic risks included moving operating tables, stretchers, and wheelchairs—activities comparable to those performed by stretcher personnel. These findings support the conclusions of the present study and underscore the urgent need for targeted, actionable ergonomic interventions to reduce occupational risks and improve the working conditions of stretcher personnel.

An examination of the nature of work performed by stretcher personnel reveals that key tasks—namely lifting, pushing, and transferring patients—present a significant risk for work-related musculoskeletal injuries. The primary cause of these injuries is the excessive physical exertion required to lift patients, particularly in cases involving overweight individuals or patients who are completely dependent and must be manually transferred on and off wheelchairs or stretchers. These tasks are frequently carried out using improper lifting techniques, such as repeated bending, twisting, and lifting while maintaining awkward postures.

Although Vajira Hospital has introduced power-lift stretchers for trial use—similar to those studied and implemented in other countries to reduce work-related injuries among emergency medical service (EMS) personnel in urban settings<sup>17</sup>—this technology has not proven entirely suitable in the current context. The nature of stretcher personnel's duties often requires rapid response under time pressure and in confined or restricted workspaces, where manual handling remains faster and more practical. As a result, health issues related to muscle injuries continue to arise. Medical history data show that 51.70% of stretcher personnel have used medication to treat muscle and skeletal pain or injury. Common treatments

include intramuscular injections, oral muscle relaxants such as Norgesic<sup>TM</sup>, analgesics like paracetamol and tramadol, and topical analgesics including Counterpain<sup>TM</sup> and Tiger Balm<sup>TM</sup>.<sup>10</sup>

## Practical Interventions for Risk Mitigation

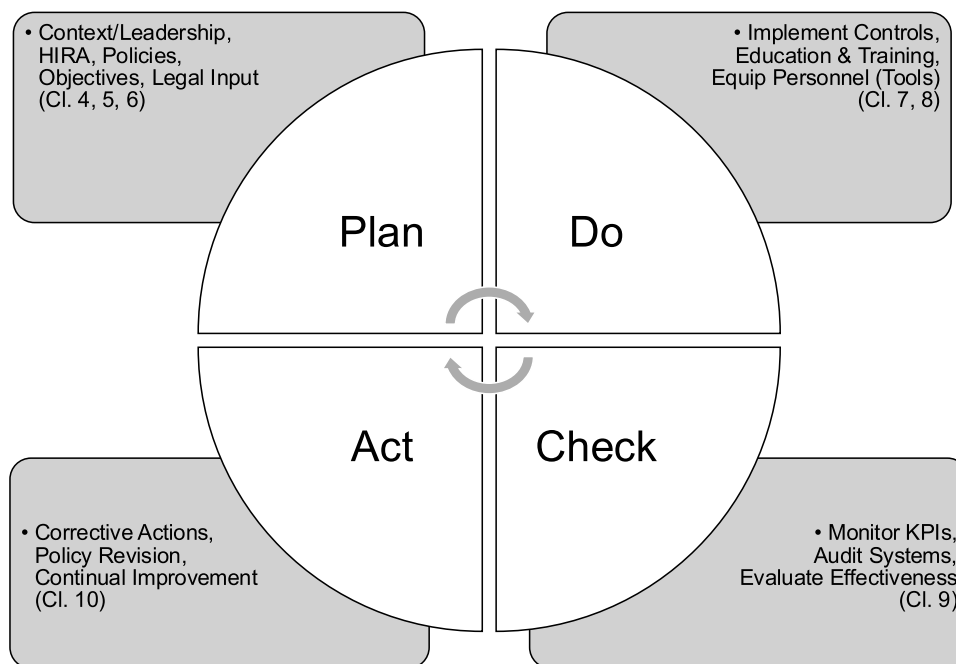
Based on the identified critical ergonomic risks (manual lifting and transfers), the study recommends specific, detailed, and feasible interventions for the Vajira Hospital context. These include: (1) The mandatory implementation and regular usage of mechanical lifting aids (eg, patient slings, transfer boards) for all high-risk patient transfers, especially those involving fully dependent or bariatric patients. (2) Establishing a structured staff rotation system during peak hours to mitigate cumulative fatigue. (3) Developing targeted, recurrent ergonomic training modules focusing explicitly on safe patient handling techniques, proper posture, and the effective use of mechanical devices. These interventions, grounded in the specific hospital context, offer actionable value for practitioners beyond general recommendations.

Thailand is among the countries that place strong emphasis on the development of its public health system. In recent years, the system has undergone continuous improvement with the goal of achieving universal health coverage and ensuring that the population has access to efficient and equitable healthcare services. Since the implementation of the Universal Health Coverage Policy in 2002, public access to healthcare has significantly increased. However, this has also resulted in a surge in the number of patients, leading to an imbalance between healthcare providers (medical personnel) and service recipients (patients). Consequently, issues such as delays, long wait times, and inefficiencies in patient referral processes have emerged. These challenges have led to dissatisfaction among patients and placed considerable stress on healthcare workers, who now operate under increasingly demanding conditions.<sup>18</sup>

Stretcher personnel at Vajira Hospital face similar challenges, with work-related stress arising from high-pressure workloads and complaints from patients or their relatives. These findings are consistent with the study by Hilintang and Kartika,<sup>15</sup> which identified psychosocial hazards as posing a high level of risk. To ensure feasibility and impact within the Thai context, effective control measures for such psychosocial risks should involve administrative interventions that are detailed and sustainable. These include: (1) Implementing structured debriefing sessions after high-stress events, (2) Reviewing and optimizing staffing ratios to better align with patient volume, and (3) Enhancing employee motivation through transparent, formal recognition and reward systems that acknowledge high-pressure work.

In terms of biological hazards, stretcher personnel are exposed to viruses and bacteria carried by patients, their family members, or via contaminated equipment such as wheelchairs and stretchers. The risk level in this context was assessed as moderate, which contrasts with the findings of Hilintang et al,<sup>15</sup> who reported high levels of biological risk. This discrepancy may be attributed to the nature of the work and the use of personal protective equipment (PPE) among stretcher personnel, such as medical hair caps, surgical masks, waterproof gowns, and medical gloves. These preventive measures, which are sufficiently supported by the institution, help reduce both exposure and the severity of potential occupational illnesses. In comparison, nurses are at higher risk of direct exposure to bloodborne pathogens, such as hepatitis viruses and HIV, particularly through needlestick injuries while administering injections. As such, the nature and severity of biological risks differ between nurses and stretcher personnel due to the type and frequency of direct contact with potentially infectious materials.

Healthcare personnel working in hospitals are universally exposed to various occupational health and safety (OH&S) hazards, including ergonomic, biological, psychosocial, and other types of risks. The OH&S risk assessment conducted in this study, based on the ISO 45001 standard, provided insights into the risk levels and identified opportunities for improvement in occupational health and safety management among stretcher personnel. The assessment also offered a comprehensive framework for addressing these risks effectively. Recently, many workplaces in Thailand have begun adopting ISO 45001 as an internationally recognized standard, to manage occupational health and safety within their organizations. The implementation of ISO 45001 is designed to enhance OH&S performance by promoting a structured approach to hazard identification, risk assessment, and control. This systematic process has been shown to reduce workplace accidents, injuries, and illnesses effectively.<sup>19</sup> Applying the ISO 45001 framework within hospitals can therefore bring substantial benefits, particularly in reducing chronic injuries among healthcare personnel, such as back pain commonly reported by nurse assistants, emergency nurses, and stretcher staff. Moreover, the adoption of ISO 45001 supports compliance with OH&S legislation, mitigates the risk of compensation claims, and boosts employee confidence. This in turn leads to improvements in service efficiency, reduced absenteeism, and a more favorable institutional reputation. Such advantages can also enhance



**Figure 2** Plan–Do–Check–Act (PDCA) cycle for ISO 45001:2018 implementation. Adapted from: International Organization for Standardization. ISO 45001:2018 – Occupational health and safety management systems – Requirements with guidance for use. Available from: <https://www.iso.org/obp/ui/es/#iso:std:iso:45001:ed-1:v1:en> [Accessed 8 June 2025].

**Notes:** The PDCA cycle illustrates the continuous improvement framework underlying ISO 45001:2018, emphasizing iterative planning, implementation, verification, and corrective action for occupational health and safety management systems.

eligibility for government funding or procurement opportunities.<sup>20</sup> The implementation of ISO 45001 is structured around the continuous improvement of the Plan–Do–Check–Act (PDCA) cycle (see Figure 2), which is the foundational concept of the OH&S management system. The Plan phase involves conducting risk assessments, developing policies, and setting measurable OH&S objectives. The Do phase includes implementing safety procedures, providing training, and equipping personnel with necessary tools. The Check phase focuses on monitoring incident reports, auditing systems, and evaluating Key Performance Indicators (KPIs). Finally, the Act phase involves revising policies, executing corrective actions, and ensuring organizational commitment to continual improvement.<sup>21</sup>

## Transferability and Study Limitations

While the findings of this study provide valuable insights into the occupational health and safety risks faced by stretcher personnel, it is important to acknowledge that the quantitative results are context-specific to Vajira Hospital. Variations in hospital infrastructure, workflow organization, patient volume, and staff characteristics may influence the nature and magnitude of risks in other institutions. Therefore, direct generalization of the risk priorities to other hospitals should be approached with caution.

Nevertheless, the structured methodology employed—integrating hazard identification, risk scoring, and ISO 45001:2018-based control prioritization—offers a replicable framework that can be adapted by other healthcare facilities to evaluate their own occupational risks. Hospitals with similar operational contexts may apply this model to identify high-risk activities, guide the design of preventive measures, and enhance compliance with occupational health and safety standards.

## Study Limitations

It is essential to acknowledge the limitations of this study. Firstly, the findings are primarily limited by its single-center, case-study design, focusing solely on Vajira Hospital. While the methodology is transferable, the specific risk prioritization may not be directly generalizable to all healthcare institutions. Secondly, potential measurement limitations include the reliance on self-

reported data in some assessment components, which may introduce a degree of social desirability bias where personnel underreport risks or injuries. Thirdly, the study did not fully control for crucial confounding factors such as the staff's years of service, pre-existing health conditions, or body mass index (BMI), all of which could potentially influence the individual's perceived or actual level of occupational risk. Future research should expand this framework to compare risk levels across different hospital departments or institutions while aiming to control for these individual characteristics, thereby supporting broader policy development and benchmarking in healthcare safety management.

In a broader context, the results of this study can inform the development of occupational health and safety strategies across diverse healthcare environments. By applying the same systematic risk assessment approach based on ISO 45001:2018, other medical institutions—such as regional hospitals, private clinics, or emergency medical service units—can adapt the methodology to their own working conditions. This adaptation would allow for the identification of common ergonomic and psychosocial risk patterns, the prioritization of control measures, and the creation of tailored interventions that improve worker safety while maintaining service efficiency. The study therefore provides not only institution-specific insights but also a transferable methodological model that can serve as a foundation for benchmarking OH&S practices in comparable healthcare settings. Future research should aim to validate and expand this approach by incorporating diverse hospital contexts, workforce characteristics, and regional safety policies, thereby enhancing the generalizability and policy relevance of the findings.

## Conclusion

This study successfully demonstrated the utility of the ISO 45001:2018 Occupational Health and Safety Management System (OHSMS) framework for the systematic evaluation of hazards and quantification of occupational risks faced by patient transport personnel at Vajira Hospital. The risk assessment process clearly identified that ergonomic hazards, specifically those related to manual patient lifting and transfer, pose the most critical (unacceptable and high) level of risk, leading to a high prevalence of self-reported musculoskeletal pain. These results strongly corroborate existing global literature on the high burden of Work-Related Musculoskeletal Disorders (WMSDs) among staff involved in patient handling in healthcare.

## Policy and Management Recommendations

The findings demand detailed, actionable recommendations for management and policy to mitigate these critical risks. It is therefore recommended that top-down organizational commitment be prioritized for:

1. **Mandatory Procurement and Utilization of Mechanical Devices:** Requiring dedicated funding for mechanical patient transfer aids and establishing protocols for their consistent use.
2. **Structured Administrative Controls:** Implementing staff rotation systems and reviewing staffing ratios as part of hospital policy to manage cumulative physical and psychosocial strain.
3. **Targeted Training:** Instituting recurrent, focused ergonomic training programs on safe patient handling techniques to improve working postures and prevent lower back injuries.

Ultimately, the successful implementation of the ISO 45001 framework, supported by commitment from all organizational levels, ensures not only legal compliance but also enhances the well-being, safety, and performance of stretcher personnel, thereby contributing to the overall quality of patient care and the long-term sustainability of the organization.

## Application of the ISO 45001 (PDCA Cycle)

The systematic management of OH&S is achieved by applying the Plan–Do–Check–Act (PDCA) cycle in alignment with the ISO 45001 standard. This study confirms that this framework provides clear steps for: (Plan) Identifying specific risks for stretcher personnel and setting objectives (eg, injury rate reduction); (Do) Implementing resources like mechanical aids and training; (Check) Monitoring performance via injury data; and (Act) Revising safety protocols based on audit findings. In summary, the adoption of ISO 45001 through the PDCA cycle enables hospitals to systematically manage occupational health and safety risks, thereby enhancing staff well-being, legal compliance, and overall service efficiency.

## Study Limitations and Future Research

It is crucial to acknowledge the methodological limitations of this study. The quantitative risk profile is context-specific to a single metropolitan hospital and derived from a small sample size. Consequently, the direct generalization of these specific risk *priorities* to other diverse hospital settings should be approached with caution.

Moving forward, future research should focus on validating the methodological model presented here. Follow-up studies should aim to (1) Test the transferability of the ISO 45001 methodology across various healthcare settings and regions, (2) Incorporate larger sample sizes and control for confounding individual factors (eg, staff tenure), and (3) Conduct cost-benefit analyses of the recommended ergonomic interventions to support large-scale policy adoption.

## Ethics Approval and Consent to Participate

This study was ethically approved by the Institutional Review Board (IRB) of the Faculty of Medicine Vajira Hospital, Navamindradhiraj University, Thailand, on May 28, 2022 (Certificate of Approval Number: COA118/2565).

All participants were fully informed about the study objectives and procedures, and written informed consent was obtained from all participants prior to their participation in the study.

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## Disclosure

The author(s) report no conflicts of interest in this work.

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