International Journal Of Health, Engineering And Technology (IJHET) *E-ISSN 2829 - 8683*
Volume 5, Number 2, July 2026, *Page. 1435 - 1443*
Email : editorijhess@gmail.com

Analysis Of Potential Hazards And Ergonomic Risks During Manual Handling Activities In The Medical Equipment Warehouse Of Pelabuhan Ratu Regional General Hospital

Dian Permana
Master of Public Health, Universitas Strada Indonesia

*Corresponding Author
Email : kang.dianpermana@gmail.com

Abstract

Logistics management activities in hospitals have complex work characteristics and often involve intensive physical workloads. This study aims to identify potential ergonomic hazards, analyze risk levels, and formulate risk control recommendations for manual material handling (MMH) activities at the Medical Devices Warehouse Installation of RSUD Pelabuhan Ratu. The implementation methods utilized during this residency included direct field observations and structured interviews with warehouse staff. The root cause analysis was qualitatively conducted using a fishbone diagram with 4M+1E parameters (man, method, material, machine, environment) , followed by problem prioritization using the USG (Urgency, Seriousness, Growth) method and intervention strategy formulation through SWOT analysis. The assessment findings revealed significant potential ergonomic risks due to piles of large and heavy medical equipment being handled manually without mechanical lifting equipment (such as forklifts or hand stackers). Limitations in narrow storage spaces, the absence of OSH (Occupational Safety and Health) signages, and the lack of a specific recording system for musculoskeletal disorders (MSDs) further aggravated the risk level. Based on the USG matrix, the most urgent primary issues are the high intensity of manual heavy lifting and the low awareness among employees regarding proper ergonomic working postures. The SWOT analysis positioned the organization in Quadrant I (Aggressive Strategy). Consequently, the SO (Strength-Opportunity) strategy is recommended to optimize management support by developing an integrated manual handling system with the hospital's OSH programs, conducting regular training and socialization on proper lifting techniques, installing educational OSH signs, and strengthening progressive supervision and evaluation to minimize musculoskeletal injuries among warehouse workers.

Keywords: Manual Material Handling, Ergonomic Risk, Medical Device Warehouse, RSUD Pelabuhan Ratu, SWOT Analysis.

INTRODUCTION

Hospitals are healthcare service institutions characterized by complex operational systems involving various supporting units to ensure optimal medical services. In addition to direct patient care, the success of hospital operations is also highly dependent on the effectiveness of logistical systems, including the management of medical equipment warehouses. Medical equipment warehouses play a crucial role in ensuring the availability, quality, and timely distribution of medical supplies in accordance with service needs. Therefore, activities within the warehouse constitute an integral part of the healthcare delivery system.

In practice, activities in medical equipment warehouses largely involve physical work performed manually, commonly referred to as manual material handling (MMH). These activities include lifting, carrying, pushing, pulling, and stacking goods. Such tasks are often carried out repeatedly with high frequency and over extended durations. Moreover, limitations in facilities or supporting equipment frequently require workers to rely heavily on physical effort in performing these tasks.

Manual handling has long been recognized as a major risk factor contributing to occupational health problems, particularly musculoskeletal disorders (MSDs). MSDs affect muscles, tendons, ligaments, joints, nerves, and other supporting structures due to non-ergonomic work conditions, repetitive movements, and excessive loading. Recent studies indicate that workers engaged in manual handling activities exhibit a high prevalence of musculoskeletal complaints, especially in the lower back, neck, shoulders, and arms (Greggi et al., 2024). This highlights the critical importance of ergonomic considerations in maintaining worker health and safety.

Empirical studies by Leggieri et al. (2023) demonstrate that non-neutral working postures, such as bending, twisting, or improper lifting techniques, significantly increase the risk of musculoskeletal injuries. Research in industrial and logistics sectors also reveals that non-ergonomic manual handling activities are positively correlated with increased work fatigue and injury risk. Additionally, factors such as load weight, lifting frequency, work duration, and environmental conditions further influence ergonomic risk levels.

In warehouse environments, ergonomic risks become more complex due to the simultaneous execution of various physical tasks. Studies in warehousing contexts indicate that manual storage and distribution activities carry high ergonomic risks, particularly when not supported by ergonomic workplace design and adequate assistive tools (Dhonny & Mahbubah, 2025). This is reinforced by findings from Arifah et al. (2025), which show that warehouse workers are highly susceptible to musculoskeletal complaints due to a combination of static and dynamic postures that do not align with ergonomic principles.

Research by Santos et al. (2025) highlights the significant role of ergonomic approaches in risk prevention. Ergonomic interventions—including improved work design, the use of mechanical aids, and training in proper lifting techniques—have been proven effective in reducing the prevalence of MSDs among workers. Recent systematic studies also indicate that comprehensive ergonomic programs can enhance productivity while reducing work-related injuries.

Pelabuhan Ratu Regional General Hospital, as a public healthcare facility, manages a medical equipment warehouse with relatively complex and intensive work characteristics. Processes such as receiving, storing, and distributing medical equipment are still largely performed manually by warehouse personnel. This condition indicates a considerable potential for ergonomic risks, particularly when such activities are conducted without adherence to proper ergonomic principles. Furthermore, limitations in infrastructure, lack of ergonomic training, and suboptimal risk control systems may further increase the likelihood of occupational health issues.

If these conditions are not properly addressed, they may lead to an increased prevalence of musculoskeletal complaints, decreased work productivity, and a higher risk of workplace accidents. These impacts not only affect workers individually but also influence overall organizational performance. Therefore, a comprehensive and systematic study is necessary to identify potential hazards and analyze ergonomic risk levels associated with manual handling activities in the medical equipment warehouse of Pelabuhan Ratu Regional General Hospital.

Through this residency program, it is expected that a clear understanding of the actual ergonomic risk conditions faced by warehouse workers can be obtained. The results of this analysis can then serve as a basis for formulating appropriate risk control recommendations, including technical, administrative, and human resource capacity-building approaches. Ultimately, these efforts aim to enhance occupational health and safety (OHS) and create a safe, healthy, and productive work environment.

RESEARCH METHODS

Ergonomics

Ergonomics is the science that studies the interaction between humans and the work environment, tools, and work systems with the aim of adjusting work to human capabilities and limitations. The application of ergonomics aims to create working conditions that are safe, comfortable, efficient, and able to increase work productivity. In the context of occupational safety and health (OHS), ergonomics is an important aspect in efforts to prevent occupational diseases, especially those related to physical activities.

Ergonomic Risk

Ergonomic risk is the potential occurrence of health problems due to a mismatch between job demands and the worker's physical capabilities. This risk generally arises from non-ergonomic

working postures, repetitive movements, excessive force, and long working durations without sufficient rest.

Ergonomic Risk Assessment

Ergonomic risk assessment is a process to identify and evaluate the level of risk faced by workers due to certain work activities. This assessment aims to determine the level of hazard and to formulate appropriate control measures.

Ergonomic Risk Control

Ergonomic risk control is a systematic effort to reduce or eliminate potential hazards that can cause occupational health problems, particularly musculoskeletal disorders (MSDs). This control aims to create compatibility between job demands and workers' physical capabilities, thereby improving safety, health, and work productivity.

Manual Material Handling (MMH)

Manual Material Handling (MMH) is the activity of moving materials manually by human labor, either without assistive devices or with simple tools. These activities include lifting, lowering, carrying, pushing, and pulling. MMH is commonly found in various work sectors, including industry, logistics, and healthcare services such as medical equipment warehouses.

Musculoskeletal Disorders (MSDs)

Musculoskeletal disorders (MSDs) are disorders of the muscles, bones, joints, tendons, ligaments, and nerves caused by work activities or workplace environmental factors. MSDs are one of the most common occupational health problems, especially in jobs involving physical activities such as manual handling.

RESULTS AND DISCUSSION

Assessment

Based on the results of observations and interviews conducted with employees of the medical equipment warehouse installation during the residency period at Palabuhanratu Regional General Hospital, a key issue identified for further in-depth analysis is the potential ergonomic hazards associated with manual handling activities within the warehouse.

During the process of moving goods, employees perform handling activities manually without the use of assistive equipment such as forklifts or hand stackers, which could otherwise facilitate the process and reduce the potential hazards and risks of occupational accidents.

Problem Identification and Formulation

The potential hazards and risks of occupational accidents identified in the medical equipment warehouse of Palabuhanratu Regional General Hospital primarily relate to ergonomic risks arising from manual handling activities. These risks may lead to workplace accidents if not properly managed.

Problem identification in this residency report utilizes a fishbone (Ishikawa) analysis approach, in which the main problem is positioned as the "head" of the fish, while contributing factors are categorized as the "bones." The fishbone analysis applied in this study includes the following aspects: man, method, material, machine, and environment.

Furthermore, the findings from observations and interviews are documented and analyzed, and alternative solutions to the identified problems are determined using USG (Urgency, Seriousness, and Growth) analysis.

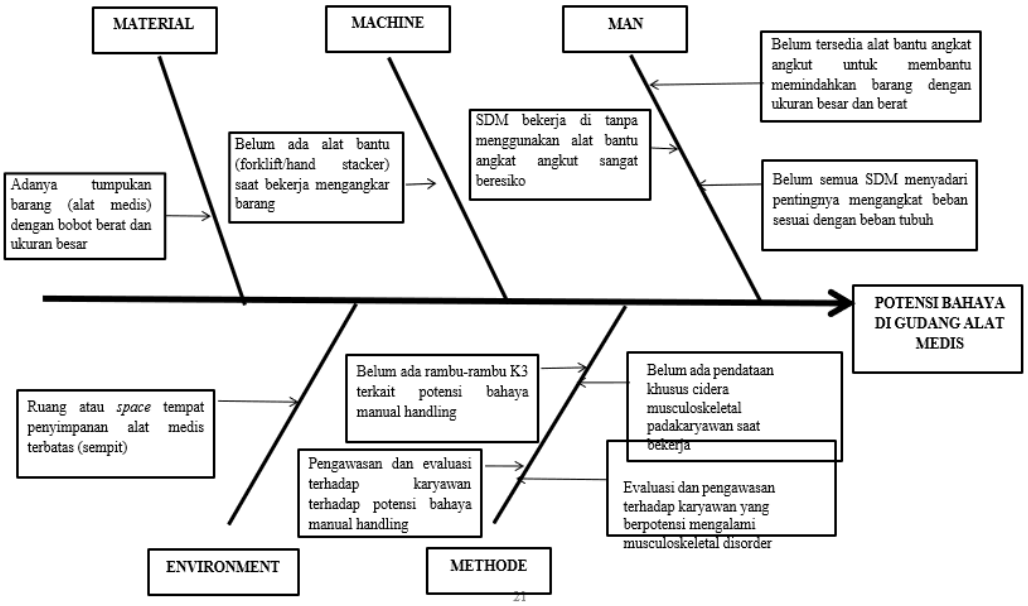

Figure 1. Fishbone Diagram

Problem Assessment

The assessment of ergonomic hazard potential during manual handling activities is categorized using the 4M+1E approach, namely: man, method, material, machine, and environment. The identified factors are described as follows:

Man (Human Factors):

a. Not all personnel are aware of the importance of lifting loads in accordance with their physical capacity.
b. Employees perform manual work involving heavy loads.
c. Employees carry out tasks without the use of lifting aids, which increases the risk of injury.

Method:

a. There is no specific data collection system for musculoskeletal injuries among employees during work activities.
b. There is an absence of occupational health and safety (OHS) signage related to manual handling hazards.
c. Supervision and evaluation of employees regarding manual handling risks are not yet optimal.
d. Monitoring and evaluation of employees at risk of musculoskeletal disorders have not been systematically implemented.

Material:

The presence of stacked medical equipment with heavy weight and large dimensions.

Machine:

There are no assistive tools such as forklifts or hand stackers to support material handling activities.

Environment:

Limited and narrow storage space for medical equipment.

Determination of Problem Priorities

The determination of priority in addressing ergonomic hazards during manual handling activities in the Medical Equipment Warehouse Installation at Palabuhanratu Regional General Hospital is conducted using the USG (Urgency, Seriousness, Growth) analysis method.

Based on the fishbone diagram developed to analyze ergonomic hazard potential, the following causative factors have been identified:

1. Lack of awareness among personnel regarding proper lifting techniques according to physical capacity.

2. Manual handling of heavy loads by employees.
3. Absence of lifting and transportation aids.
4. Lack of specific data collection on musculoskeletal injuries among employees.
5. Absence of OHS signage related to manual handling hazards.
6. Insufficient supervision and evaluation of employees regarding manual handling risks.
7. Limited monitoring of employees at risk of musculoskeletal disorders.
8. Presence of heavy and large medical equipment stacks.
9. Lack of mechanical aids such as forklifts or hand stackers.
10. Limited and confined storage space.

Based on the identification of these causative factors from the fishbone analysis, the next step involves determining problem priorities using the USG method (Urgency, Seriousness, and Growth) to identify the most critical issues requiring immediate intervention.

Tabel 1. Indicator

IndiCator	U	S	G	UxSxG	Ranking
Not all human resources (HR) are aware of the importance of lifting loads according to body capacity	5	4	4	80	**2**
HR work manually with heavy loads	5	5	5	125	1
HR work without using lifting/transport assistive devices	5	5	5	125	1
There is no specific data collection on musculoskeletal injuries among employees while working	4	3	3	36	5
There are no K3 (occupational safety and health) signs related to manual handling hazard potential	5	5	5	125	1
Supervision and evaluation of employees regarding potential manual handling hazards	4	3	4	48	4
Evaluation and supervision of employees who have the potential to experience musculoskeletal disorders	4	4	3	48	4
There are piles of goods (medical equipment) with heavy weight and large size	5	5	5	125	1
There are no assistive devices (forklift/hand stacker) when lifting goods	4	4	4	64	3
Storage space for medical equipment is limited (narrow)	4	4	4	64	3

Based on the table above, the priority issues that require immediate resolution are as follows: not all personnel are aware of the importance of lifting loads according to their physical capacity, employees perform manual handling involving heavy loads, employees work without the use of lifting and transportation aids, and the presence of stacked medical equipment with heavy weight.

Intervention Plan

Based on the prioritization of problem resolution outlined above, the intervention plan for this residency is formulated through a SWOT (Strengths, Weaknesses, Opportunities, and Threats) analysis of both internal and external factors within Palabuhanratu Regional General Hospital. The following section presents the problem-solving analysis using the SWOT approach.

Table 2. IFE Analysis

No	Analysis Factors	Weight	Rating	Score
	Strength (S)			
1	Management commitment to creating a safe workplace	0,18	4	0,72
2	Supporting training management system	0,22	5	1,1
3	Management support in promoting health programs	0,22	5	1,1
Total Strength		**0,62**		**2,92**
Weakness (W)				
1	No standard regulations and education procedures for OHS (K3)	0,15	4	0,6
2	No specific data collection on musculoskeletal injuries among employees while working	0,08	4	0,32
3	No training and socialization from training management regarding OHS standards	0,15	4	0,6
Total Weakneses		**0,38**		**1,52**
Total IFE		**1,00**		
S-W (2,92-1,52)				**1,40**

Table 3. EFE Analysis

No	Analysis Factors	Weight	Rating	Score
	Opportunities (O)			
1	Absence of government regulations related to ergonomic systems in hospital environments	0,18	4	0,72
2	No direct review from ergonomic experts regarding manual handling techniques	0,22	4	0,88
3	No gradual evaluation by OHS experts regarding hazards from manual handling	0,22	5	1,1
Total Opportunities		**0,62**		**2,70**
Ancaman - Threats (T)				
1	Risk of workplace accidents due to lack of OHS socialization	0,08	4	0,32
2	Lack of counseling by OHS experts can increase workplace accident rates	0,15	4	0,6
3	Lack of OHS supervision by government OHS personnel to reduce accident risks	0,15	4	0,6
Total Threats		**0,38**		**1,52**
Total EFE		**1**		
O-T (2,70-1,52)				**1,18**

Based on the calculation of the values of internal factors, including strengths and weaknesses, as well as external factors, including opportunities and threats, the final scores obtained are 1.40 for S–W (Strength minus Weakness) and 1.18 for O–T (Opportunity minus Threat). These values are then plotted on a SWOT kite diagram to determine the organization's position within the SWOT quadrant. Based on the identified quadrant position, appropriate strategic actions can subsequently be formulated.

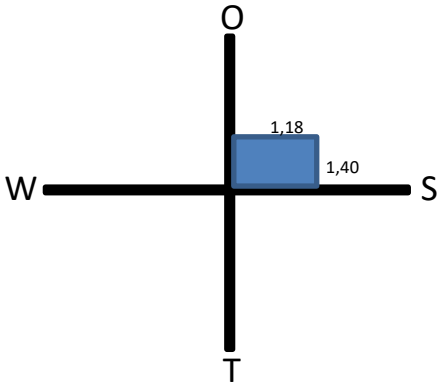

Figure 2. SWOT Kite Diagram

Based on the SWOT kite diagram shown above, the strategy that can be applied is in Quadrant I, or an aggressive strategy, which is a strategy to maximize the strengths and opportunities possessed by adopting an attacking or aggressive approach. The meaning of aggressive according to the Indonesian Dictionary (KBBI Online) is to attack or have a tendency (desire) to attack something that is perceived as disappointing, obstructing, or hindering (KBBI Online, n.d.).

Table 4. SWOT Analysis

Internal / **Exsternal**	**Strength**	**Weakness**
	Management's commitment to creating a safe workplace A supportive training management system Management support in creating health promotions	There are no regulations regarding procedures and education on OHS standards. There is no specific data collection on musculoskeletal injuries among employees at work. There is no training or outreach from management regarding OHS standards.
Opportunity	**SO Strategy**	**WO Strategy**
There are no government regulations regarding ergonomic systems in hospitals. There has been no direct review by ergonomics experts regarding manual handling techniques. There has been no phased evaluation by OHS experts regarding the dangers of manual handling.	The Manual Handling System continues to be developed in accordance with regulations and the Palabuhantratu Regional Hospital's K3 work program. Conducting regular outreach and training related to Manual Handling Techniques.	Motivation, shared commitment, and leadership support to implement a safe work system. Installing occupational health and safety signs to prevent workplace injuries.
Threat	**ST Strategy**	**WT Strategy**
There is a risk of workplace accidents due to a lack of K3 socialization. Insufficient counseling by an K3 expert can increase the number of workplace accidents. Lack of K3 supervision by the government's K3 human resources to reduce the risk of workplace accidents.	The Manual Handling System continues to be developed in accordance with regulations and the Palabuhantratu Regional Hospital's OHS work program. Conducting regular outreach and training related to work ergonomics. Supervising OHS implementation by the hospital's OHS team.	Create regulations regarding manual handling techniques Perform manual handling in accordance with safe load standards Provide manual handling education flyers to reduce the risk of workplace accidents

Based on the SWOT analysis presented above, the SO (Strength–Opportunity) strategy in Quadrant I (aggressive strategy) that can be implemented includes the following:

1. Continuously developing the manual handling system in accordance with existing regulations and the Occupational Health and Safety (OHS) work programs of Palabuhanratu Regional General Hospital.
2. Conducting regular socialization and training programs related to proper manual handling techniques.
3. Performing periodic evaluations of manual handling practices.
4. Implementing supervision and documentation of ergonomic issues occurring in the workplace.

Based on the proposed strategies and the results of the fishbone, USG, and SWOT analyses, the strategy applied in this residency activity, as well as a form of community service, is the development of OHS signage related to manual handling techniques. This initiative aims to prevent workplace accidents during work activities.

Implementation

The implementation of this residency activity includes the following steps:

1. Coordinating with the OHS (K3) unit of Palabuhanratu Regional General Hospital.
2. Coordinating with the Training and Education (DIKLAT) unit of Palabuhanratu Regional General Hospital.
3. Coordinating with the Head of the Medical Equipment Warehouse Installation at Palabuhanratu Regional General Hospital.
4. Developing and installing OHS signage related to proper manual handling techniques.

CONCLUSIONS

The conclusions drawn from the residency activities addressing the issue of potential ergonomic hazards during manual handling among employees of the Medical Equipment Warehouse Installation at RSUD Palabuhanratu are as follows:

1. Human resources (HR) play a crucial role in achieving occupational health and safety (OHS) performance within the Medical Equipment Warehouse Installation of RSUD Palabuhanratu.
2. Based on problem analysis using the fishbone diagram, USG (Urgency, Seriousness, Growth), and SWOT analysis, several implementable measures were identified, including the installation of OHS signage and the socialization of OHS practices in the workplace.
3. Coordination between management and operational staff in efforts to prevent workplace accidents among employees of the Medical Equipment Warehouse Installation at RSUD Palabuhanratu represents an essential component in evaluating the implementation of the OHS system.

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