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## OCENA ERGONOMII PRACY PIELEŃNIAREK

**Streszczenie:** Stosowanie zasad ergonomii w pracy pracowników firm produkcyjnych staje się coraz bardziej popularne już na etapie projektowania miejsca pracy. Koncentrowanie się na ergonomii w obszarze opieki zdrowotnej jest nadal bardzo rzadkie. Artykuł dotyczy potrzeby oceny ergonomii pracy pielęgniarek, a także opisuje możliwe rozwiązania zaistniałych problemów.

**Słowa kluczowe:** ocena pracy, ergonomia, pielęgniarka, stanowisko pracy

## EVALUATION OF AN ERGONOMICS IN THE WORK OF NURSES

**Summary:** Application of ergonomic principles in the work of manufacturing employees is becoming more popular already in the phase of designing a workplace. Focusing on ergonomics in the healthcare area is still very rare. The article is about a need for evaluating ergonomics in the work of nurses, and there are also written possible solutions to existing problems.

**Keywords:** work evaluation, ergonomics, nurse, work position

### 1. Introduction

Ergonomics design or modify work to fit workers, not the other way around. Nowadays, in the area of the industry, it is typical to design workplace ergonomically by using tools of digital company [1,2]. In the healthcare area, it is rare. Nevertheless, there is a need to evaluate ergonomics in this segment, as well. The largest group of staff caring for patients are nurses. They are spending most of the working day caring for patients. Handling them is very specific. The patient is not a classic load with grips.

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Patients move and also have a weight which often exceeds the legislation work limits several times over.

## 2. Risks in the work of nurses

There are various risks involved in this profession that can cause injuries. The breakdown of these threats is below:

Risks associated with work responsibilities:

- Application of force: the degree of physical effort required to perform an activity (such as lifting heavy loads, moving and towing) or to maintain equipment and tools. Safe patient handling techniques are one of the essential preconditions for the prevention of spinal cord injury. Therefore, they should be given increased attention. The current trend is aimed at minimizing the tasks associated with lifting and carrying the patient and the application of appropriate technical means. The emphasis is on patient cooperation.
- Repetition: continuous or frequent execution of the same movement or series of actions during working hours.
- Improper positions: adopted positions that strain the body, such as leaning over the bed, kneeling or rotating the torso during lifting.

Risks associated with the patient. Patients cannot be lifted as classic loads. Safe rules cannot be used when handling a patient:

- Patients cannot be kept close to the body.
- Patients do not have handles.
- It is never possible to predict what will happen during patient handling.
- Patients are obese.

Risks associated with surroundings:

- Risk of slipping, tripping and falling.
- Uneven work surfaces.
- Space limitations (small spaces, lots of equipment).

Other risks:

- Help is not available.
- Unsuitable equipment.
- Unsuitable footwear and clothing.
- Lack of knowledge or insufficient training. [3]

There are various principles of handling to reduce these risks:

- Principles of load handling.
- Principles of kinesthetics.
- Principles of substantial parts and gaps.

All these principles should simplify the work and also to involve the patient in the process of transferring as much as possible. Education in the field of ergonomics, which approximates the principles mentioned above, is already included in the secondary school study.

The dangers arising from patient manipulation are mainly related to the spine. It is most loaded with simultaneous pressure and rotation. The riskiest part of the spine is the bottom part (L5 / S1). Fig. 1 shows the spine and the movements that occur on it during the manipulation of the patient. Because of this, there is no gentle way to manipulate the patient. There may come the danger of Musculoskeletal disorders.

The physical effort required to lift and move the patients repeatedly is more significant than the musculoskeletal system can tolerate [4].

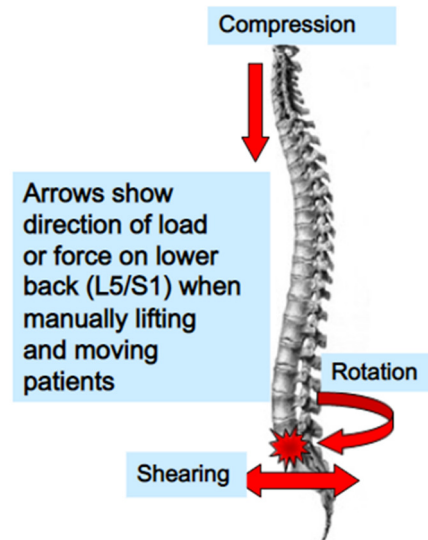


Figure 1. Movement of the spine under load [4]

### 3. New evaluation method

Specific activities in the work of nurses and requirements for workplace types of equipment also require individual evaluation. General evaluation methods are not suitable for the overall evaluation, especially specific activities. That is why was a procedure for evaluating in the work of nurses created, in the Department of Industrial Engineering at UNIZA. It takes into account all the specifics of nurses work. We are currently working on its verification in real conditions.

### 4. Application in the workplace

The ward of the surgical intensive care unit (ICU) in the Hospital with a polyclinic in Považská Bystrica (Figure 2) was selected for the evaluation by the proposed procedure. Ergonomics was evaluated by a new evaluation procedure created in the Department of Industrial Engineering at the University of Žilina. The review was done by marking information in worksheets in the xlsx format. In this ward work, a total of 10 nurses and their shifts takes 12 hours. There can be a maximum of six patients in the ward, and this capacity is usually full. The nurses were evaluated on the morning shift; there are two in the community during the service. There were six patients in the ward during the evaluation.



Figure 2. Evaluated ward [5]

#### 4.1 Workplace analysis

The subjective analysis was performed using a modified Nordic Questionnaire (NQ). Questions were adapted specifically for the work of nurses. There are four parts:

1<sup>st</sup> Part – General Information.

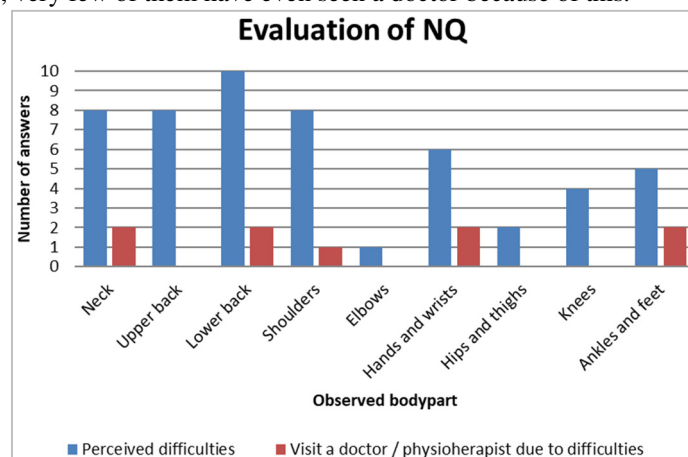
2<sup>nd</sup> Part – Subjective evaluation of difficulties with the musculoskeletal system.

3<sup>rd</sup> Part – Subjective assessment of the response to specific situations.

4<sup>th</sup> Part – Knowledge and use of particular terms. [6]

General information is about gender, duration of work shifts and age. We have already known there are just women who work for 12 hours shifts. In the age group 18 - 29 years, there is only one nurse. There are five nurses in the age group of 30 - 39 years and two nurses aged 40 - 49 and 50 - 60 years in each group.

Graph 1 evaluates the difficulties experienced in each part of the body and visits the doctor because of them. Most of the nurses' experience or have experienced problems; very few of them have even seen a doctor because of this.



Graph 1. Evaluation of difficulties from NQ [Autors]

Table 1 is an evaluation of the feeling loaded from individual work activities. They were evaluated according to the Borg scale (0 to 10). The most difficulties for nurses are lifting and carrying the patient. These activities need to exert the most significant amount of force. Based on the average values, we can say that the nurses feel a medium loaded in their work. A small load was indicated when working with the hands overhead. The situation occurs, especially when administering infusions, blood, or setting up monitors that measure the patient's vital signs and are located above his bed. The lowest feeling of the load makes the temperature in the workplace. The ward is air-conditioned, so there is almost no load in this place.

Table 1. Evaluation of load from NQ [Authors]

Situation	No load			Low load			Medium load			High load		Average values
	0	1	2	3	4	5	6	7	8	9	10	
Lifting, carrying the patient								2		6	2	9
Rushing / time pressure							4		1	1	4	8
Long-time work in the same positions						3		2		1	4	8
Forward bend, torso rotation						1		2	5	2		8
Overtime work, long work shifts						2		3	3	1	1	7
Work on the edge of physical strength						2	1	2	3	2		7
Poor quality of handling aids			1				1	4	2	1	1	7
Insufficient rest breaks						4	2		1		3	7
Uncomfortable working position						3	2	4		1		6
Bad training on how to work properly			1		1		3	3	1	1		6
Working overhead			1		3	4	2					5
Cold, heat, humidity in the workplace		3	4	2	1							2

Supplementary questions are the last part of the NQ. These are principles that make it easier to work with the load/patient. Using them can eliminate the risk of injury, for example, in the sacral area - one of the most stressed areas on the body. The questions are discussed in detail below, along with an evaluation of the answers, in Figure 3.

<b>1. Do you know the concept of ergonomics?</b>	
1. Yes, I know what ergonomics is	9
2. I have heard, but I can't explain	1
3. No, I have never heard before	0
<b>2. Do you know the principles of proper handling of heavy loads / patients?</b>	
1. Yes, I know this principle	7
2. I have heard, but I can't explain	3
3. No, I have never heard before	0
<b>3. Do you know the concept of kinesthetic?</b>	
1. Yes, I know what kinesthetic is	7
2. I have heard, but I can't explain	2
3. No, I have never heard before	1
<b>4. Do you know the principle of solid parts and gaps?</b>	
1. Yes, I know this principle	3
2. I have heard, but I can't explain	2
3. No, I have never heard before	5

Figure 3. Supplementary questions of NQ [Authors]

These answers show weak knowledge of the principles. Nurses do not know them, not even use. These are terms that should be learned from high schools. It is necessary to deal with this topic more at secondary schools and universities, or in training that takes place even during employment. That is about the health and safety of nurses and also patients. By proper handling, we can reduce the risk of injury or the occurrence of an occupational disease.

The new evaluation procedure made an objective analysis. The first part assessed the factor of work duration and personnel and material equipment. The overall assessment of these factors pointed to a possible risk of damage to health. The evaluation sheet is shown in Figure 4.


PHYSICAL LOAD IN THE WORK OF NURSES 				
Rough evaluation				
<b>Factor: duration of work</b>	Duration of workshift [min]	Duration of breaks [min]	Total duration of work [min]	
	720	30	690	
	Total score			
			1,50	
<b>Factor: personnel and material equipment</b>	Personnel equipment			
	Number of patients per ward	Number of nurses per ward	Number of patients per nurse	
	6	2	3	
	Total score			
				1,00
	Material equipment			
	Number of adjustable beds	Number of beds trapeze	Number of wheelchairs	
	6	6	0	
	Partial score			
	1	1	2	
Total score				
			2,00	
Risk of health damage due to physical activity				
Evaluation	Description and recommendation			
3,0	The risk of health damage due to physical activity is moderate. There is a possibility of health damage due to physical activity in less physically fit individuals. Corrective measures should be considered.			

Figure 4. General evaluation sheet [Authors]

In the detailed evaluation, the observed activities were divided into four groups, according to the type of work performed. The categories of work are divided as follows:

- Administration – a depreciation of medicines to patients, registration of new and disposal of patients.
- Patient positioning – helping the patient to change position to lie down, sit down, get up, help with changing clothes.
- Medicines preparation – tablets, injections, blood for transfusion, infusions.

- Medicines administration – mentioned in the previous category.  
For example, in Figure 5, we can see the evaluation sheet of neck position. There are also evaluated positions of body, upper and lower limbs.


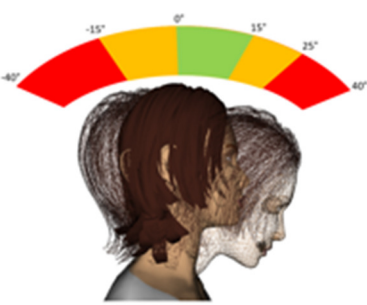
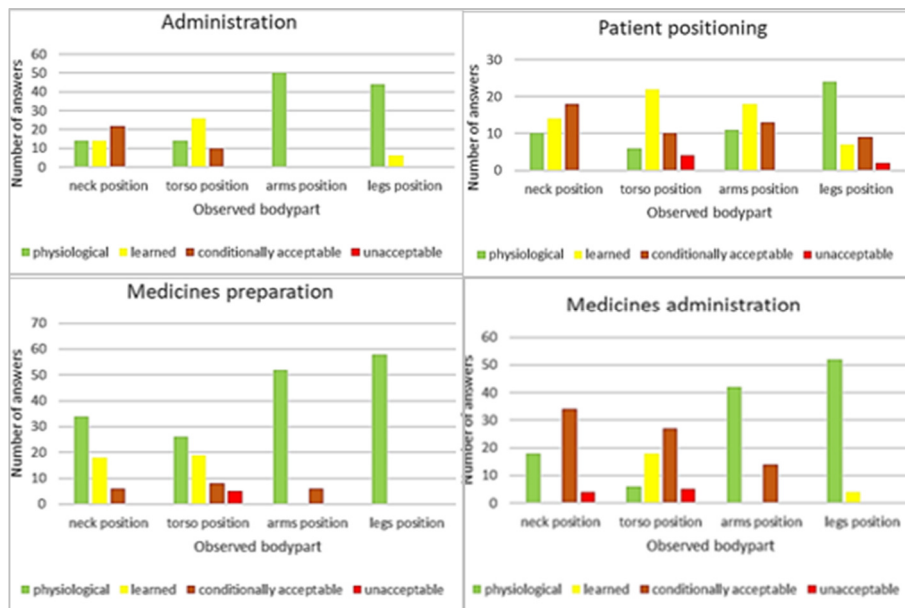
PHYSICAL LOAD IN THE WORK OF NURSES 		
Activity:	Administration	
Neck position		
<input type="checkbox"/> NO	Physiological position	Continue below!
<input type="checkbox"/> YES	Learned position	Retrain!
<input type="checkbox"/> NO	Possible to edit the workplace	Evaluate position!
Evaluation		
<input type="checkbox"/> Conditionally acceptable position	Notes to work position	
		

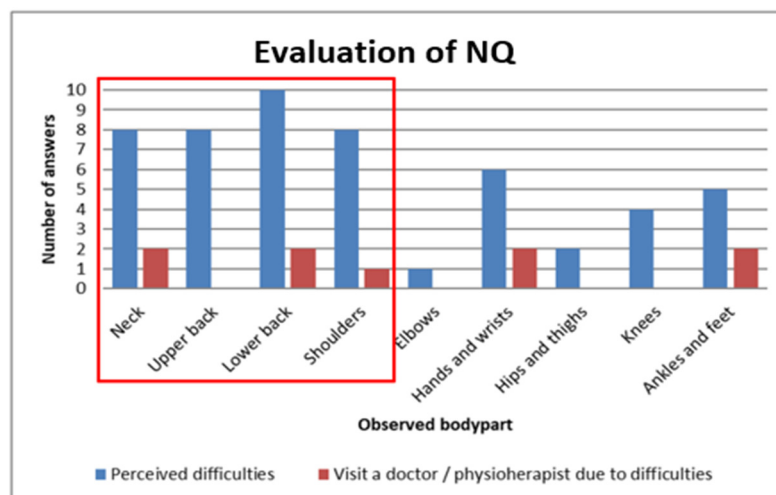
Figure 5. Evaluation of neck position [Authors]

Evaluation of all positions is shown in Graph 2. The number of non-physiological jobs (learned, conditionally acceptable, unacceptable) is highest in-patient positioning and medicines administration. Patient handling makes up the majority of nurses' worktime. It was also marked as the most massive activity in NQ. It is necessary to take corrective measures that increase the number of physiological positions to prevent the development of damage to health.

The subjective and objective analysis was compared. When comparing the perceived difficulties of nurses and the highest incidence of non-physiological positions of the body at work, it was found that most of them are located in body parts that the nurses mentioned as the body parts where they feel the most difficulties. The intersection is shown in red in Graph 3. The intersection shows the nurses have problems with their backs because of their work. That means we have to take corrective measures.



Graph 2. Evaluation of all work categories [Authors]



Graph 3. Intersection of analysis [Authors]



## 5. Recommendations

The results show that the ergonomics in the ward is not right. It should be solved by teaching about existing principles that will increase nurses' knowledge. All of them should know and use ergonomic principals for safe work and reduction of injury. We can use tools of e-learning, virtual reality, which can help with imagination [7, 8]. However, no manual handling is entirely secure. Since the most significant risk came from manipulating the patient, nurses need to be relieved the most in this area. In this, handling aids such as lifting devices for handling the patient will help. The handling device cost around 1000 € and would do this most massive work instead of nurses. These recommendations could help to better ergonomics in this ward.

## 6. Conclusion

Evaluation of analysis show, it is necessary to solve ergonomics in healthcare. Improving teaching in schools and training would increase nurses' awareness of safer and more comfortable work. Learning could reduce new learned positions that are not physiological. Nevertheless, it is necessary to provide a lifting device for lifting and transporting patients instead of nurses. The role of nurses in the patient's treatment process is irreplaceable, and therefore care must be taken to ensure their health and well-being in the workplace.

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