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**STRATEGIES FOR THE PREVENTION OF WORK-RELATED  
MUSCULOSKELETAL INJURIES: SYSTEMATIC REVIEW OF  
LITERATURE**

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***Abstract***

The work-related musculoskeletal disorders (WMSDs) affect a large number of nurses decreasing their life quality and are considered a true public health issue. In this context, the main goal of the study is to identify which are the most effective strategies to prevent the work-related musculoskeletal in nurses in a hospital context. We chose to create a secondary and retrospective study, following the methodology of a systematic review of the literature proposed by the Cochrane Handbook. The research of corpus studies was carried out in the databases of PubMed, B-On, Scielo e Medline Complete, in the period between 2005-2016. In compliance with the validation criteria, 6 primary studies were selected and analysed. The results revealed that multifactorial intervention programs, with a systemic and integrated approach to work situations, are the most beneficial, both in terms of their implementation and in terms of cost-benefits. This type of program combines ergonomic solutions with organizational policies and training sessions and specific training in order to enable nurses to provide better healthcare with less risk. However, it has been verified that this type of programs only succeeds depending on the involvement of the professionals, the managers, the adopted policy, the type of leadership and the continuous monitoring. The results obtained evidenced the need for an early implementation of this type of WMSDs prevention programs, where the intervention of the rehabilitation nurse, with the multidisciplinary teams, will certainly play a fundamental role.

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**Keywords:** Prevention e control, Work-related Musculoskeletal Disorders, Nurses, Hospital, Rehabilitation.



## 1. Introduction

Over the last decades, work-related musculoskeletal injuries (WMSDs) have been increasing due to the implementation of new models of work organization (Buckle, & Devereux, 1999).

Technological evolution and competitiveness in organizations increase the workload, requiring workers to make significant efforts, repetitive movements or incorrect postures, which contributes to the development of occupational injuries. Serranheira (2007) refers to WMSDs, as chronic and multifactorial pathologies of a professional component, being a functional disorder where the main manifestation is pain (Pombeiro & Carnide, 2006). This type of injury affects the muscles, tendons, ligaments, joints, cartilage, bones, spine and peripheral nerves. Currently, WMSDs have a major impact on organizations, with increasing damage not only to the organization (high absenteeism rates) but also to workers' health (inability, both for professional tasks and for Daily life) (Pombeiro, & Carnide, 2006).

In the European Union (EU) cervical and upper limb affections are a significant health problem, as are the costs associated with work. Available data from the Nordic countries and the Netherlands suggest that the costs of this type of disturbance range from 0.5% to 2% of gross domestic product. The scale of this problem tends to increase as workers are increasingly exposed to risk factors that cause these disorders. In the European Union 57% of workers mention that work involves repetitive movements of arms and hands; 56% are exposed to time constraints; 54% are subject to excessive work rates and 42% are not free to decide on break times (EUROFOUND (2012).

Interest in WMSDs and its relation to certain risk factors is relatively recent in nursing, although it is one of the most affected professions. Nursing is one of the professions where WMSDs have a high incidence and prevalence. Baumann (2007) reports that health workers suffer more injuries than other professionals, such as high rates of strains and dislocations. In one of the most recent national studies carried out by Serranheira, Uva, & Leite (2012), it was found that the most prevalent complaints were located in the lumbar region (60.6%), followed by the cervical spine (48,6%) and the dorsal column (44.5%). At the level of the upper limbs, the most prevalent complaints are in the right wrist (12.76%). The authors reported that the 2 most affected anatomic segments were the spine and upper limbs, and at least partially more vulnerable to the demands of nursing work (Serranheira, Uva, & Leite, 2012)

Nurses' working conditions and tasks, especially in the hospital context, present several risk factors, namely postural level, repetitiveness and force application. Nurses perform activities during care that require extreme joint positions, application of strength with the upper limbs, as well as demanding efforts at the spine. Such situations occur daily during feeding, administration of intravenous medications, transfers and other mobilizations, such as positioning, and the provision of hygiene care to the patient. In addition, nursing tasks are often performed in inadequate working spaces, which often present incorrect and ineffective provisions of equipment and technical means, and are worsened by time pressure and shift work schedules.

WMSDs affect a large number of nurses, decreasing their quality of life (Fonseca, & Serranheira, 2006), leading to a decrease in motivation and proactive participation in daily work. Absenteeism and the early abandonment of the profession, with the consequent effects at the professional, social and family level, reflect the importance of the WMSDs study (Serranheira, Uva, & sousa, 2010). On the other hand, the search for solutions that minimize this problem led to the increase of studies related to work-related

risk, as well as the search for ways to reduce this type of pathology (Simões et al., 2003 cited by Pombeiro, 2011). In this sense, given the need to prevent WMSDs and the invariability of the work situation, we see that a bet on the implementation of prevention programs may be the way. The introduction of WMSDs prevention strategies in organizations with a view to reducing their impact has become more significant. Growing concern in the field of social responsibility has led to an increase in the number of organizations facing training and information in the area of WMSDs prevention, ergonomic analysis of workplaces and workforce (GL) as essential and indispensable conditions for The productivity and competitiveness of these organizations.

## **2. Problem Statement**

In this study, "Strategies more effective for the prevention of work-related musculoskeletal injuries in nurses, in a hospital context" emerges as an attempt to rigorously present a possible methodology as a way of preventing WMSDs in nurses in a hospital context. We chose a systematic review (without recourse to meta-analysis), in which it is a form of research that uses as literature data a specific topic. This type of study was chosen because it is particularly useful for integrating information from a set of studies performed separately on a particular therapy and / or intervention, using a clearly defined, rigorous and reliable methodology that allows an analysis of the state of the art about this problem, Contributing to the development of practice-oriented strategies based on scientific knowledge (Sampaio & Mancini, 2007).

## **3. Research Questions**

In order to situate the problem the following research question was stated: "What are the most effective strategies for the prevention of work-related musculoskeletal injuries in nurses in a hospital setting?"

## **4. Purpose of the Study**

The central objective of this systematic review is to determine which strategies are recommended as the most effective for the prevention of work-related musculoskeletal injuries in nurses who perform the functions in a hospital context, in order to contribute to their prevention and to understand cost-benefit strategies aimed at the individual and the environment.

## **5. Research Methods**

We chose to create a secondary and retrospective study, following the methodology of a systematic review of the literature proposed by the Cochrane Handbook. In an initial phase, the database was available in the library of the School of Health of Viseu (ESSV), the Scientific Repository of Open Access of Portugal and the Journal of Nursing "Referência", in order to deepen knowledge on the subject, research needs and levels of evidence. The following research question was based on the PI[C]OD methodology - Population, Intervention, Control, Outcomes, Study Design (Liberati et al., 2009).

## 5.1 Research strategy

The inclusion criteria are those that allow the establishment of the profile of the participant subject; consist of the characteristics of the target population, which is why it is relevant to establish a research work. As such, and according to Fortin (2009), it is important that certain criteria be followed, namely: they can be used throughout the study, that are generalizable to other populations and that can include decisions about practical and scientific objectives. According to the same author, the exclusion criteria consist of the subgroup of individuals / textual corpus that, although fulfilling the inclusion criteria, also have characteristics that can interfere in the data quality, as well as in the interpretation of the results.

With reference to these considerations, the inclusion criteria for exclusion were established for the present study, as shown below (see Table 1).

**Table 01.** Inclusion and exclusion criteria for the selection of studies

SELECTION CRITERIA	INCLUSION CRITERIA	EXCLUSION CRITERIA
Participants	Nursing professionals, in hospital context	All other professionals Studies on nurses who do not work in a hospital context
Interventions	Studies where LMELT prevention strategies / plans with or without health improvement are identified	All studies that do not refer to LMELT prevention strategies / strategies
Comparisons	Comparison between studies with nurses who did not participate in LMELT prevention programs, but who talk about them	
Results	Study the variables: -Plans or prevention strategies Symptoms or work-related musculoskeletal injuries	All studies that do not analyze inclusion variables
Drawing	Exploratory; Qualitative; Quantitative; Descriptive; Cross studies	Other drawings than those of inclusion

The research strategy of the studies is the key component of a systematic review of the literature. It is the definitions of the appropriate search terms that make it more sensitive than specific, ensuring that all available evidence is available. Thus, the elaboration of the search strategy should be thought from the components of the research question structured in the PI[C]OD format, that is, it should answer a clearly formulated question using systematic and explicit methods to critically identify, select and evaluate and collect and analyze data from studies included in the review (Buehler, Figueiró, Moreira et al., 2013). It should be emphasized that the search strategy was not restricted to the descriptors only, since it had to be as sensitive as possible and also included the uncontrolled vocabulary, as suggested by the aforementioned authors. This process required the use of text words, synonyms, acronyms, related terms, keywords and spelling variations, which ensured the retrieval of older articles, since the indexing of some subjects was only introduced later. To ensure a good information retrieval, the search strategy was elaborated with the sum of the terms in the three languages that predominate in the bases: Portuguese, Spanish and English, plus the categories. One strategy to increase the sensitivity of the search in the database was to include the so-called entry terms, which fall within the definition of the MeSH term. The amount of these terms varies from the MeSH term to the MeSH term. With the definition of the terms to

be used, the search results were combined, using Boolean operators, especially "OR" and "AND". The logical operators of search or Boolean operators allowed to relate the words or the groups of words in the process of elaboration of the research. The location and selection of studies was a process consisting of three steps:

#### 1st Stage

The initial research of the bibliography was centered on the databases available at the School of Health of Viseu (ESSV). It was decided to start the research in PubMed, because it presents the Thesaurus application that covers a multiplicity of terms in a certain expression. The descriptors for research included the variables of the research question. The terms MeSH descriptors were confirmed through the National Library of Medicine (NIH) at <https://www.nlm.nih.gov/mesh>, obtaining a positive response to:

- # 1 MeSH descriptor "musculoskeletal disorders" (explode all trees);
- # 2 MeSH descriptor "musculoskeletal pain" (explode all trees);
- # 3 MeSH descriptor "occupational injuries" (explode all trees);
- # 4 MeSH descriptor "occupational diseases" (explode all trees);
- # 5 MeSH descriptor "nurses" (explode all trees);
- # 6 MeSH descriptor "human engineering" (explode all trees);
- # 7 MeSH descriptor "health promotion" (explode all trees);
- # 8 MeSH descriptor "prevention and control" (explode all trees);

The search strategy applied the descriptors mentioned above, combining them

With the Boolean operators in the following format: ("Musculoskeletal diseases" [MeSH Major Topic] and "occupational injuries" [MeSH Major Topic] ). In the first strings of research were carried out in order to contemplate a greater range of studies in the thematic scope. In the following strings we sought to delimit the research, looking for the variables under study, namely musculoskeletal injuries, prevention, ergonomics, nursing professionals, hospital context. The identification of the bibliography ran from January 2005 to August 2016.

#### 2nd stage

In the second step the descriptors were replicated in the remaining PubMed, B-On, Scielo, Medline Complete and Google Academic databases.

#### 3ª Step

The bibliography of the retained articles was also reviewed, with the purpose of identify relevant articles not found in databases. Thus, the first selected sample consisted of 6699 studies, however, due to the size of the sample, the limiters were applied, only studies that met the following requirements were considered: English and Portuguese language, the others being excluded; Publication date from January 2005 to August 2016; Present full text training; Free (Open-Access).

The selection of the studies was carried out by 3 researchers who, by consensus, decided which studies to include. The studies surveyed in the databases gave rise to a much larger number of articles than were actually eligible under the established criteria. This process, according to Buehler, Figueiró, Moreira et al. (2013), it occurs because the search strategy is performed with the purpose of achieving sensitivity over specificity. For this reason, the title and the abstract were read, which made it possible to classify the studies, discarding a large number of references that did not comply with the inclusion criteria

outlined in the review. In order to present the results more explicitly, a flow chart was drawn up with the selection of articles retrieved in the databases. It should be noted that there were cases in which the same article was indexed in more than one database, which implied its elimination. Articles that did not meet the eligibility criteria were also excluded.

## 6. Findings

According to the selection criteria, six studies were selected: Zadvinskis IM & Salsbury SL. (2010) in order to answer the research question. The presentation of the results should be detailed in order to verify if the conclusions of the reviewers are supported by the results found. The results should be presented in a table that highlights their main characteristics, such as: authors, year of publication, methodological design, number of subjects (N), comparison groups, characterization of the intervention protocol (time, intensity, frequency of sessions, etc.), and main results (Sampaio & Mancini, 2007).

**Table 02.** Studies included in the systematic review

<b>Study 1 – Lim, H.J., Black, T.R., Shah, S.M., Sarker, S. &amp; Metcalfe, J. (2011). Evaluating repeated patient handling injuries following the implementation of a multi-factor ergonomic intervention program among health care workers. <i>Journal of Safety Research</i>, 42, 185-191.</b>	
<b>Kind of study</b>	Control case experimental study
<b>Population</b>	Nursing professionals 789 for the intervention group and 691 for the control group. 90% were women and the mean age was 40 years. Data were collected at 6 hospitals in Saskatchewan, Canada, with different "large, medium and small" sizes, from September 1, 2001 to December 1, 2006
<b>Objectives</b>	To evaluate the repeated musculoskeletal injuries in nursing professionals in a hospital context, after the implementation of a multifactorial ergonomic intervention program.
<b>Intervention</b>	The control group did not receive any form of injury prevention program. The following measures were implemented to the intervention group: - furnished mechanical equipment: two mechanical lifts / unit; - formation on anatomy, injuries, body mechanics, personal health, lifting and patient handling procedures - 8-hour single training session and one one-hour refresher session per year. Course book and training materials were provided. Participation in these sessions was mandatory. Both groups were followed up for two years.
<b>Results (outcomes)</b>	The intervention group had significantly fewer repeated lesions than the control group ( $p = 0.001$ and $p = 0.0001$ , respectively). Multivariate analysis showed that the intervention group had 38.1% fewer chances of having repeated lesions compared to the nurses in the control group. The 2-year pre-intervention and 2-year post-intervention results showed that the mean length of time lost due to injury in intervention hospitals decreased significantly by 55% (and from 36 days to 16.2 days). There was no statistically significant interaction between hospital size and group size.
<b>Conclusions</b>	The study concluded that work-related musculoskeletal injuries in nurses after the intervention program were reduced. Implementing a multifactor program with the right equipment and training can reduce the risk of injury among health professionals.
<b>Critical quality review</b>	85%
<b>Study 2 – Fujishiro, K., Weaver, J.L., Heaney, C.A., Hamrick, C.A., &amp; Marras, W.S. (2005). The Effect of Ergonomic Interventions in Healthcare Facilities on Musculoskeletal Disorders. <i>American Journal of Industrial Medicine</i>, 48, 338-347.</b>	
<b>Kind of study</b>	Prospective experimental study
<b>Population</b>	Nursing professionals working at 86 facilities, totaling 100 health units in Ohio.
<b>Objectives</b>	To evaluate the effect of an ergonomic intervention program on rates of work-related

	musculoskeletal injuries in nurses. It occurred in two moments of evaluation: a 1-year pre-intervention and up to 2 years post-intervention.
<b>Intervention</b>	The following measures were implemented: - financial support from the Bureau of Workers' Compensation (BWC) for the purchase of ergonomic devices; - Ergonomic evaluation performed by ergonomists of the program, for consultation, guidance and technical assistance after installation of the devices; - use by the ergonomist of a checklist of conformities relating to the actual use and maintenance of the equipment. - held a single session of training given by the ergonomics of 4 hours. Comparisons were made between different types of interventions: reduction of flexion, elimination of elevation, reduction of the Survey, and a combination of the three.
<b>Results (outcomes)</b>	The mean rate of LMLT decreased from 12.32 to 6.64 per 200,000 hours worked. 77 units of work decreased LMELT rates. 23 units of labor increased LMELT rates.
<b>Conclusions</b>	The implementation of programs to improve ergonomic conditions and financial support for ergonomic equipment is an effective intervention to reduce rates of work-related musculoskeletal injuries in nurses.
<b>Critical quality review</b>	83%
<b>Study 3 – Lee J.E, Kim S.L, Jung H.S, Koo J.W., WooK.H. &amp; Kim,M.T. (2009). Participatory Action Oriented Training for Hospital Nurses (PAOTHN) Program to Prevent Musculoskeletal Disorders. <i>J Occup Health</i>, 51: 370–376</b>	
<b>Kind of study</b>	Experimental study without control group
<b>Population</b>	Nursing professionals from a hospital in the suburbs of Seoul, South Korea, with 689 beds. 16 Units participated in the study- 7 general wards, 4 intensive care units, 1 operating room, 1 emergency room, 1 hemodialysis room, 1 delivery room and 1 outpatient clinic. 16 head nurses working as managers.
<b>Objectives</b>	To construct and test a participatory action-oriented training program for Hospital Nurses (PAOTHN) to prevent work-related musculoskeletal injuries in nurses.
<b>Intervention</b>	Research team (two nursing professors, three nursing doctorates, three occupational health physicians, one ergonomist, two hygienists, six head nurses and one nurse) developed a checklist with five types of nursing tasks with 43 items that were related to musculoskeletal injuries: - patient care and treatment (8 items); - safe handling of drugs, medical devices and equipment (7 items); - workstation design (11 items); - physical environment (6 items); - facilities and administration (11 items). The following measures were implemented: - several participatory workshops: research team handed out a checklist to the participants, they visited the units and filled in, then discussed in the room the positives and what needed improvement. - continuous technical assistance by the research team; - discussion and implementation of participant improvements; - periodic forums to share "Best Practices" among participants - Conquest competitions. The program had two phases: development phase, followed by implementation and evaluation phase. Each participant presented a short study (within 3 months) and a long-term (within 6 months-1 year) action plan for musculoskeletal injuries in their own unit.
<b>Results (outcomes)</b>	Improvement plans were presented (23 short-term and 23 long-term plans). Of the 46 plans, 18 of the suggested plans were completed, for an overall completion rate of 39.1%: 15 (65.2%) of the short-term plans and 3 (13.0%) long-term plans. In terms of the various types of tasks implemented, 9 (52.9%) involved the safe handling of drugs, devices and equipment; 4 (50.0%) involved patient care and treatment; 4 (40.0%) involved welfare institutions and administration; 1 (33.3%) involved Environments.
<b>Conclusions</b>	The PAOTHN program was considered feasible and potentially useful in reducing risk factors and providing a practical model for efforts to prevent work-related musculoskeletal injuries in nurses in a hospital environment.
<b>Critical quality review</b>	88%
<b>Study 4- Nelson A., Matz M., Chen F., Siddharthan K., Lloyd J &amp; Fragala G. (2006) Development and evaluation of a multifaceted ergonomics program to prevent injuries associated with patient handling tasks. <i>Int J Nurs</i></b>	

<b>Stud. Aug;43(6):717-33.</b>	
<b>Kind of study</b>	Experimental study without control group
<b>Population</b>	825 Nursing professionals from 23 health units
<b>Objectives</b>	Design and implement a multifaceted safety improvement program and evaluate the impact of the program on the rate of injuries, lost work days, job satisfaction, program effectiveness, costs and investment.
<b>Intervention</b>	The following measures were implemented: - ergonomic assessment of working conditions; - evaluation and decision of the technique of mobilization to be used with the implementation of the professional expert in security; -assignment of mechanical equipment for patient mobilization after ergonomic evaluation; - learning with error / incidents (after action reviews) and "do not perform manual lifting" policy.
<b>Results (outcomes)</b>	In the short term there was a reduction associated with injury rates from 24/100 to 16.9 / 100, service days lost from 14.2 to 10.5, increased job satisfaction, self-reported safety in patient handling tasks reduced With statistical significance (p = 0.027). For cost-effectiveness over a 10-year period, \$ 204,599 per year is saved. The capital invested in materials and training of human resources is recovered at the end of 3.75 years.
<b>Conclusions</b>	More research is needed to assess the long-term impact of the program. The program was successful in the short term.
<b>Critical quality review</b>	96%
<b>Study 5- Warming, S., Ebbehøj, N.E., Wiese, N., Larsen, L.H., Duckert, J. &amp; Tonnesen, H. (2008) Little effect of transfer technique instruction and physical fitness training in reducing low back pain among nurses: a cluster randomised intervention study. Ergonomics. Oct;51(10):1530-48.</b>	
<b>Kind of study</b>	Experimental Case-control
<b>Population</b>	156 Nursing professionals from 11 wards. 6 wards for the intervention group with 105 nursing professionals (55 for TT and 50 for PTSD) and 5 wards for the control group with 76 nursing professionals
<b>Objectives</b>	To evaluate the effect of a technical transfer education (TT) program in combination with physical fitness training (TTPT) compared to a control group.
<b>Intervention</b>	No measures were implemented to the control group. The following measures were implemented to the intervention group: - a technical education program on transfer and mobilization of patients for 4 days, given by an experienced trainer to the nurses in the services (training taught according to the model of the knowledge of transfer and movement assistance: the ergonomic principles are used and the patient capacity is taken into account when performing the mobilization techniques.) - physical program, 1 hour, 2 times a week, lasting 8 weeks. (Training plan: warm-up exercises, aerobic workout [running at the treadmill, rowing or bicycle]) and strength training [aimed at the trunk and glutes]. Place: performed at the Hospital, during working hours. Follow-up of 12 months.
<b>Results (outcomes)</b>	The intervention group significantly improved LBP disability (p = 0.001).
<b>Conclusions</b>	The implementation of the training program on patient mobilization techniques in combination (or not) with the exercise program did not decrease the number of self-reported LMELT complaints at the end of 1 year. However, improving physical capacity has been shown to alleviate some of the consequences of LMELT, in particular disability.
<b>Critical quality review</b>	88%
<b>Estudo 6 - Zadvinskis IM &amp; Salisbury SL. (2010).Effects of a multifaceted minimal-lift environment for nursing staff: pilot results. West J Nurs Res. Feb;32(1):47-63.</b>	
<b>Kind of study</b>	Near-experimental with control group
<b>Population</b>	77 Nursing professionals - 46 Nursing professionals (intervention group) and 29 Nursing professionals (control group). 95% women, with a mean age of 33.7%. Average hours worked per week was 35.5%
<b>Objectives</b>	To examine the effectiveness of a multifactorial program of minimum elevation on the use of mechanical equipment, rates of musculoskeletal injuries and the costs of compensation for occupational accidents.
<b>Intervention</b>	Both intervention and control groups received engineering control (various equipment with recommendations for the different types of equipment), and they maintained the lifting equipment

	that they had previously had to study. All these equipment remained for a year. The following measures were implemented to the intervention group: - engineering controls (equipment) - administrative (nursing policy reflected the best evidence and algorithms of the VISN Patient Safety Center). - behavioral (training program): eight coaches to cover the 24 hours, had training training, two sessions of 4 hours each.
<b>Results (outcomes)</b>	Nursing staff in the intervention group presented greater use of lifting equipment (p = .002). The incidence rate of injury in the intervention group was 3.26 / 100 to 3.43 / 100 in the control group. The costs related to work accidents decreased from US \$ 6,566 compared to US \$ 11,145
<b>Conclusions</b>	The multifaceted program with mechanical equipment presented a decrease in the rate of injuries, with reduction of workers' compensation costs.
<b>Critical quality review</b>	90%

## 7. Conclusion

The results obtained evidenced the need for the early implementation of this type of WMSDs prevention programs, where the intervention of the rehabilitation nurse, in articulation with the multidisciplinary teams, will certainly play a fundamental role. In the analysis of the results we found that there were three types of programs: (1) training / training program combined with the assignment of equipment to help mobilize and transfer patients; (2) training program on patient mobilization and transfer, combined with physical capacity improvement program; and (3) systemic multifactorial program. Given the results obtained, and in general terms, all programs were found to be successful because they reduced WMSDs incidence rates or improved some of the consequences of WMSDs. However, systemic multifactorial intervention programs due to multifactorial nature presented advantages, since they approach several strategies in a single program. They use the contributions of ergonomics, in order to understand the relations between the worker and the work. On the other hand, they reconcile organizational policies that are required of professionals in order to improve working conditions. Transversal to the whole process are used training sessions and information in a way to enable health professionals to provide better health care for the patient with lower health risk for himself. However, this type of program only succeeds depending on the worker's involvement, the type of leadership of the program, the adopted policy and finally the continuous monitoring, with the necessary adjustments. We can verify with scientific evidence that the systemic multifactorial programs of Lee et al. (2009), Nelson et al. (2006), Zadvinskis & Salsbury (2010) presented improvements in the incidence rates of WMSDs, number of days lost and work satisfaction.

### 7.1. Implications for practice

Based on the most effective strategies that this study allowed us to identify, as well as based on some European norms, we consider it pertinent, from a perspective of practical implication of this work, to propose a set of recommendations for the prevention of musculoskeletal injuries linked to work in nurses, in a hospital context, not forgetting that the participation of all professionals, including the administration / management departments and the intermediate managers will undoubtedly be fundamental.

Ergonomic recommendations regarding WMSDs prevention:

### Individual

1. Adopt healthy postural habits inside and outside the work environment;
2. Avoid static postures for prolonged periods or repetitive work (alternating postures during care);
3. Avoid falling unnecessarily (when lowering the nurse should do knee flexion);
4. Plan rest breaks whenever possible (pauses should be 10 minutes each hour worked);
5. Work whenever possible with the help of an auxiliary;
6. Prioritize collective protection measures regarding personal protective measures.

### Collective

1. Perform ergonomic evaluation of the workstation;
2. To adapt the work to the professional;
3. Replace what is dangerous with what is safe or less dangerous;
4. Acquire ergonomic devices designed and suitable for the functions in question;
5. Promote the use of ancillary equipment whenever possible to facilitate patient manipulation.

Educational and training recommendations regarding WMSDs prevention:

1. Implement annual informative and update sessions, with a participatory component on WMSDs and its prevention, for all professionals including administrative / management bodies and intermediate managers;
2. Reinforcing risk awareness and training on appropriate working methods;
3. Promote an error / incident workshop, where professionals are encouraged to report adverse events and can analyze and propose solutions to adverse events;
4. Implement stress management programs in the workplace;
5. To promote training courses on good practices for manual mobilization and transfer of patients and using mechanical devices;
6. Develop organizational policies to prevent and combat musculoskeletal injuries, including working conditions, social relations and the influence of factors related to the work environment;
7. Promote information and clarification sessions on legislation, guidelines, recommendations, action plans from national, European and international sources.

Recommendations for improving physical capacity to prevent WMSDs:

### Individual

1. Practice regular physical activity after work;
2. Perform muscle stretches whenever deemed necessary during working time;

### Collective

1. Develop a Labor Gymnastics program three times a week and during working time, lasting between 10 and 12 minutes..

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