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Ergonomics — Manual handling of people in the healthcare sector

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National foreword

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TECHNICAL REPORT

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Ergonomics — Manual handling of people in the healthcare sector

Ergonomie — Manutention manuelle des personnes dans le secteur de la santé

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Foreword

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In exceptional circumstances, when a technical committee has collected data of a different kind from that which is normally published as an International Standard ("state of the art", for example), it may decide by a simple majority vote of its participating members to publish a Technical Report. A Technical Report is entirely informative in nature and does not have to be reviewed until the data it provides are considered to be no longer valid or useful.

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ISO/TR 12296 was prepared by Technical Committee ISO/TC 159, *Ergonomics*, Subcommittee SC 3, *Anthropometry and biomechanics*.

Introduction

National and international statistics provide evidence that healthcare staff are subject to some of the highest risks of musculoskeletal disorders (particularly for the spine and shoulder), as compared with other jobs.

Manual patient handling often induces high loads on the musculoskeletal systems, in particular on the lower back. Manual patient handling ought to be avoided where possible[1)] or be performed in a low-risk manner.

Factors such as the number, capacity, experience and qualification of caregivers can interact with the following conditions to produce an increased risk of musculoskeletal disorders:

— number, type and condition of patients to be handled;

— awkward postures and force exertion;

— inadequacy (or absence) of equipment;

— restricted spaces where patients are handled;

— lack of education and training in caregivers' specific tasks.

An ergonomic approach can have a significant impact on reducing risk from manual patient handling.

A good analysis of work organization, including handling tasks and the above-mentioned risk determinants, is extremely important in reducing risks to caregivers.

The recommendations presented in this Technical Report allow identification of hazards, an estimation of the risk associated with manual patient handling and the application of solutions. They are based primarily on data integration from epidemiological and biomechanical approaches to manual (patient) handling and on the consensus of international experts in patient handling.

The assessment and control of risks associated with other aspects of manual handling can be found in ISO 11228-1, ISO 11228-2, ISO 11228-3 and ISO 11226.

1) As per European Council Directive 90/269/EEC on the minimum health and safety requirements for the manual handling of loads where there is a risk particularly of back injury to workers.

TECHNICAL REPORT **ISO/TR 12296:2012(E)**

Ergonomics — Manual handling of people in the healthcare sector

1 Scope

This Technical Report provides guidance for assessing the problems and risks associated with manual patient handling in the healthcare sector, and for identifying and applying ergonomic strategies and solutions to those problems and risks.

Its main goals are

— to improve caregivers' working conditions by decreasing biomechanical overload risk, thus limiting work-related illness and injury, as well as the consequent costs and absenteeism, and

— to account for patients' care quality, safety, dignity and privacy as regards their needs, including specific personal care and hygiene.

It is intended for all users (or caregivers and workers) involved in healthcare manual handling and, in particular, healthcare managers and workers, occupational safety and health caregivers, producers of assistive devices and equipment, education and training supervisors, and designers of healthcare facilities.

Its recommendations are primarily applicable to the movement of people (adults and children) in the provision of healthcare services in purposely built or adapted buildings and environments. Some recommendations can also be applied to wider areas (e.g. home care, emergency care, voluntary caregivers, cadaver handling).

The recommendations for patient handling take into consideration work organization, type and number of patients to be handled, aids, spaces where patients are handled, as well as caregivers' education and awkward postures, but do not apply to object (movement, transfer, pushing and pulling) or animal handling. Task joint analysis in a daily shift involving patient handling, pulling and pushing or object handling and transport is not considered.

2 Terms, definitions and abbreviated terms

For the purposes of this document, the following terms, definitions and abbreviated terms apply.

2.1
aids and equipment
assistive devices eliminating or reducing the caregiver's physical effort during handling of a non- or partially cooperating patient

2.2
caregiver
individual required by his or her job specification to perform manual patient handling activities

2.3
environment
all physical conditions of the area where patients have to be handled, including space, climate and surfaces

2.4
manual patient handling
activity requiring force to push, pull, lift, lower, transfer or in some way move or support a person or body part of a person with or without assistive devices

2.5
patient
individual who requires assistance to move

Note 1 to entry: Types of patients include

— totally non-cooperating patients (to be fully handled by a caregiver),

— partially cooperating patients (to be partially handled by a caregiver).

— fully cooperating patients.

Note 2 to entry: Missing willingness of the patient for cooperation may induce an increase in musculoskeletal load for the caregiver.

Note 3 to entry: Other types of patient classifications are mentioned in C.4.

Abbreviated terms

NC	totally non-cooperating patient
PC	partially cooperating patient
MSD	musculoskeletal disorders
MPH	manual patient handling
LBP	low-back or lower-back pain
PU	pressure ulcer

3 Recommendations

3.1 General aspects

A systematic review of patient handling literature shows that a strategy for risk assessment, application of engineering controls and management must be comprehensive (multifactor interventions) to be successful.

Consequently, a strategy for risk prevention based on analytical assessment of the risk itself, all of its potential determinants (organizational, structural and educational), and on some key aspects of risk management is outlined below (see Figure 1).

The strategy includes the use of managerial processes and systems for reducing causes and effects of musculoskeletal and other organizational losses from healthcare institutions.

The participatory approach is emphasized in all aspects especially in changing work practices, defining training needs, purchasing technology/equipment and designing work environments.

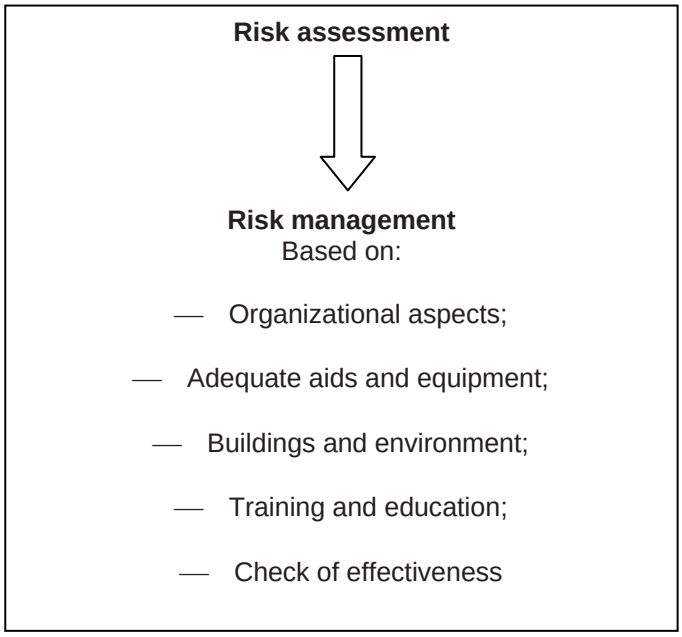


Figure 1 — Comprehensive strategy

The annexes present details of the main relevant aspects of the general strategy: risk assessment (Annex A); organizational aspects (Annex B); aids and equipment (Annex C); buildings and environment (Annex D); staff education and training (Annex E); effectiveness check (Annex F).

The following sections (3.2 and 3.3) describe the basic recommendations for this strategy.

3.2 Risk assessment

Risk assessment is one of the pillars of preventive strategies. Risk assessment consists of the following steps: hazard/problem identification, risk estimation/evaluation.

It is emphasized that for the purposes of this Technical Report, hazard identification and risk assessment are related not just at health risk identification but also in problem identification and problem solving.

A risk assessment is recommended when new equipment is introduced, organizational issues are modified (number of caregivers, number of non-cooperating patients), spaces are reorganized from an environmental viewpoint (rooms, services) and whenever other changes could affect risk characteristics, even if the previous condition was found to be acceptable.

For the purposes of this Technical Report, the risk assessment model shown in Figure 2 is used.

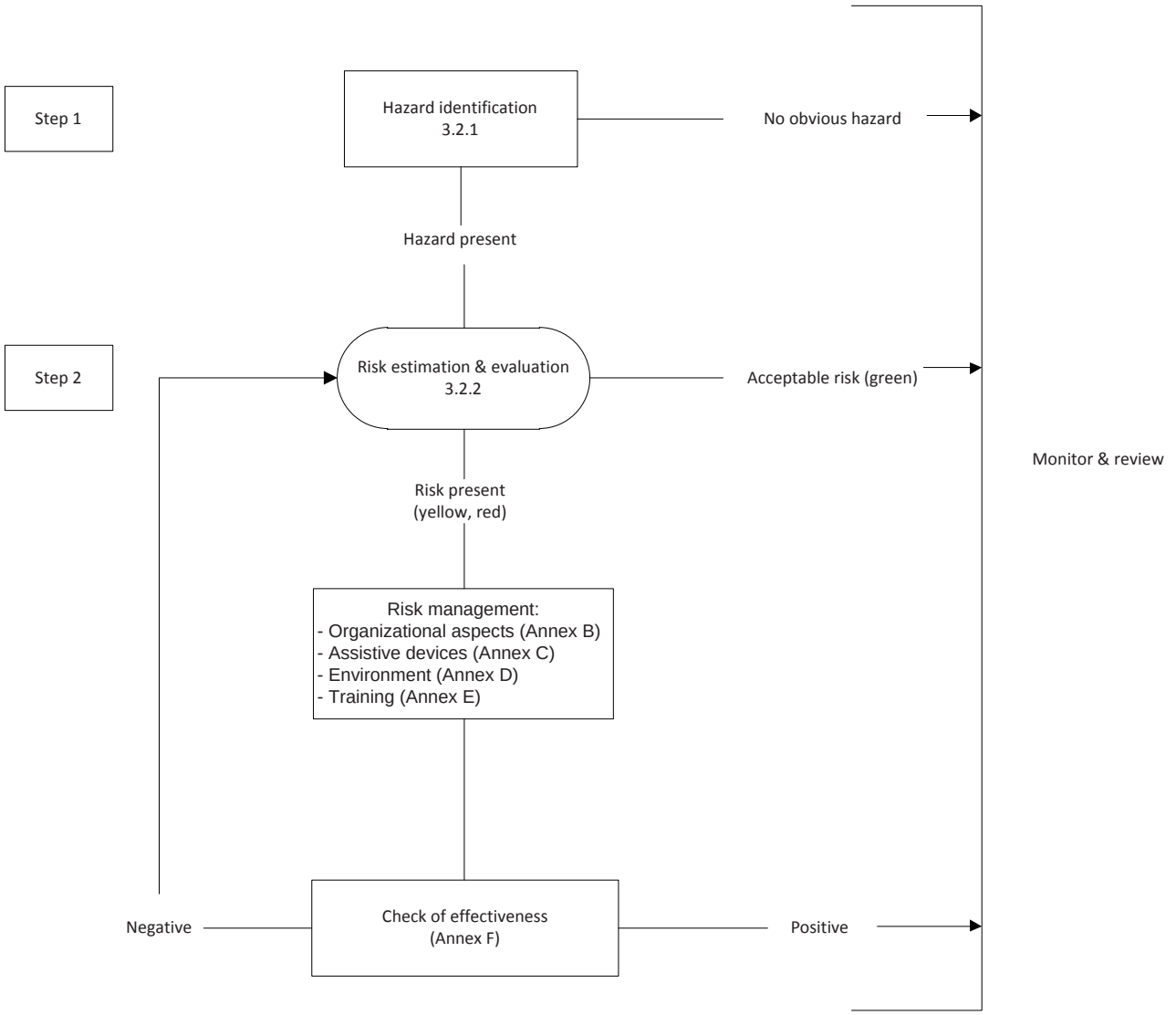


Figure 2 — Risk assessment model

3.2.1 Hazard identification

A hazard is present when patients are manually handled. The number and type of these patient transfers should be quantified (e.g. on a daily average) in different ways according to the healthcare area considered. For example: in operating theatres it would constitute the number of operations needing patient handling; in outpatient operations, the number of access requests for patients; in hospital wards, the number of patients. Patient quantification will be a preliminary factor to assess the time, number and frequency of handling.

Also the presence of a hazard requires that other factors should be taken into account that may address the subsequent risk evaluation.

3.2.1.1 Type of handling

The type of handling is defined by the task to be performed (e.g. repositioning a patient lying in the bed, or emplacing the bed pan) as well as by the handling technique applied for task execution. Task execution may be biomechanically improved, in particular, if small aids are additionally used. Furthermore, the type of patient (totally non-cooperating, partially or fully cooperating) and the type of assistive procedures will determine the handling method used by caregivers to a certain extent. The type of handling associated with patient's functional mobility level will define different hazard levels. A handling type used for cooperating patients may result in a low hazard while for a non-cooperating patient the same handling method may produce a much

higher hazard. Analysing patient handling currently carried out in a given healthcare area should lead to quantification of different types of handling necessary to address both the choice of most appropriate handling mode and usage of aids in that situation and also the number of caregivers needed throughout the day.

3.2.1.2 Work organization

The overall work organization can modify the risk of injury. The number of caregivers carrying out patient handling and their organization (one or more caregivers) over the day is a crucial factor to assess along with handling frequency and mode. Furthermore, caregivers should be trained to safely perform each task and how to recognize hazardous workplaces, tasks, equipment conditions and time allocated to the task.

3.2.1.3 Posture and force exertion

During patient-handling activities, the spinal column of caregivers, especially the lumbar section, is subject to high mechanical loading (i.e. compressive and sagittal or lateral shear forces at the intervertebral discs). Biomechanical load through patient handling is regarded as one of the most relevant factors inducing low-back pain and the development of degenerative disorders at lumbar spinal structures. Lumbar load strongly depends on the mobility status of the patient, equipment in use, posture adopted and the forces exerted by the caregiver to perform the handling action. Patient handling often coincides with postures and asymmetric forces with respect to the median sagittal plane that result in relatively high biomechanical load and an increased overload risk. Awkward postures due to various elements and conditions (available spaces, equipment used, number of caregivers handling the patient and education and training) often lead to decreased abilities for force exertions and increased risk of injury from high loads being placed on body joints or segments. For postures, asymmetry may be due to arm position or lateral trunk flexion or torsion. Forces may act laterally or are bilaterally imbalanced. A reduction of high lumbar loads can be achieved by using biomechanically efficient transfer methods.

The caregiver should exert the force with a stable and balanced posture enabling application of his/her body weight to their environment (e.g. bed, chair, patient) and thus minimizing the forces acting on the back and shoulders.

3.2.1.4 Assistive devices

The lack, absence or inappropriateness, of aids and equipment is a hazard during patient handling. The application of appropriate aids and equipment is strongly recommended to obtain a vital load reduction for the lumbar spine and to limit the biomechanical overload risk for the caregivers. Equipment and facilities must be currently and properly maintained for safe usage. The equipment purchase process should be based upon clear task requirements (type of handling) and the environment where they are used, and thus result in the selection of equipment fit for the specific workplace and task conditions.

3.2.1.5 Environment

The environment where patients are handled may be a hazard if inadequate. All spaces where patients are handled should be considered for equipment use and correct handling postures. Additional factors such as thermal constraints, steps, thresholds, obstacles and slippery floors should be considered.

3.2.1.6 Individual characteristics

Individual skills and capabilities, level of training, age, gender and health status of the caregiver should be considered when carrying out a risk assessment. Skill and experience are likely to benefit the caregiver when performing the task and reduce the risk of injury. Training may increase the level of skill and ability to carry out a task. Clothing and footwear should be functional and should facilitate movement and a stable posture.

3.2.1.7 Patient characteristics

The patient's body weight may be a hazard by itself. In particular, bariatric patients require adequate equipment and space for their needs. Handling of even a part of the body may produce biomechanical

overload. Special hazards may arise in case patients oppose the motion for psychiatric or cognitive problems or issues due to medication. In this case, biomechanical load of musculoskeletal structures could be high.

From an operative point of view it is recommended to proceed with the next step (risk estimation/ evaluation) whenever there is a presence of non- (or partially) cooperating patients and one or more of the above quoted hazards/problems are identified.

The next step (risk estimation/evaluation) should include patient characteristics such as non- (or partially) cooperating patient, and/or body size and mass.

3.2.2 Risk estimation and evaluation

An accurate analytical risk assessment, including data collection for consequent preventive measures, should consider the presence of several factors and their interrelationships: type of patient; induced “care load”; available caregiver staff; available and adequate equipment; building; environment and spaces and training and skill of nursing staff. Given the above factors, the use of consolidated methods applicable to manual handling of objects (such as those reported in ISO 11228-1 and ISO 11228-2) for patient handling is difficult.

Annex A is devoted to risk estimation and risk evaluation:

A.1 reports an “oriented” review of several methods useful for the purposes of risk estimation or evaluation as intended in this Technical Report, as derived from literature or from relevant national or international guidelines.

The methods described are classified primarily in relation to their simplicity/complexity. Complexity generally entails a more involved task of risk estimation or detailed risk evaluation. Methods can also be classified in relation to the healthcare sectors in which they could be most effectively applied.

Users of this Technical Report should start with the information in Annex A to select the appropriate method to use for a simple or detailed risk assessment, depending upon the kind of hazards and risk factors identified in step 1, the healthcare sectors examined and the experience of the analyst in the use of the proposed methods.

A.2 presents guidelines, taken primarily from national sources, for risk assessment for manual patient handling and provides suggestions on any relevant issue (aids, environment, caregivers' training and education, etc.) directed to reducing risk. As such they are not actual risk assessment tools but do provide useful information.

A.3 reports, on the basis of the same scenario, practical applications of four methods (Dortmund Approach, TilThermometer, MAPO and PTAI), so the intended users can choose the most appropriate one for the situation to be assessed.

The risk assessment method used (estimation, detailed evaluation) should allow the collection of pertinent data regarding the type and quantity of required handling, availability and requirements of handling aids and equipment and the level of specific training received (and the consequent training needs) of caregivers.

The method used for risk assessment should allow risk classification by the three-zone model (green, yellow, red) and address the consequent action to take according to criteria given in Table 1.

Table 1 — Risk estimation/evaluation — Final assessment criteria

Zone	Exposure classification	Consequences
GREEN	ACCEPTABLE	Acceptable, no consequences.
YELLOW	NOT RECOMMENDED	Advisable to set up improvements with regard to structural risk factors or to suggest other organizational and educational measures. Further evaluation is required and adequate measures have to be done if necessary.
RED	UNACCEPTABLE/TO BE AVOIDED	Redesign or take actions to lower the risks.

3.3 Risk reduction

Where a presence of risk/problems resulted from the previous step, a comprehensive approach (multifactor interventions) for risk reduction should be adopted. The comprehensive approach is most likely to be successful. This approach should be based on the results of the analytical risk assessment. A proper risk/problem assessment is the basis for appropriate choices in risk reduction.

Risk reduction can be achieved by combining improvements to different risk factors and should consider, among other things:

— The adequate number and the quality of the staff for taking care of the different kind of patients.

— The selection and correct use of appropriate aids for handling patients. Aids should be chosen according adequate ergonomics and quality criteria (see Annex C).

— Adequate programs of staff information, education and training considered as part of the risk management system of the organization and as complementary to the other interventions types here considered (literature reports that interventions based solely on technique training had no impact on working practices or injury rates).

— The definition of a general risk management system and of clear policies and procedures by the organization.

A check on the effectiveness of the intervention (part of the risk reduction strategy) is highly recommended.

Annex B presents organizational aspects of patient handling interventions.

Annex C presents criteria for the choice and use of adequate aids and equipment.

Annex D presents information on buildings and environment for the aspects involved in this Technical Report.

Annex E presents information regarding the fundamentals of staff education and training.

Annex F presents information regarding the evaluation of intervention effectiveness.

Annex A
(informative)

Risk estimation and risk evaluation

A.1 Methods of risk estimation and evaluation

This annex provides a synthetic description of risk estimation and risk evaluation methods found in scientific literature. For each of them the main characteristics are described.

Method	Quantified factors	Main determinant risk factor/s	Benefits	Limitations	Type of use	When and where applied (also grey literature)
OWAS (Karhu et. al. 1977)	Postures of whole body, force and frequency	Posture of all body segments	It allows scoring as well as analytical speed; it considers all body segments and is useful for redesign. It fits analysis of nearly all working tasks. It can be used in all healthcare sectors.	It analyses posture-related aspects as the only determinant. It makes it difficult to define selection criteria of postures to be analysed. It requires some time commitment.	Analysis of gesture modes; it can be used in an effectiveness check system.	Though it has not been designed for this specific goal, it has been applied in risk assessment of operating theatres.
LBP as a function of patient lifting frequency (Stobbe et. al. 1988)	Average frequency of manual lifting by shift	Lifting frequency	It determines the manual lifting frequency and analysis speed. It may predict effects on caregiver's health. It can be used in hospital departments and at home.	It analyses only some types of handling (bed–wheelchair and vice versa, wheelchair–wheelchair) and action frequency is the only risk determinant considered.	Rough analysis of areas-departments more at risk	
BIPP (Feldstein 1990)	Full movement analysis: from preparation to implementation	It assesses preparation to movement, caregiver's position at beginning of movement, dynamic behaviour and at the end of movement repositioning, if necessary.	Task analysis seems to be exhaustive. Seven items are used to identify a final score of movement modes through direct observation analysis. It can be applied in all healthcare areas and also at home.	It neglects all the other risk determinants (frequency, environment, work organization, etc.).	It can be used in an effectiveness check system.	

Method	Quantified factors	Main determinant risk factor/s	Benefits	Limitations	Type of use	When and where applied (also grey literature)
REBA (McAtamney and Hignett, 1995)	Postures of full body, force mainly determined by handled loads	Posture of all body segments	Determination of scores, analysis speed useful to identify ergonomic problems associated with awkward postures and load manual handling. Extremely useful in hospitals and can be used in all healthcare areas.	Like OWAS it practically assesses posture as the only risk determinant. Actually the load exceeding 10 kg always produces a similar score. It is difficult to define the selection criteria of postures to be analysed. It requires a moderate time commitment.	Analysis of gesture modes. It can be used in an effectiveness check system.	
PATE (Kjellberg et. al. 2000)	Full movement analysis: from preparation to implementation	It assesses preparation to movement, caregiver's position at movement beginning and dynamic behaviour.	Task analysis seems to be exhaustive. 17 items are used to identify a final score of movement modes through video camera. It can be used in hospitals and at home.	It requires a video shot and hence may be expensive in terms of time. It analyses only manual movements and not those regarding bathrooms. It neglects all the other risk determinants (frequency, environment, work organization, etc.).	It can be used in an effectiveness check system.	
DINO (Johnson et. al. 2004)	Analysis of patient transfer manoeuvres	It assesses preparation, implementation and results with 16 items. Directly at workplace without movies.	Task analysis seems to be exhaustive. A final score of movement modes is identified. It can be used in hospitals and at home.	It neglects all the other risk determinants (frequency, environment, work organization, etc.)	It can be used in an effectiveness check system.	
Patient handling assessment (Radovanovic and Alexandre 2004)	Anthropometry, disability degree, furniture and environment	There is not one factor only, but all those that have been mentioned have the same impact.	Fast analysis with a score for 8 items. Assessment sum can identify crucial areas.	It must be carried out for each patient and at present it has been assessed only for two departments: Cardiology and Coronary Unit. It seems, however, oriented to assessing assistance rather than PMH risk.	Rough analysis of areas — departments more at risk	At time of publication of this Technical Report, it had been applied in only two wards.

Method	Quantified factors	Main determinant risk factor/s	Benefits	Limitations	Type of use	When and where applied (also grey literature)
PTAI (Karhula et. al. 2007)	Frequency of observed and experienced manual patient transfers, classification into the three categories	It assesses frequency of patient transfers, environment, use of aids, physical load on back, arms and legs, handling skill, guidance, work arrangements, experienced physical and mental strain.	Uses both observation and employees interview. Allows classification into three areas (green, yellow and red). The repeatability and usability of the method is studied in two different pilot studies, validity was corresponded to expert evaluations. The method is available both in Finnish and in English from the Internet.	A video shot is recommended. The method is validated only for hospital wards. The calculation of overall load index requires some time commitment.	It can be used as a practical tool in the identification and evaluation of the risks and as an effectiveness check system. It helps to develop work and work conditions. Includes work-design hints	
MAPO (Menoni et. al. 1999, Battevi et. al. 2006)	Work organization, average frequency of handling and type of patients, equipment, environment and education and training	Considers interaction of factors.	It allows classification into three zones green, yellow and red, which correspond to increased likelihood of acute low back pain. It considers the different factors in an integrated manner and analysis of a ward needs a short evaluation time, approx. 1 h (interview and inspection)	For the time being, the method was validated only for hospital wards.	It can be used for risk analysis in hospital wards.	Applied in 400 wards for a total of approx. 6 000 exposed subjects
TilThermometer (Knibbe et. al., 1999)	Analysis of exposure to physical loads during patient care Complements the use of the TilThermometer	It assesses exposure level to physical load, specifies the use of equipment, identifies compliance with the national guidelines and assesses developments in the care load.	Covers main sources of exposure, not limited to lifting and handling, but also static load and pushing and pulling. Fairly quick to use. Experienced as easy to use and practical. Software available for free on the internet. National statistics available as reference material. Data collection on a	It is not specific enough for individual assessments in the patients care plan. This will require additional individual assessments. The combination with the *Beleidsspiegel* (Policy Mirror) is recommended to ensure an adequate preventive policy.	It is used for monitoring purposes on a regular basis.	Four national monitoring studies are performed with this instrument. (numbers of patients assessed exceeds 150 000)

Method	Quantified factors	Main determinant risk factor/s	Benefits	Limitations	Type of use	When and where applied (also grey literature)
			national scale. If weak spots are identified in the policy users are referred to solutions in order to improve their policies. Tool available for all healthcare sectors with minor differences.			
Manual Handling Assessments in Hospitals and the community (Ref [190])	It defines three risk assessment levels: patient-based level, department or ward level and top level. There are no factors quantitatively defined.	Checklists are provided to assess issues concerning: load, posture and movement, duration frequency and job design, environment, training, organization	The method can easily be used by skilled staff and is applicable in wards and communities	Since no criteria to define checklist items are available, the result of different detectors is hardly comparable. It needs an in-depth training for the detector and a well-structured nursing case file.	It can be used for risk analysis in hospital wards and community but also for monitoring purpose.	Manual Handling Assessments in Hospitals and the community
The Dortmund Approach (Jäger et. al. 2010)	Full movement analysis for caregiver and patient Measurement of caregiver's action forces transferred to the patient Biomechanical modelling: forces and moments at lumbar intervertebral discs	Awkward postures; exertion of high action forces; disadvantageous action-force direction; jerky movement; inadequate handling mode; disuse or misuse of aids or equipment; inadequate load-bearing capacity (e.g. due to age, gender)	Lumbar-overload prevention for patient-handling activities Sophisticated measurement-based determination of the biomechanical load on the lumbar spine and its evaluation with regard to lumbar overload; identification of ergonomic work-design measures (posture, movement, handling technique, aids, etc.)	It is focussed on and, hence, restricted to - selected handling activities, - the mechanical load on the lumbar spine, - handling by one caregiver, - “normal” patient body weight and stature, - cooperation of patient, - adjusted bed height, - adequate standing position of the caregiver. It neglects other risk determinants: - handling frequency, - restricted space, - environment, - insufficient physiological capacity of caregiver.	It can be used for rapid evaluation of low-back loading, i.e. for the identification of performance deficits. Work-design hints are evident.	Principles and quantities are standard, applied in every corresponding occupational disease evaluation in Germany to assess the individual work-related presuppositions.

A.2 National guidelines for managing manual patient handling

The annex presents the synthetic contents of guidelines, generally at the national level, set up for an overall management of patient handling risk. They also reflect the cultural level and sensitiveness of the publication country. It is impossible to know the actual application (in the sense of how many structures have been applied), but no doubt they are useful tools to check, reduce and follow in time the issues associated with manual patient handling risk. In most cases they are resources that can be freely downloaded from the web.

A Back Injury Prevention Guide For Health Care Providers (Ref. [23])	Presents general guidelines that can be used in any healthcare sector and are addressed only to physical risk factors. The guide deals with the following topics: understand why LBP is a problem, analyse the workplace to identify associated activity, equipment and factors likely to contribute to LBP development, identify and implement solutions, assess results. The first section reports a set of interesting data on LBP injury incidence and an evaluation of its (high) direct and indirect costs. A part is dedicated to the different risk occurrence (lifting, use of equipment, etc.). A second section is specifically dedicated to assessment of working activities. Some steps are analytically defined: Involve workers and discuss with them, Obtain statistics on number, type and seriousness of injury, use a set of tools (cards/forms) providing an actual work/risk assessment only after identifying (from previous actions) the key problems. As to the latter point, check lists were prepared to analyse: the risk associated with type of patient, the risk associated with specific task, type and adequacy of equipment, environment, administration issues associated with this problem (presence of procedures, aid purchasing modalities, education, etc.). The most detailed section regards identification and suggestions for the most effective solutions with special reference to the proposal (to be further investigated) to set up a team dealing with non-cooperating patients' lifting. It also includes two interesting effectiveness studies. A part of the guide includes “information resources” whose exhaustive iconographic documentation shows which lifting devices and minor aids are useful for patient's hygiene for which operations/patients, etc. A list of suggested characteristics needed in the different equipment is also suggested for each type of device. The same section also provides information on the behaviours to be enacted in the different handling, repositioning and other daily activities (e.g. hygiene). Like other guides, it highlights workers' involvement through all process stages because of its positive impact at different levels. The problem rough analysis comes from information gathered on injury and disease. There are no standardized criteria to judge the magnitude of MPH risk but the judgement is at “expert's” discretion. Management is less involved than in other guide lines. There is a proposal of a team specifically engaged in patients' transfer/handling. Iconography is useful to implement a solution data bank (like in other guides).

Patient Care Ergonomics Resource Guide: Safe Patient Handling and Movement (Ref. [24])	Developed by the Patient Safety Center of Inquiry (Tampa, FL), Veterans Health Administration and Department of Defence after over thirty years of experience on this particular topic, the website can be used also to tackle special issues of MPH risk management. They are extremely interesting guidelines and need to be analytically investigated as regards manual patient handling accidents, a full-time caregivers' team tackling the problem and continuous patient monitoring: in this regard an accurate patient's case file is necessary. In short, MPH risk management proposal is based on 9 steps that have to be sequential. Assessment of all MPH accidents with (direct and indirect) quantification. Selection and identification of high risk wards according to accident occurrence. Interview with ward heads for pre-assessment of the different factors jointly producing the specific risk: type of patient and disability (subdivided according to how many times a week the patient needs total lifting), furniture and spaces, equipment, education and training. Identification of high risk tasks and proposed improvements. Inspection on concerned area for checking collected information. Summary of risk analysis. Recommendations to improve identified risk issues. Selection of equipment Monitoring of results. The guidelines end with a section devoted to bariatric patients (Special Handling and Movement Challenges Related to Bariatrics). For each stage, protocols, administration modalities and (not always) assessment criteria will be provided. A special feature is the development of an algorithm for each of the key transfer and repositioning tasks designed to assist healthcare employees in selecting the safest equipment and techniques based on specific patient characteristics.
The Guide to the Handling of People (Ref. [211])	This publication is a collaboration of BackCare (formerly the National Back Pain Association) and National Back Exchange in association with the Royal College of Nursing, Chartered Society of Physiotherapy, College of Occupational Therapy, Institute of Ergonomics and Human Factors, Health and Safety Executive and NHS Employers. Previous editions date back to 1981, recording an advanced cultural background which may not be easily exportable to other countries. It is subdivided into sections on Manual handling legislation, Risk management, Ergonomics in health and social care, Mechanics and human movement, Systems approach to safer handling practice, Training strategies, Equipment strategies and Health and wellbeing. The third section provides a summary of core practical skills with rick iconographic references.
Transferring people safely — A guide to handling patients, residents and clients in health, aged care, rehabilitation and disability services (Ref. [27])	Australian guideline in its third edition. Produced specifically for Victorian employers to assist in reducing the incidence and severity of injuries to their staff resulting from manual handling risks when transferring people. This guide complements the publication, *A guide to designing workplaces for safer handling of people.* It provides a series of tools for managing manual patient handling risk classified as follows: The patient risk assessment worksheet that guides the assessment of manual handling risks for an individual task. Assessment takes into consideration environmental issues (furniture, space, equipment). Organizational issues (training, adequate staff numbers, working hours) and patient characteristics (cognitive, physical and behavioural signs). No criteria are defined for judgement of different proposed items. The patient transfer guide. A set of completed risk assessments for 12 common transfer or moving procedures. For each of them, risk-ranked solutions are provided: from highly recommendable to highly hazardous. Patient and resident records should be done when the patient arrives in the unit and whenever her/his condition changes significantly. Examples of patient recording forms are provided that staff may use to identify risks and record the handling/moving procedures. This needs a nursing chart or a specific form to

	start a “handling programme”. Task assessments and class risk assessments. A description of each task from the Patient transfer guide and a discussion of the risk factors based on: type of patient disability, characteristics of equipment, characteristics of environment and finally organizational characteristics (staff education and training and number of available caregivers). In the light of this description it is clear that this guideline can be used in wards (acute or chronic patients) and in home assistance. As regards risk assessment, it considers different elements in an integrated manner: type of patient, equipment, environment and work organization. No effectiveness assessment tools of adopted strategies are provided even if periodically a report is produced.
Dutch Guidelines for Practice 2002	These guidelines are based on ergonomic standards and are formulated in simple “care language” and state the do's and don'ts for daily practice in healthcare. The total set of guidelines (for details see the scenario and Annex C) comprises a maximum of two pages depending on the healthcare sector. There are marginal differences between health are sectors. The guidelines were developed with full participation of nurses themselves to ensure their commitment and to facilitate a complete and easy integration in normal day-to-day care routines. For each of the healthcare sectors groups of 15–20 representatives from practice were closely involved. They also piloted draft versions in a few stages in their own facility. After these phases the guidelines were officially supported by the covenant parties: unions, employers and the government. Following this formal stage of official commitment considerable effort was made to implement the guidelines from management.
AORN Guidance Statement: *Safe Patient Handling and Movement in the Perioperative Setting* (2007)	A broad panel of experts was set up to identify risk factors for musculoskeletal disorders for registered nurses and other members of the perioperative team. After a systematic assessment of task demands, direct measurement of weights and forces involved in the tasks, and direct observation of work tasks and equipment, the panel applied ergonomic principles to develop clinical tools for utilization in the perioperative area. Seven high risk tasks were identified: transferring patients on and off operating table, repositioning patients on the operating table, lifting and holding the patient's extremities, standing for long periods of time, holding retractors for long periods of time, lifting and moving equipment and sustaining awkward positions. For each task an algorithm was set up to avoid biomechanical overload. Algorithms account in particular for applied effort and number of caregivers involved at the same time. Also indications on recommendations for object handling and frequent pulling and pushing frequent in operating theatres are interesting. Also measurement of lifting index and directly measured pulling and pushing are provided. It is a guideline applicable only in operating theatres and is task-oriented. It is especially useful for working procedure and policy writing.

A.3 Example of an application of the methods commonly used for risk assessment of manual patient handling

It is possible, to some extent, to compare on the basis of similar scenario, described below, the practical application and the differences among methods.

A.3.1 Scenario

A medical ward with 25 beds is considered, all being generally occupied and with 10-day average hospitalization stay. The staff involved in manually handling patients consists of nine people: in the first shift four workers are present simultaneously, in the second three and at night two workers. During the first morning shift of assistance to patients, nurses are organized in two couples of workers, in the second and third shifts, only one couple and in the afternoon the operator who works on her/his own assists partially cooperating patients (PCs).

Patients who require assistance with transfers are on average elderly patients with multiple diseases confined to bed and whose hospitalization is addressed to diagnostic assessment (specialized tests). Out of the 20

patients with severely limited mobility (that are those who have to be lifted or moved during assistance operations), i.e. non-cooperating patients (NCs) who are present on average, 12 have to be fully lifted or moved while eight have residual movement capabilities in lower limbs and hence have to be partially lifted and cannot or may not bear full body weight.

Most manual patient handling activities are as follows.

— Transfers upwards in bed and turning for all disabled patients every shift, which may be in the first shift at least twice. These manoeuvres are currently performed manually. In short this category is named “repositioning in bed”.

— Bed–wheelchair transfer and wheelchair–toilet transfer and vice-versa (only for all PCs) in the morning and afternoon. These manoeuvres are performed manually.

— Only 2 or 3 patients are moved via a bed-stretcher lifting and vice versa for diagnostic tests only in the unit. The other transfers (stretcher–X-ray bed and vice-versa) are performed in radiology by radiology technicians.

The present equipment consist of a sliding board and a height-adjustable stretcher (always used during bed–stretcher transfer and vice versa, for totally non-cooperating patients).

In this ward there is no shower chair available and all patients are washed in bed. The patients cannot take a bath or a shower.

Anti-embolism stockings above grade 2 are used.

All beds are manually driven, mechanically height adjustable and have a three-section profiling surface. The environments in which the patients are handled have enough space and/or little encumbrances. Only one room out of 13 and two bathrooms out of 14 have inadequate spaces for equipment use. There are few (six) wheelchairs available but one is not optimal from an ergonomic point of view (brake malfunctioning, non-extractable armrest and cumbersome backrest).

Specific education and training on specific risk of handling patients has never been implemented.

A.3.2 Risk evaluation, applied to the scenario, based on the Dortmund Approach

A.3.2.1 Introduction

The *Dortmund Approach* aims at a biomechanically oriented assessment of the load on the spine for occupational manual materials handling, here applied to the specific occupational tasks of manual patient handling (Jäger et. al. 2010). The method is based on laboratory investigations into selected patient handlings (The *Dortmund Lumbar Load Study 3 – DOLLY 3*), applying:

a) posture recordings of caregiver and patient;

b) measurements of caregiver's action forces transferred to the patient;

c) subsequent 3-D dynamic biomechanical computer simulations;

d) quantitative description of the (bio-)mechanical load on the lumbar spine by several indicators (i.e. compressive and shear forces as well as bending and torsional moments at the lumbosacral disc).

With regard to possible mechanical overloading the lumbar-spine structures, the discal compressive forces for the analysed tasks are compared with recommended limits for work design. The corresponding lumbar-overload risk of the diverse tasks is classified by a 3-zone model (**GREEN, YELLOW, RED**) so that:

a) lumbar load can be evaluated rapidly;

b) performance deficits can be identified and;

c) measures of work design can be derived directly in order to enable a biomechanically-justified ergonomic task performance.

DOLLY 3 elucidates that lumbar load is often very high for the caregivers and may exceed the ergonomic limits mentioned below, in particular, in case of “conventional” task execution modes and/or for moving more or less passive patients (partially non-cooperating patients); accordingly, the risk is classified **RED**. A considerable reduction can be achieved by a biomechanically “optimized” mode of execution, when indicated accompanied by the use of small aids; according to the individual task conditions, the risk is classified **YELLOW** and, in some cases, it can be lowered to achieve the **GREEN** zone.

In Table A.1, the compressive forces at the lumbosacral disc for several patient handlings are listed. Lumbosacral disc-compression is, in this context, regarded as a typical indicator for the mechanical load on the lumbar spine during manual handling activities. Lumbar-load values, represented by means and ranges, are provided for three handling modes: conventional, optimized and optimized using small aids additionally. In the right part of Table A.1, risk classification according to the 3-zone model is demonstrated; categorization mainly depends on task conditions, handling mode and patient's cooperation level. Conditions for lowering the risk are thereby evident, i.e. the task conditions specified in Table A.1 represent ”minimal demands” and the biomechanical overload risk can be diminished in case of more advantageous task-or-execution characteristics.

Criteria for risk classification according to the 3-zone model are derived from Table A.2 as follows:

GREEN disc-compressive forces lower than lowest recommended limit (nearly 2 kN for older female adults), i.e. the work is assumed acceptable for almost all persons under the given circumstances;

YELLOW disc-compressive forces in the range of the recommended limits for females (nearly 2 to 4,5 kN dependent on age), i.e. the work may be acceptable under improved circumstances;

RED disc-compressive forces higher than highest recommended limit for females (approx. 4,5 kN for younger female adults), i.e. the work is assumed unacceptable for females under the given circumstances.

The recommended limits mentioned in these definitions are based on the so-called *Dortmund Recommendations* (cf. Table A.2) representing ergonomic limits for the lumbar-disc compressive forces during manual materials handling (Jäger et. al. 2001a, ISO 11228-2). The limits were derived in analogy to NIOSH's Action Limit (1981); the underlying data base on the ultimate compressive strength of lumbar-spine sections enabled the consideration of the most influencing factors on spinal load-bearing capacity, i.e. age and gender of the task-performing person.

Table A.1 — Lumbar load during manual patient handling and risk-level categories for biomechanical overload — Lumbosacral compressive forces (mean and range) caused by activities performed in three execution modes, and classification by a 3-zone risk model accompanied by task-condition description

Patient-handling activity	**Lumbar load** [mean (range)] Lumbosacral compressive force in kN			**Risk zone** *yellow, green:* The specified task conditions represent "minimal demands", i.e. the biomechanical overload risk can be lowered in case of more advantageous conditions.
	conventional	optimized	optimized + small aids	
Raising a patient from lying to sitting in bed or vice versa	3.4 (1.8 - 5.4)	2.3 (2.0 - 2.5)	n.a.	red in all cases except yellow or green condition yellow optimized technique + part. co-op. pat. green fully co-op. pat.
Elevating a patient from lying to sitting at the bed's edge or vice versa	5.0 (3.3 - 6.2)	2.7 (2.0 - 3.6)	n.a.	red in all cases except yellow condition yellow optimized technique + part. co-op. pat.
Moving a patient towards the bed's head (CG at bed's longside)	6.9 (5.6 - 8.1)	5.4 (3.7 - 6.5)	2.8 (2.3 - 3.2)	red in all cases except yellow condition yellow using small aids + fully co-op. pat.
Moving a patient towards the bed's head (CG at bed's head)	5.7 (2.8 - 8.9)	2.5 (2.0 - 3.0)	2.4 (2.2 - 2.8)	red in all cases except yellow condition yellow optimized technique *or* using small aids *or* fully co-op. pat.
Moving a patient in the bed sidewards	4.9 (3.3 - 5.8)	2.6 (2.0 - 3.4)	1.9 (1.6 - 2.2)	red in all cases except yellow or green condition yellow optimized technique + part. co-op. pat. green using small aids + part. co-op. pat.
Lifting a leg of a lying patient or vice versa (CG at bed's longside)	2.8 (1.9 - 4.0)	n.a.	n.a.	yellow in all cases except green condition green CG at bed's foot (see below)
Lifting a leg of a lying patient or vice versa (CG at bed's foot)	1.8 (1.8 - 1.8)	n.a.	n.a.	yellow CG at bed's longside (see above) green in all cases except yellow conditon
Lifting both legs of a lying patient or vice versa	3.5 (3.0 - 4.5)	n.a.	n.a.	yellow in all cases except green condition green presumed for CG at bed's foot
Inclining the bed's head with the patient lying in the bed or vice versa	4.3 (3.8 - 5.4)	4.1 (3.5 - 5.2)	n.a.	red in all cases except yellow condition yellow inclining: optimized technique + fully co-op. pat.; lowering: no further demands
Shoving a bedpan or vice versa	4.2 (2.6 - 6.5)	3.3 (3.3 - 3.3)	n.a.	red inadequate transfer technique yellow in all cases except red condition
Placing small aids or vice versa	n.a.	2.4 (2.2 - 2.6)	n.a.	red presumed for totally non co-operating patients yellow optimized technique + part. co-op. pat.
Transferring a patient from bed to bed	n.a.	n.a.	2.4 (2.3 - 2.4)	red presumed for totally non co-operating patients yellow using small aids + part. co-op. pat.
Placing a patient from sitting at bed's edge in a chair or vice versa	5.1 (3.8 - 6.5)	3.7 (2.3 - 4.4)	3.1 (1.6 - 5.3)	red in all cases except yellow and green condition yellow opt. tech. *or* small aids (exc. inadequate use) green small aids + fully co-op. pat. with max. 70 kg
Raising a patient from sitting to upright standing position or vice versa	4.9 (3.8 - 6.4)	2.5 (1.9 - 3.1)	n.a.	red in all cases except yellow condition yellow raising: optimized technique + fully co-op. pat.; lowering: fully co-op. pat. with max. 70 kg
Raising a patient from lying on the floor to standing position	4.1 (3.3 - 4.7)	n.a.	n.a.	red all cases except yellow condition yellow fully co-op. pat.

Key:
CG: caregiver
n.a.: not applicable or not analyzed

fully co-op. pat.: fully co-operating patient
part. co-op. pat.: partially co-operating patient
without co-operation: The handling of totally non co-operating patients was not studied explicitly, however, a high risk may be presumed in many cases.

Risk zone and level
red high: risk unacceptable
yellow medium: risk eventually acceptable under improved circumstances
green low: risk acceptable

Table A.2 — Dortmund Recommendations — Age-and-gender related limits for lumbar-disc compressive forces during manual materials handling to avoid biomechanical low-back overload, here applied to the evaluation of manual patient-transfer activities

Dortmund Recommendations evaluating the (bio-)mechanical load on the lumbar spine during manual materials handling		
Limits for compressive forces on lumbar discs		
Age	Female	Male
20 years	4.4 kN	6.0 kN
30 years	3.8 kN	5.0 kN
40 years	3.2 kN	4.1 kN
50 years	2.5 kN	3.2 kN
≥ 60 years	1.8 kN	2.3 kN

A.3.2.2 Risk assessment

A.3.2.2.1 General remark — Risk levels and comments regarding the tasks 1 to 3

Education, training and follow-up checks are unequivocally necessary to enable an adequate application of "biomechanically optimized manual patient handling techniques" and a proper use of small and/or technical aids. Otherwise, optimized handling cannot be guaranteed, and the induced biomechanical overload risk is presumed being too high in most cases of manual patient handling actions (risk level RED).

1) ---------- TASK ONE a+b ----------

a) **"transfers upwards in bed"** is interpreted as "moving the patient towards the bed's head";

NC: The risk class is RED, the work is assumed unacceptable for females under the given circumstances.

> The minimal demand to receive a YELLOW risk is, in case of the caregiver acting at the bed's long side, a fully cooperating patient instead of a non-cooperating. In case of a carer acting at bed's head, a partial cooperation of the patient is demanded to enable a YELLOW risk. Hence, for non-cooperating patients, the conditions for a YELLOW risk are not fulfilled.

PC: The risk class is YELLOW if an optimized technique without or with small aids is applied (sliding sheet or mat which are, however, actually not present on the ward and should then be allocated to the caregivers) and the handling action is performed from the bed's head.

> Interpreting measurements' results in an extrapolating manner, the risk class can potentially be changed to GREEN if two or more caregivers act simultaneously in well-timed co-ordination and adequate small aids are applied (actually not present on the ward).

b) **"turning"** is interpreted as "moving a patient in the bed sideward";

NC: The risk class is RED, the work is assumed unacceptable for females under the given circumstances.

> The minimal demand to receive a YELLOW or a GREEN risk is a partial cooperation.

PC: The risk class is YELLOW if an optimized technique without small aids is applied.

The risk class can be changed to GREEN if an optimized technique with usage of small aids would be applied (sliding sheet or mat which are, however, actually not present on the ward and should then be allocated to the caregivers).

2) ---------- TASK TWO ----------

"bed–wheelchair transfer" and **"wheelchair–toilet transfer"** are interpreted both as "placing a patient from sitting at bed's edge in a chair or vice versa".

NC: Totally non-cooperating patients are not intended to be transferred in this case.

PC: The risk class is YELLOW if an optimized technique without or with small aids is applied (a sliding board is available on the ward; if supportive equipment is used, it should be applied adequately, i.e. users should be trained in its use).

Even if an adequate small aid is applied (the available sliding board) and even if only patients of limited weight are transferred (up to approx. 70 kg), the risk can nevertheless not be changed to GREEN as PC patients support the action insufficiently, in comparison to fully cooperating patients. However, the risk class can potentially be changed to GREEN if technical lifting aids would be used: e.g. stand-assists which are, however, actually not present on the ward and should then be allocated to the caregivers.

3) ---------- TASK THREE ----------

"bed-stretcher lifting" is interpreted as "transferring a patient from bed to bed";

Whoever this task will perform (i.e. a caregiver on the ward or a radiology technician in radiology) is subject to a lumbar overload risk which is therefore to be evaluated.

NC: Although not explicitly analysed in corresponding laboratory studies, the risk class is evaluated RED, the work is assumed unacceptable for females under the given circumstances.

The minimal demand to receive a YELLOW risk is a partial cooperation of the patient and usage of small aids, i.e. a rolling board which is actually not present on the ward and should then be allocated to the caregivers.

PC: The risk class is RED, even if an optimized technique is applied, as an appropriate small aid (i.e. a rolling board) is not available on the ward and can therefore not be applied.

The risk class can be changed to YELLOW if an optimized technique with usage of small aids is applied (i.e. a rolling board which is, however, actually not present on the ward and should then be allocated to the caregivers).

The risk class can potentially be changed to GREEN if two or more caregivers act simultaneously in well-timed co-ordination and adequate small aids would be applied, or if technical lifting aids are used (e.g. total-body lifter, actually not present on the ward).

A.3.2.2.2 Overall assessment and hints for work design

The tasks to be performed on the ward as described in the scenario (see A.3.1, tasks 1 to 3) are evaluated with regard to potential biomechanical overload of the spinal structures of female caregivers by applying the Dortmund Approach:

a) For moving NCs, the risk class is RED for all manual handling activities assumed in the scenario.

b) For PCs, a YELLOW risk class can be attained if, at minimum, a biomechanically optimized handling technique is applied. In specified tasks, an adequate small aid must be applied supplementary to enable a YELLOW risk.

c) A GREEN risk class may be achieved for specified tasks, but only for partially cooperating patients, if two or more caregivers act simultaneously in well-timed co-ordination and apply adequate small aids, and/or if technical aids are used properly.

d) Allocation of adequate small aids (e.g. sliding sheets or mats and a rolling board in addition to the sliding board) is unequivocally necessary; for performing some extremely high-loading tasks, usage of technical aids (e.g. total-body lifter, ceiling lifter) is recommended.

A.3.3 Risk evaluation, applied to the scenario, based on MAPO index application

A.3.3.1 Introduction

MAPO methodology is aimed at providing a parametric index representing the risk level of the unit considered, hence it is not addressed to analysing the single movement but to the whole of the determinants negatively or positively contributing to defining the risk level for unit operators.

Focus is on work organizational issues (number of operators, distribution over working shifts, handling and education to specific risk) which thus become of major importance.

For the sake of simplicity, the patients to be fully lifted during handling are defined as “non-cooperating” (NC) while all the other patients needing help during handling (lifting or moving) are defined as partially cooperating (PC). The patients who do not need any help in handling are defined as fully cooperating patients.

The data collection form is configured to acquire information for MAPO index calculation and description of characteristics needed to formulate an intervention/improvement appropriate for the specific situation.

Completing the form requires an interview, generally lasting 30–40 min, with the head nurse or anyhow someone having worked for a long time in the unit considered.

This stage is followed by an inspection addressed to collect further information on equipment and environment where patients are handled: hence just a tape measure is necessary. This stage generally needs 30 min. The inspection is also a check of the information gathered in the interview.

The MAPO index is calculated considering in an integrated manner the organizational issues, type of patients, type of handling, use of equipment (if available), education of operators to specific risk and handling environment.

A.3.3.2 Risk assessment

DATA COLLECTION SHEET — RISK ASSESSMENT FOR MANUAL PATIENT HANDLING IN WARDS WITH MAPO METHODOLOGY

HOSPITAL :__Example_____ WARD :__MEDICINE UNIT__ ward code : _____

No beds: __25__ AVERAGE NUMBER OF HOSPITALIZATION DAYS: ____10___date __/////_____

1. INTERVIEW

NURSING STAFF ENGAGED IN PATIENT TRANSFERRING: please mark the total number of operators by job.			
Nursing staff: **6**	Nurses aides: **10**		other: //
of these how many operators with limitations/prescriptions to MPH: **0**			
No OPERATORS ENGAGED IN MPH OVER 3 SHIFTS: please mark the number of operators present in each shift.			
	morning	**afternoon**	
Shift schedule: (00:00 to 00:00)	from___7.00____to__14.00_____	from __14.00___to___21.00___	from___21.00___to___7.00
No of operators over the whole shift	**4**	**3**	**2**
(A) Total of operators present over the whole shift =			**9**

No of PART-TIME OPERATORS : please mark the exact timetables worked and calculate them as unit fractions (in relation to the overall duration of the specific shift).			
No of present part-time operators	Presence timetable in shift: (00:00 to 00:00)	Unit fraction	(unit fraction by No of present operators)
	from_____to_____		
	from_____to_____		
(B) Total of operators (as unit fractions) present by shift duration =			

TOTAL Nº OF OPERATORS ENGAGED IN MPH IN THE 24 HOURS (Op): please sum the total number of operators present over the whole shift duration **(A)** to the total number of part time operators (**B**)	**9**	**Op**

Is the work carried out by two nurses? If yes, please indicate the number of couples by shift:

1st morning ___**2**_____ 2nd afternoon_____**1**_____ 3rd night ____**1**_____

TYPE OF PATIENTS:

By totally Non-cooperating patients (**NC**) we mean the patient who is to be fully lifted in transfer operations. By Partially Cooperating patient (**PC**) we mean the patient who is only partially lifted.

DISABLED PATIENT (**D**)____**20**_____ (please indicate their number as a daily average)

Non-cooperating patients (**NC**) No. _____**12**_____ Partially Cooperating patients (**PC)** No. ___**8**___

DISABLED PATIENTS	No. NC	No. PC.
Elder with several diseases	12	8
Hemiplegic		
Surgical		
Severe ictus/stroke		
Dementia		
Other neurologic diseases		
Fractured		
Bariatric patients		
Other		
Total	12	8

OPERATORS' EDUCATION AND TRAINING					
EDUCATION AND TRAINING			INFORMATION		
Attended theoretical-practical course	☐ YES	X NO	Only trained to equipment use	☐ YES	X NO
If yes, how many months ago? How many hours per operator?	months ___ hours ____		Provided only information material on MPH	☐ YES	☐ NO
If so, how many operators attended?			If so, to how many operators?	0	
Attendance is documented, EFFECTIVENESS CHECK?			☐ YES	☐ NO	

PATIENT HANDLING TASKS CURRENTLY CARRIED OUT IN SINGLE SHIFTS:

MANUAL HANDLING: please describe the usually tasks involving total or partial patient lifting	**Total lifting (TL) WITHOUT EQUIPMENT**			**Partial Lifting (PL) WITHOUT EQUIPMENT**		
Please indicate in each shift the **amount of tasks** involving manual patient handling	**morning**	**afternoon**	**night**	**morning**	**afternoon**	**night**
	A	**B**	**C**	**D**	**E**	**F**
X lifting towards pillow	X X □□	X □□□	X □□□	X X □□	X □□□	X □□□
X rotations in bed (for decubitus change)				X X □□	X □□□	X □□□
X bed/wheelchair and vice-versa	□□	□□	□□	X X	X X	□□
□ lifting from seated to upright position				□□	□□	□□
□ bed/stretcher and vice-versa	□ □	□ □	□□	□□	□□	□□
X wheelchair/toilet and vice-versa	□□	□□	□□	X X	X X	□□
□ other	□□	□□	□□	□□	□□	□□
□ other	□□	□□	□□	□□	□□	□□
TOTAL: please calculate the total of each column	2	1	1	8	6	2
Sum of total (STL) or partial (SPL) lifting manual tasks	A+B+C = STL		4	D+E+F=SPL		16

AIDED HANDLING: please describe the usually tasks involving total or partial lift of patients aided by available equipment	**Total lifting (TL) AIDED**			**Partial Lifting (PL) AIDED**		
Please indicate in each shift the amount of tasks involving patient AIDED handling	**morning**	**afternoon**	**night**	**morning**	**afternoon**	**night**
	G	**H**	**I**	**L**	**M**	**N**
□ **lifting towards pillow**	□□□□	□□□□	□□□□	□□□□	□□□□	□□□□
□ **rotations in bed (for decubitus change)**				□□□□□	□□□□□	□□□□□
□ **bed/wheelchair and vice versa**	□□	□□	□□	□□	□□	□□
□ **lifting from seated to upright position**				□□	□□	□□
X **bed/stretcher and vice versa**	X X	□□	□□	X X	□□	□□
□ **wheelchair/toilet and vice versa**	□□	□□	□□	□□	□□	□□
□ **other**	□□	□□	□□	□□	□□	□□
□ **other**	□□	□□	□□	□□	□□	□□
TOTAL: please calculate the total of each column	**2**			**2**		
AIDED handling total (ATL) or partial (APL) lifting	**G+H+I = ATL**		**2**	**L+M+N=APL**		**2**
% OF AIDED TOTAL LIFTING OPERATIONS (% ATL)	**ATL**(STL + ATL)	**2/6=33 %**				
% OF AIDED PARTIAL LIFTING OPERATIONS (% APL)				**APL (SPL + APL)**	**2/18=11 %**	

NOTE There is a sliding BOARD and an adjustable height stretcher always used when necessary

ON SITE INSPECTION: EQUIPMENT FOR DISABLED PATIENT LIFTING/TRANSFER

DESCRIPTION OF EQUIPMENT	No.	Lack of essential requirements	Lack of adaptability to patients	Lack of adaptability to environment	Lack of maintenance
LIFTING EQUIPMENT type :		YES NO	YES NO	YES NO	YES NO
LIFTING EQUIPMENT type :		YES NO	YES NO	YES NO	YES NO
LIFTING EQUIPMENT type :		YES NO	YES NO	YES NO	YES NO
Adjustable STRETCHER type : mechanical	1	YES X NO	YES X NO	YES X NO	YES X NO
Adjustable STRETCHER type :		YES NO	YES NO	YES NO	YES NO

OTHER AIDS (MINOR AIDS):

Sliding sheets No.___ **or** Sliding boards No. **1**	ERGONOMIC BELTS No._____	POWERED STANDING ASSIST LIFT No._____	ROLLERS No._____

WHEELCHAIRS:

TYPE OF WHEELCHAIR

FEATURES AND INADEQUACY SCORE OF WHEELCHAIRS	Score	A	B	C	D	E	F	G	
		No **3**	No **2**	No **1**	No	No	No	No	Total no. of wheelchairs
Poor maintenance									**|_6_|**
Malfunctioning brakes	1		X	X					
Not extractable armrest	1			X					
Not extractable footrest									Total
Cumbersome backrest	1			X					wheelchair
Width exceeding 70 cm	1	cm	cm	cm 80 X	cm	cm	cm	cm	score
Column score **(No. wheelchairs × sum of scores)**		**0**	**2**	**4**					**6**

Mean score (**MSWh)** = Total wheelchair score/No Wheelchairs **|_1,0__| MSWh**

STRUCTURAL FEATURES OF ENVIRONMENT BATHROOMS (centralized or individual in rooms):

TYPE OF BATHROOMS WITH SHOWER/BATH

FEATURES AND INADEQUACY SCORE OF BATHROOMS WITH SHOWER/BATH centr = centralized in ward indiv. = in room	Score	A centr X indiv.	B centr X indiv.	C centr X indiv.	D X centr indiv.	E centr indiv.	
		No. **2**	No. **1**	No. **10**	No. **1**	No.	Total no.
Free space inadequate for use of aids	2	X					bathrooms
Door opening inwards (not outwards)		X	X				**|_14_|**
No shower							
No fixed bath		X	X	X			
Door width less than 85 cm	1	X		X			Total score
Non-removable obstacles	1	X					bathrooms:
Column score **(No. bathrooms × sum of scores)**		**8**	**0**	**10**	**0**		**18**

Mean score bathrooms (**M.S.B.**) = total score bathrooms/total N. bathrooms : **|__1,28__| MSB**

TOILETS (WC) (centralized or individual in rooms)**:**

TYPE OF TOILETS (WC)

FEATURES AND INADEQUACY SCORE OF TOILETS centr = centralized in ward indiv. = in room	Score	A ☐ centr X **indiv.**	B ☐ centr X **indiv.**	C X centr ☐ **indiv.**	D ☐ centr ☐ **indiv.**	E ☐ centr ☐ **indiv.**	
		No. **2**	No. **11**	No. **1**	No.	No.	Total no.
Free space insufficient to turn wheelchair round	2	X					toilets (WC)
Door opening inwards (not outwards)		X					**|_14_|**
Insufficient height of WC (below 50 cm)	1	X					
WC without grab bars	1	X	X				
Door width less than 85 cm	1	X					Total WC score
Space at side of WC less than 80 cm	1						
Column score **(No. toilets × sum of scores)**		**10**	**11**	**0**			**21**

Mean score (**M.S.WC.**) = total WC score/No WC: **|__1,5___| MSWC**

PATIENT ROOM CONFIGURATION

PATIENT ROOMS

FEATURES AND INADEQUACY SCORE OF WARDS	Score	No. **10** Rooms	No. **1** Rooms	No. **2** Rooms	No. ___ Rooms	No. ___ Rooms	
No. of beds		**2**	**3**	**1**			Total no.
Space between beds or between bed and wall less than 90 cm	2		X				rooms
Space between foot bed and wall less than 120 cm	2		X				**|_13_|**
Presence of non-removable obstacles							
Fixed beds with height less than 70 cm							
unsuitable bed : needs to be partially lifted	1						
Inadequate side flaps							
Space between bed and floor less than 15 cm	2						
Beds with 2 wheels or without wheels							Total rooms
Height of armchair seat less than 50 cm	0,5			X			score
Column score (No. wards × sum of scores)		**0**	**4**	**1**			**5**

Mean score rooms (**M.S.R.**) = total score wards/total No Rooms **|__0,38__| MSR**

ENVIRONMENT AVERAGE SCORE = M.S.B. + M.S.WC.+ M.S.R. = |__3,16__| MSE

HEIGHT-ADJUSTABLE BEDS

DESCRIPTION OF BEDS	No	Electric adjustable	Mechanical adjustable	No of sections	Manual lifting of bedhead or bedfoot
BED A:	20	YES NO X	X YES NO	1 2 3 4	YES NO
BED B:		YES NO	YES NO	1 2 3 4	YES NO
BED C:		YES NO	YES NO	1 2 3 4	YES NO
BED D:		YES NO	YES NO	1 2 3 4	YES NO

PLEASE INDICATE IF BATHROOMS (OR WHEELCHAIRS) ARE NOT USED BY DISABLED PATIENTS (BEING CONFINED TO BED) ☐ YES ☐ NO

Name and family name of interviewer:

_____

MAPO INDEX

HOSPITAL :___EXAMPLE_____ UNIT :_MEDICINE_

NUMBER OF DISABLED PATIENTS/OPERATORS RATIO

No non-cooperating patients (NC) __**12**___mean	No operators _**9**___ =	**1,33** NC/OP
No partially cooperating patients (PC) _**8**_mean	No operators _**9**___ =	**0,88** PC/OP

LIFTING DEVICE FACTOR (LF)	VALUE OF LF	
Absent OR Inadequate (% ATL < 90 %) +Insufficient Lifting Devices		_**4**_ LF
Insufficient OR Inadequate Lifting Devices	4	
Adequate AND Sufficient Lifting Devices	2	
	0.5	

MINOR AIDS FACTOR (AF)	VALUE OF AF	
Minor Aids Absent OR Insufficient		_**1**_ AF
Minor Aids Sufficient AND Adequate (% APL ≥ 90 %)	1	
	0,5	

WHEELCHAIR FACTOR (WF)							
Mean wheelchair score (MSWh)	0,5–1,33		1,34–2,66		2,67–4		_**1**_ WF
Numerically sufficient	YES	NO	YES	NO	YES	NO	
VALUE OF WF	0,75	1	1,12	1,5	1,5	2	

ENVIRONMENT FACTOR (EF)				
Mean environment score (MSE)	0–5,8	5,9–11,6	11,7 –17,5	_**0,75**_ EF
VALUE OF EF	0,75	1,25	1,5	

TRAINING FACTOR (TF)	VALUE OF TF FACTOR	
Adequate training	0,75	

Only information	1	|_**2**_| TF
No training	2	

MAPO INDEX = $\left(\left|\_1{,}33\times\right|\_4\_\left|\right.\right.$ \|__0,88__\| × \|__1__\|$\left.\right)$ × \|__1__\| × \|_0,75_\|× \|__2__\| = 9,33

NC/OP LF PC/OP AF WF EF TF

MAPO INDEX	EXPOSURE LEVEL
0	ABSENT
0,1–1,5	NEGLIGIBLE
1,51–5	MEDIUM
> 5	HIGH

COMMENTS TO ORGANIZATIONAL ISSUES

The high risk is the absence of equipment used for assistance at patients' bed and bed-wheelchair and wheelchair-WC transfers for PC patients. Besides, there is the total lack of education and training of staff. The simultaneous high amount of tasks involving NC patients' handling in each shift versus the small number of operators is a priority action to reduce the risk.

PROPOSALS OF SHORT-TERM RISK REDUCTION

Availability of 2 sliding sheets (for assistance in bed to NC and PC patients) to be supplied 1 per couple of operators + availability of stand lifting device + education to correct postures and specific use of equipment + 5 ergonomic wheelchairs + 5 height-adjustable beds.

PERCENTAGE OF OPERATIONS AIDED AFTER REDUCTION ACTION:

% OF AIDED PARTIAL DISPLACEMENTS = 100 % % OF AIDED TOTAL DISPLACEMENTS = 100 %

MAPO REASSESSMENT AFTER IMPLEMENTATION OF PREVENTIVE STRATEGIES	NC	OP	PC	VALUE OF LF	VALUE OF AF	*WHEELCHAIR FACTOR (WF)*	*ENVIRONMENT FACTOR (EF)*	*TRAINING FACTOR (TF)*	**MAPO INDEX**	RISK LEVEL
	12	9	8	0,5	0,5	0,75	0,75	0,75	**0,47**	NEGLIGIBLE

COMMENTS FOR FURTHER MODIFICATIONS

N.B.: We still have to improve the environment to make toilets more usable by PC patients.

Besides, we have to check in time the aided operations (that have to remain 100% because of the ratio between NC patients and operators, which is quite unfavourable for operators) and the correct postures ad defined during operators' training.

We should also consider the increase in caregiver numbers, especially for the afternoon shift.

A.3.4 Risk evaluation, applied to the scenario, based on PTAI method

A.3.4.1 Introduction

The PTAI (patient transfer assessing instrument; Karhula, Rönnholm & Sjögren 2009) is a practical tool that occupational safety and occupational health professionals can use to evaluate the risk of patient transfers in the unit. Total 15 factors are observed and interviewed. The criteria allow classifying the risk by 3-zone model (green, yellow and red). The first factors are filled in by the evaluator on the basis of observing the work environment and the nurse performing the patient transfer as usual. The patient is guided and helping devices

are used in the normal manner. The last factors are assessed according to nurse's answers in an interview after the transfer situation.

Observed factors:

— physical work environment (temperature, draught, and lighting);

— other features of work environment (space, adjustability, floor and working shoes);

— availability and use of hoists and transfer aids;

— transfer distance and height;

— load on different body parts (back, trunk and limbs) during transfers;

— transfer skill and smoothness of transfer.

Interviewed factors:

— received guidance on manual handling;

— received guidance on usage of hoist and transfer aids;

— work arrangements (breaks and assistance);

— mental strain;

— subjective physical load of patient transfers;

— frequency of manual patient handling.

Every factor has three criteria and they all must be in order before the “in order” column can be marked. If criteria 1–2 are in order, the “partially in order” column is marked according to whether one or two criteria are in order. If no criteria are met, the section being assessed is “not in order”. A load index can be calculated on the basis of the results of observations and the interview. This index expresses the relative share of objects that are in order and the criteria that are partially in order in comparison to all the evaluations. The coefficient for factors that are partially in order is 0,67 if two criteria are in order. The coefficient is 0,33 if only one criterion is in order. The coefficient 0,33 is also used in responses for assessment objects 14 and 15 that are partially in order, because there is only one response option in the partially in order evaluation field for these factors. Factors that are not in order are not taken into account in the top line of the equation, but their number is included in the total number of evaluation objects.

There are a total of 15 objects for evaluation. If a patient hoist is used in the transfer, the total number of evaluation objects is 13 because objects 4, “Need for and use of non-mechanical transfer aids”, and 5, “Transfer distance and transfer height” are excluded from the index. The equation for calculating the index has been modified from the Finnish Institute of Occupational Health's method for evaluating workload (Laitinen et. al. 2000, Ketola & Laaksonlaita 2004). The information provided by the index figure of the load index is a guideline.

The load index is calculated according to the following equation:

$$\text{INDEX} = \frac{\text{No. of “in order” criteria} + (0{,}67 \times \text{no. with 2 criteria in order}) + (0{,}33 \times \text{no. with 1 criterion in order*})}{\text{No. of all factors}} \times 100\ \%$$

Interpreting the index:

Over 80 % If the index figure exceeds 80 %, the situation in terms of patient transfer ergonomics is good in the evaluated transfers. The evaluator and/or occupational healthcare representative provides instructions on maintaining and further improving the situation.
60–80 % If the index figure is 60–80 %, the load of patient transfers is relatively/quite high, and measures to correct the problems identified in the evaluation form should be taken at the workplace.
Under 60 % If the index figure is under 60 %, the employer must take immediate measures to improve ergonomic working methods. The development measures should utilize the input of employees, occupational healthcare, the occupational safety and health organization and possibly external experts.

A.3.4.2 Risk assessment

Assessment instructions:

a) Observe a typical patient transfer performed by the employee in which the patient requires assistance;

b) After each assessment object sub-criterion, record whether the sub-criterion in question is in order (x) or not (line);

c) On the basis of the sum of the sub-criteria in the vertical columns, use a tick to mark whether the matter is in order (3/3), partially in order (2/3 or 1/3) or not in order (0/3).

EXAMPLE of Risk Assessment

Observed transfer: _from bed to wheelchair_____ Workplace and workstation: __medical ward_____

Employee's profession: ____nurse_____ Gender of employee: F x M Age of employee: ___35_____

Date:_____/_____/_____ **Evaluator: _____T.R._____**

OBJECTS OF OBSERVATION	IN ORDER 3/3 criteria	PARTIALLY IN ORDER 2/3 or 1/3 criteria	NOT IN ORDER 0/3 criteria	NOTES
1. CONDITIONS IN THE WORK ENVIRONMENT Temperature _____, draft __x___, lighting _x____		X		temperature is too high in bathrooms
2. FEATURES OF WORK ENVIRONMENT AND WORKING SHOES Sufficient space____, adjustability_x__, suitability of floor and working shoes __x_		X		2 bathrooms have not sufficient space
3. NEED FOR AND USE OF PATIENT HOIST Equipment available_____, appropriateness_____, used correctly/not needed_____			X	no patient hoist available
4. NEED FOR AND USE OF NON-MECHANICAL TRANSFER AIDS Equipment available_____, appropriateness_____, used correctly/not needed_____			X	not enough non mechanical aids available
5. DISTANCE AND HEIGHT OF TRANSFER No steps_____, knee-elbow level__x__, no reaching_____		X		Nurse is stretching far and has to take some steps
6. LOAD ON UPPER LIMBS AND TRUNK Holding up__x__, elbows and shoulders_____, wrists and fingers_____		X		Lifting lasts only few seconds but shoulders are tensed and hands are gripping
7. LOAD ON LOWER BACK Flexion___x____, rotation_____, body control_____		X		The back has rotation and the movement is wrenching.
8. LOAD ON LOWER LIMBS Weight transfer and muscle force_____ knees-feet. alignment_____, no squatting/on knees__x____		X		No weight transfer is done and the knees and feet are not in line.
9. TRANSFER SKILLS AND TRANSFER SMOOTHNESS Guidance/facilitation_____, grip_____, transfer skills_____			X	No activation of patient and grips are preventing the patient's normal movement

INTERVIEW QUESTIONS FOR THE EMPLOYEE	IN ORDER	PARTIALLY IN ORDER	NOT IN ORDER	NOTES
10. GUIDANCE IN WORK POSTURES 1) Have you received orientation and guidance at this workplace regarding ergonomic work postures and movements? Yes (Y) No (N) x 2) Have you taken part in patient transfer training in the past two years? Y N x 3) Do you master good work postures during patient transfers? Y N x			x	No training received during last two years nor earlier
11. USE OF PATIENT TRANSFER EQUIPMENT AND GUIDANCE IN THEIR USE 1) Have you received guidance at this workplace in the use of helping devices? Y N x 2) Does the workplace have an agreed repair and maintenance practice for the equipment? Y x N 3) Do you know how to use all the helping devices in the ward/workplace? Y N x		x		The repair and maintenance practice for the equipment exists.
12. WORK ARRANGEMENTS 1) Are the work shift breaks carried out as planned? Y N x 2) Do you receive assistance in patient transfers on all shifts if necessary? Y N x 3) Can you stop work to take a short recovery break? Y x N		x		The planned breaks are difficult to keep and needed assistance is not always available.
13. MENTAL STRAIN OF PATIENT TRANSFERS 1) Are the transfer situations planned in advance? Y N x 2) Are the transfer situations mostly unhurried? Y x N 3) Is there more than one employee on all shifts? Y x N		x		
14) PHYSICAL LOAD OF PATIENT TRANSFERS In your opinion, are the patient transfers a) physically light or quite light, b) moderately heavy or quite heavy or c) very heavy?	a)	b)	c) x	

15. FREQUENCY OF MANUAL PATIENT TRANSFERS How many manual (over 15 kg assistance) patient transfers do you perform on average during a shift? a) < 6, b) 6–12, c) > 12	a)	b) X	c)	
TOTAL		3 7	5	

Instructions for calculating the index:
Add up the number of ticks in the 'in order' and 'partially in order' columns and then add up the total number of ticks in all the columns.
Place the responses for the 'in order' items in the equation. The number of 'partially in order' responses in the equation are multiplied by the standard value of 0.67 or 0.33, depending on whether two or one criteria are 'in order' Divide the resulting sum by the total number of responses and multiply by 100.

$$\text{INDEX} \quad \frac{0 + (0{,}67 \times 3) + (0{,}33 \times 7)}{15} \times 100 =$$

INDEX = 28,8 %

Conclusion

>80 %	**60–80 %**	**< 60 %**

In this example only one nurse has been observed and interviewed. It is advisable to evaluated altogether five nurses the same way. Overall risk is considered to be very high, when the index figure is 28,8 %. The employer must take immediate measures to improve ergonomic working conditions and methods. In this example case the unit should have a mechanical hoist available for those non-cooperating patients who do not bear weight and a stand aid lift for partially cooperating patients. Also sliding material should be available for non-cooperating patients. Education, training and follow-up checks are necessary to enable an adequate application of helping devices and optimized manual patient handling techniques.

A.3.5 Risk assessment based on TilThermometer analyses

The TilThermometer (=LiftThermometer) is an instrument to assess exposure for physical overload for carers/nurses who are carrying out basic care and assess compliance with *Guidelines for Practice* (see Annex C). Originally it was developed in an Excel format and is available for all care sectors. With the excel format, the results will be calculated automatically. Afterwards the results can be automatically aggregated from ward level to facility level or any larger scale. The one used in the analysis below, is especially developed for hospital care. All data left of the blue line has to be filled in, all outcome at the right side of the blue line follows automatically, as do the graphs.

The basic principles of the TilThermometer are 100 % correlated to *Guidelines for Practice* (see below and also Annex C). The TilThermometer in combination with the *BeleidsSpiegel* (=Policy Mirror) is used frequently in The Netherlands as an instrument for monitoring on ward, facility and national level. Both instruments are compulsory. Currently *Guidelines for Practice* have an official status and the Health and Safety Executive (HSE) inspects compliance with them with the use of the TilThermometer and the *BeleidsSpiegel*. (http://www.arbocatalogusvvt.nl)

On a national level these instruments are an essential part of the national monitoring progress in which every two to three years the results are collected per facility and aggregated to a national level and reported to social partners, that is unions and employer organizations. The instrument has been validated (Knibbe et. al., 1999, Knibbe et. al. 2006).

The TilThermometer has been further developed into the CareThermometer (Knibbe et. al. 2011).

1. Repositioning in bed

Repositioning in bed (up in bed, sideways, rolling, turning)	Mobility of the patient	Number of patients where this task is carried out	Number of patients where an electric height-adjustable bed is used	Number of patients where sliding/rolling material is used	% of patients with an electrical height-adjustable bed	% of patients transferred with sliding/rolling material	Care load
	Good	5					
	Limited	8	0	0	0 %	0 %	80 %
	No	12	0	0	0 %	0 %	

2. Lateral transfers

Lateral Transfers (Lying to Lying)	Mobility of patient	Number of patients where this task is carried out		Number of patients where sliding/rolling material or a lift is used		% of patients where sliding/rolling material or a lift is used	Care load
	Limited	0		0			
	No	3		0		0 %	12 %

3. Transfers from and to bed, (wheel) chair, toilet, etc.

Transfers from and to bed, (wheel) chair, toilet, etc. (Lying to sitting/sitting to sitting	Mobility of patient	Number of patients where this task is carried out		Number of patients where a lift is used		% of patients where a lift is used	Care load
	Limited	8		0		0 %	
	No	0		0			32 %

4. Static load

4a. Washing/showering sitting patient + care tasks	Duration of procedure	Number of patients where this task is carried out		Number of patients where a lift is used		% of patients where a lift is used	Care load
	1–4 min	0		0			
	> 4 min	0		0			0 %

4b. Washing/caring in bed	Duration of procedure	Number of patients where this task is carried out		Number of patients where an electric height-adjustable bed is used		% of patients where an electric height-adjustable bed is used	Care load
	1–4 min	8		0		0 %	
	> 4 min	12		0		0 %	80 %

4c. Washing/caring in lying position (also stoma care, incubator care, etc.)	Duration of procedure	Number of patients where this task is carried out		Number of patients where an electric height-adjustable bed is used		% of patients where an electric height-adjustable bed is used	Care load
	1–4 min	0		0		0 %	
	> 4 min	0		0		0 %	0 %

5. Use of compression (anti-embolism) stockings

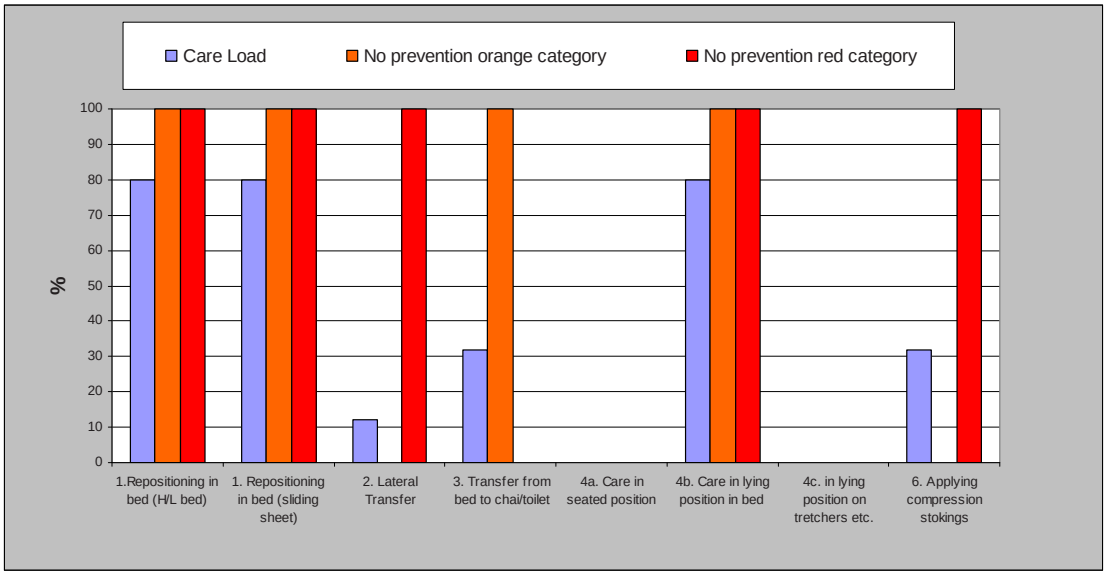
Putting on/of compression stockings		Number of patients where this task is carried out		Number of patients where an compression stocking applicator is used		% of patients where an electric height-adjustable bed is used	Care load
	Compression grade >2	8		0		0 %	32 %

6. Number of used aids and equipment

6a How many lifts are in use?	Active lift	0
	Passive lift	0
	Ceiling lift	0
6b How many sliding sheets, sliding rolls and roll boards are in use?		1
6c How many height-adjustable stretchers, care tables and chairs are in use?	H/l/ stretchers	1
	H/l care/incubator tables	0
	H/l/ chairs	0

A.3.5.1 Outcome

The outcome is provided in tables and in different graphs, automatically generated. Shown below is a summary of these graphs.



A.3.5.1.1 Care load

As can be seen in the above graph, the scenario unit has a high physical care load, also when compared to national Dutch statistics (reference data available, Knibbe et. al., 1999–2008). A large number of the patients need considerable or full assistance with a range of daily activities.

A.3.5.1.2 Prevention of medium and high risks

Presented below are the basic conclusions of the assessments as shown in the graphs above.

a) Although there are height-adjustable beds, the exposure according the TilThermometer and the Dutch Guidelines for Practice is high. Mechanically height-adjustable beds are often not used in a proper way, which is why The Netherlands' standard specifies a powered, electrically operated, height-adjustable bed for all patients who are repositioned in bed or cared for more than 1 min. Mechanical beds with hydraulic systems are not sufficient for compliance with the guidelines.

b) Another medium to high risk is due to the lack of availability of an active or passive lifter. All bed/chair transfers are carried out manually, also with the complete immobile and therefore passive patients.

c) No sliding sheets are available for repositioning in bed, causing also a high risk for physical overload. Lateral transfers are carried out with the use of rolling boards and a height-adjustable stretcher. In the Dutch Guidelines a roller board is considered to be an acceptable solution. In the meantime however research has been done that shows that if the patient is more than approx. 70 kg and the roller board is not a full body length version, also the use of a roller board can cause physical overload (Meijsen et. al. 2008). Furthermore nurses are often standing in bad postures, while carrying out these kinds of transfers.

d) All patients are washed in bed. An electrically powered high-low bed would provide an adequate solution, but there are no such beds on this ward. Therefore this is also considered unacceptable on this particular situation. Solutions could be the use of powered beds and/or a reduction of the static load by washing or showering on height-adjustable (shower) chairs or stretchers.

e) Since 12 of all patients (those who have to be fully lifted) are not transferred out of bed, it is assumed they have to be positioned on a bed pan several times a day. This in combination with the use of mechanically operated beds will also cause an extra risk for physical overload.

f) 32 % of the patients have compression stockings above grade 2. Getting these stockings on and off is, according to *Guidelines for Practice*, identified as a risk for physical overload of the finger and wrist joints. The use of a special applicator is needed for compression stocking removal. In this particular case these solution is necessary and the current situation on this ward is considered inadequate.

A.3.5.2 *BeleidsSpiegel*

In addition to the TilThermometer the *BeleidsSpiegel* will always be used to evaluate the weak and strong aspects of a physical load prevention policy. The *BeleidsSpiegel* is used on a facility level, is compulsory and the aggregated results are also used on a large scale to monitor the progress in The Netherlands on a national basis.

The *BeleidsSpiegel* gives insight for

— the need for a preventative policy for physical load,

— the quality of the existing policy, and

— the direction for improvements of the existing policy.

The Policy Mirror is a six-page checklist that is required to be filled in every year. It checks for any unfavourable policy issue in the facility and provides recommendations according to the national standards endorsed by unions, employers and Health and Safety Executives.

The scenario only briefly describes factors in policies that are not implemented; thus the *BeleidsSpiegel* can only be partially demonstrated. However, it seems that these are deficiencies in:

a) training and education: the standard is once every year and needs to be written down in the carer-nurse-competency-passport for training and education.

b) spatial and environmental problems.

Other main aspects monitored within the Policy Mirror are:

— mobility level of patients;

— risk assessment/evaluation done?;

— physical overload carers/nurses;

— physical overload other staff;

— presence of an active policy in place for care staff;

— presence of an active policy in place for other staff;

— presence of explicit standards and Guidelines for Practices in place to reduce dynamic and static overload for carers and other staff;

— identification of specific people responsible for implementing a policy for physical overload and existence of a platform;

— presence of official peer leaders per functional group/on ward level;

— conduct of regular meetings;

— scheduling of patient assessments to determine the mobility of the patient and the need for solutions;

— presence of a policy for specific situations, such as aggression, pregnant staff, 50+ staff, young staff, fall prevention, what to do after a fall, transferring bariatric patients, mortuary transfers;

— sufficient equipment;

— maintenance of equipment.

Annex B
(informative)

Organizational aspects of patient handling interventions

B.1 Introduction

Several published reviews of patient handling intervention literature identified a wide range of strategies to reduce the effects from patient handling risks (Hignett et. al., 2003, Amick et. al., 2006). The strategies can be categorised in three approaches of organizational, physical and personal interventions. As regards the physical approach, please refer to Annex C and for what concerns the person's approach to Annex E.

Annex B provides indications on interventions belonging to organizational category and falls within the broader “participative” strategy of risk management described elsewhere in this Technical Report.

Several intervention strategies can be identified within organizational interventions, more frequently in combination:

— risk assessment;

— work organization/practices change;

— feedback;

— group problem solving/team building;

— review and change of policies and procedures/safe systems of work;

— discussion of goals with clients (patient);

— change/introduce patient risk assessment system;

— introduction of hazard register;

— audit of working practices/risk assessments;

— Peer leader, back care advisor, ErgoCoach, local risk assessment facilitator or patient handling supervisor;

— management systems, change management, organizational structures;

— national regulation.

Interventions have been the focus of much of the research and development of patient handling methods and risk management. It is the transfer of theoretical and laboratory based studies that should carry most influence in the practitioner field, as they define the actions used to change the behaviours in the organization concerned. It has been seen in the UK and USA that more easily available general professional literature may have a stronger effect on current practice. Publications such as Nelson (ed) (2006), Smith (ed) (2005) and Charney and Hudson (ed)(2006) indicate that the more positive results of patient handling interventions are found with multi-factorial interventions which agrees with the scientific evidence.

Most strategies are considered to have an organizational level input as they are associated with the process of risk assessment and the delivery of appropriate patient handling solutions. National guidance (see also A.2)

can support the development of organizational solutions and appeared in two large studies funded and supported by a government body (Australia — Victorian Government, 2004; Netherlands — Knibbe and Knibbe, 2006). Other studies suggested that government guidance was being evaluated by the study, but the National Guidance was not described in the details (Collins et. al., 2004; Michaelis et. al., 2006; Yassi et. al., 2001; Chhokar et. al., 2005; Engst et. al., 2005).

Change strategies on a personal level comprise two approaches: firstly the very common approach of training and education (see Annex E) and the less frequently included occupational health services. There were no intervention studies published that only treated or managed injuries from manual patient handling as most services offer management for all MSD.

The overriding factor of the evidence collected is that most patient handling interventions are multi-factorial in structure. The efficient and effective implementation of these complex processes requires organizational leadership and control. It is the aim of this annex to indicate the organizational methods that can be used to improve the reduction of the risks from patient handling activities.

A second major factor to assist the implementation and effectiveness of patient handling interventions is the development of a positive safety culture. Safety culture shows good correlation with the processes for managing the effects of musculoskeletal injuries in healthcare organizations. Different methods can be used for developing, measuring and reinforcing the measureable levels of safety culture. The systems outlined in this annex all have a contribution to the promotion of a positive safety culture for patient handling risks. Specifically the creation of robust management structures, policies and procedures create positive organizational behaviour. The identification of financial and high level managerial commitment leads by example and facilitates a positive behaviour in all concerned. The provision of skilled and motivated personnel to deliver the expertise and facilitate changes in the workplace also adds to the positive culture. The final recommendation in the next section is the suitable provision of an occupational health service. If used appropriately occupational health supports injured workers through their injury to the point of successful return to work and develops the feeling of a caring organization which again supports positive patient handling culture.

B.2 Specific guidance for organizational systems

B.2.1 Management systems

Health and safety management guidance indicates that a clear line of responsibility and accountability needs to be identified to create a positive environment for change. These management structures in part should reflect the local legislation and the type of healthcare organization. The use of an ergonomics systems approach would identify both top down and bottom up solutions to ensure the effective implementation of patient handling risk management as shown by Hignett (2001). The provision of a suitable management structure to manage the patient handling risks is key. This structure should define the roles and responsibilities to ensure the appropriate control measures are in place to reduce the risks. The following areas are important and should be addressed when considering the management structures for a patient handling organization:

Senior management commitment: The organization should identify the position of patient handling risk management in the structure of the hierarchy. Whether this role lies within patient care, nursing provision or under the guidance of a wider role for health and safety or risk management recognition of the risks and a line of accountability should be seen up to board level in all healthcare organizations.

Local management commitment: Some healthcare organizations are large and single-person leadership of management systems is not suitable. In larger healthcare organizations the commitment to managing the risks of patient handling should be repeated at lower levels in the organization.

Specific resource to deliver patient handling guidance and solutions: The level of knowledge surrounding methods, equipment options and possible methods for moving patients has grown significantly over the recent past. The knowledge to deliver best practice in patient transfers and care tasks should be supplied in any organization. A range of different roles have been created in different countries and under different healthcare provision systems. The options for this role are discussed in section B.2.4.

Financial and equipment resources: The risk assessment process will identify a range of needs from equipment, training and environmental change. The management systems should support the provision of equipment and physical adaptation and have a structure in place for maintaining both the level of equipment and its suitability for purpose. As with the knowledge provision organization wide and local systems may be appropriate (see section B.2.3).

B.2.2 Policies and procedures

A strong system driver in many healthcare organizations is the provision of a policy. Many documented policies and procedures have been developed to assist an organization to develop its response to the problems of MSD from the manual handling of people. The use of policies and procedures help the organization to direct its resources and personnel to behave in a positive fashion to the potential problems. Studies have reported positive effects of the implementation of policies and procedures to assist with the implementation of best practices and the reduction of organizational losses (Passfield, 2003, Garg, 2006, Collins et. al., 2004, Yassi et. al., 2001)

The content for a safer patient handling policy can cover many different issues but should clearly represent the organization's strategy for reducing the potential losses from the risks of moving and handling patients. The following items can be included in the policy document (adapted from Collins, 2006).

— Aims and objectives for the organization in reducing the risks, e.g. injury reduction, improvement of patient care.

— A clear structure for risk assessment for patient handling activities (see Annex A). Patient handling risk assessment should be active at several levels in a complex healthcare organization. Each patient should be assessed for their own assistance level and specific requirements delivered to complete transferring and care needs. Each ward or department should also have a location based assessment to review the systems in place and ensure that all treatment possibilities can be provided without high or unacceptable risk.

— A system for the purchase and provision of suitable equipment, e.g. adjustable height beds, lifting equipment, sliding aids, repositioning equipment.

— A system for equipment cleaning, maintenance and storage.

— Roles and responsibilities for managers, staff, patients and other carers involved in patient handling tasks.

— The requirements and systems for delivering competence in the various levels of risk assessment and patient handling practice.

— Appropriate provision of occupational health service to monitor, treat and manage conditions created by the completion of patient handling tasks.

The provision of any policy within a healthcare organization will be nested within many other policies covering the wide range of governance requirements for quality assurance. It is expected that this policy document will be supported by a number of more specific procedural documents to give the people within the organization direct guidance to deliver best practices.

Procedures: The use of prescriptive systems or procedures can assist in organizational behaviour and will develop targets for organizational commitment. The development of integrated policies and procedures can also allow for the suitable development of clinical practice to include safety aspects of patient movement. These documents should to be sufficiently detailed to create a quick and accurate response for the reader and should include the local arrangements and practice. Successful procedures have been used to support the following.

— The most frequently seen procedural documents are to support the selection of a safe method to transfer a patient between locations (Fray et. al. 2001, Nelson et. al. 2003). Commonly, a series of options are offered or an algorithm is created to guide the suitable selection.

— Equipment maintenance schedules and procedures.

— Equipment storage and battery charging.

— Infection control procedures for equipment use.

— Specific guidance for the movement of high risk patients, e.g. bariatric patients.

— Specific guidance for the evacuation of patients in the case of emergency, e.g. fire.

— Procedures for audit or review of risk assessments, equipment provision, etc.

B.2.3 Financial commitment

As identified in the management systems section of this annex each organization needs to show that financial assistance is available to help implement the appropriate change or purchase equipment. The financial pressures on healthcare delivery suggest there is a requirement to be able to justify the cost benefit of these interventions to ensure continued support. There is growing evidence surrounding the costs and returns on patient handling interventions, with some studies showing reductions in staff absence figures (Evanoff et. al., 1999, Wood, 1987, Fujishiro et. al., 2005, Michaelis et. al., 2006, Engst et. al., 2005) while others directly report financial evaluation from absence claims (Passfield et. al., 2003, Chhokar et. al., 2005).

It is important to note that the most positive evaluation in staff absence and financial return is seen at the time of first system implementation and the longer term programmes see diminishing return year on year. For this and many other reasons it is important that each implementation not be subjected to financial evaluation alone. Other important outcomes and evaluation tools can be used to justify continued investment in safer handling strategies, i.e. patient care measures, staff comfort and satisfaction, improved treatment outcomes, etc. (see Annex F).

B.2.4 Provision of appropriate staff

When an organization decides on its organizational structure for managing the risks of patient handling there are many different functions that could be created to facilitate the process. Some of these successful methods outlined below utilize key individuals and others have a more disperse system of expertise. All these systems will need to be included within the management processes reported in the previous pages.

Staff to patient ratios: The staff numbers for any given care location have traditionally been calculated on patient health needs over the patient population. It should be noted that the development of safe systems for patient handling has an effect on the staffing ratios for measured nursing demand and also interacts with the competence and qualification levels of the staff in a given area. It is recommended that the numbers required for safe patient handling tasks be incorporated into the staffing ratio calculations.

Lifting (handling) teams: One specific system that has produced good results is the development of lifting teams (Charney 2003, Hefti et. al., 2003, Donaldson, 2000). This process removes many of the hazardous patient movement tasks from the wide body of nursing and care staff and introduces a highly skilled and physically competent group of specialist lifters. The processes for introducing lifting teams can be varied but the approach suggests that suitable numbers of lifters are available to improve the quality and speed of patient movement tasks and free care staff to deliver better care. The evidence from a range of studies (Haiduven, 2003) suggests clear reductions in the injury rates and the claims rates due to the reduction of exposure to staff. It is important in the implementation of these systems to assess and ensure improvements in patient care during this process.

Patient handling advisor: In some organizations, particularly in the UK, the central role of supporting, facilitating and delivering a patient handling strategy is the responsibility of a single individual recognized within the management structure. The UK model of patient handling advisor (PHA) or back care advisor (BCA) is supported by clearly defined roles and responsibilities and postgraduate training through UK universities (Ruszala,Hall, Alexander, 2010). Peer support is also delivered through a national group (NBE, www.nationalbackexchange.org.uk). The most successful implementation of this role is seen where the

individual develops a team to support the role, utilizing peer leaders, risk assessors, supervisors or patient handling trainers. Some direct responsibility is usually seen so that the individual has the ability to respond to the problems which are identified via the risk assessment process.

Peer safety leaders: Sometimes in conjunction with the above an alternative system is to create a series of location based assistants to the risk assessment and management process. The role of these individuals can fulfil a range of functions to ensure knowledge transfer into the organization as a whole, e.g. competency based training, mentorship, risk assessment and solutions for handling problems, brainstorming, etc. These providers of expertise at a local level are also supported by peer group feedback and education. Excellent examples have been developed e.g. Back Injury Resource Nurse (BIRN) (Nelson et. al., 2006), Ergo Ranger (Matz, 2006) and Ergo-coach (Knibbe and Knibbe 2006).

Occupational health management services: For an organization to be able to manage and evaluate the effects of patient handling risks and to reduce the effects of potential injuries on the organization as a whole it is essential to provide a suitable occupational health system. It is not the remit of this annex to describe a suitable service to the extent that it is written elsewhere but an organization should be able to support staff through the injury process and facilitate those individuals back to full time work.

B.2.5 Summary

The successful management of patient handling risks is essential in a healthcare organization. The provision of suitable risk assessment, analysis and risk reduction methods in the physical actions is only a part of the process. It is essential that management at all levels of an organization show commitment and structures that allow the appropriate human, time, financial and physical resources to be available to reduce the potential losses from patient handling tasks.

Annex C
(informative)

Aids and equipment

C.1 General

The use of appropriate aids and equipment for handling and moving patients with limited mobility is a fundamental part of a preventive policy to both reduce the risk of MSDs from the manual handling of patients and to increase the quality of care. The advantages derived from such practices are widely shown in the literature and in several guidelines used around the world and are applicable for all healthcare sectors. In principle the guidelines for usage and related ergonomic characteristics are the same for all healthcare segments. The lack of more than one caregiver and restricted space and environmental issues such as carpet or thresholds, can have its influence on ergonomic guidelines while using equipment in home care.

C.2 Definition of included aids and equipment

Since it is known that within a safe patient handling policy it is important to bring dynamic load, static load and pulling and pushing forces within safe limits, the most relevant products are listed in Table C.1, including a short description, intended use, benefits and limitations.

Within the above-mentioned aids and equipment, the ergonomic characteristics of the caregiver should also be defined. The ergonomic characteristics for the patient should be defined where the patient operates the aid/equipment him or herself. The ergonomic characteristics should be defined according the intended use, i.e. pushing a mobile lift over carpeting may, along with patient weight, have a huge impact on the pushing/pulling forces and if they are within acceptable limits. Also, the size of the caregiver and the patient should be defined, since this can influence the applicable ergonomic characteristics. Patient and caregiver populations can differ around the world and are too detailed to include in this general annex.

Also not included in Table C.1 are aspects relevant for the ergonomics of service engineers and cleaning staff. These aspects may also be seen as a concern of this annex and could be added to it in the future.

Maintenance of all mentioned aids and equipment in Table C.1 is a relevant issue regarding safe patient handling practices.

Table C.1 — Maintenance of aids and equipment

Aid/equipment	Activity	Feature	Benefit	Limitation
Medical bed	Care in bed	Electric height-adjustable	Reduction awkward postures Optimal independence for the mobile patients	Check lowest and highest level to avoid any limitation
	Care in bed	Mechanical height-adjustable	Reduction of awkward postures	In practice not adjusted frequent enough. No independency for patient
	Manual transfer in/out	Electric height-adjustable	Personalized height for optimal transfer. Optimal independence for the mobile patients	Check lowest and highest level to avoid any limitation
	Manual transfer in/out	Mechanical height-adjustable	Personalized height for optimal transfer	Check lowest and highest level to avoid any limitation. In practice not adjusted frequent enough No independency for patient
	Repositioning in bed	Two-section profiling	Half sitting position for patient	Patient slides downwards, risk for shear forces/pressure ulcers Creates frequent lifting up in bed
	Repositioning in bed	Three-section profiling	Half sitting position for patient	Same restrictions as two section, slightly better
	Repositioning in bed	Four-section profiling	Diversity in sitting positions. If used in a proper way, sliding downwards can be reduced to almost zero, which in itself reduces manual repositioning in bed. Less shear forces reduces risk of PU	Check position of the four sections to avoid any limitation
	Repositioning in bed	Mechanical adjustment of section(s)	Sitting position for patient	Heavy to operate if the patient is immobile. Risk of sliding downwards
	Repositioning in bed	Electric adjustment of section(s)	Sitting position for patient, diversity in sitting positions. Due to smooth movement and often the leg and back section moves at the same time to avoid any sliding downwards	Check position of the four sections to avoid any limitation
	Care/repositioning in bed	Side rail	Safety while caring and repositioning the patient. Options for the patient to actively support while repositioned	Check for risk of entrapment that a specialist has to advise about the use of the correct bedrail Check if there can be an obstacle to movement.

Table C.1 (*continued*)

Aid/equipment	Activity	Feature	Benefit	Limitation
	Manual transfer in/out	Side rail	Divided in two parts enables mobile patient to sit at the edge of the bed and to go in/out bed independently	Check for risk of entrapment
	Repositioning in bed	Hand grip	Options for the patient to actively support while repositioned	Check for optimal positioning and maximum load to avoid limitations
	Moving/manoeuvring	Weight and castors	Combination of the total weight and quality of castors determines the pushing and pulling forces while driving with the bed (including the patient?)	Manoeuvring a medical bed often above pushing/pulling limits Extra attention needed
	Moving/manoeuvring	Pivoting castors	Facilitates direction changes	Manoeuvring a medical bed often above pushing/pulling limits. Extra attention needed
	Stable positioning	Brakes	If placed at an easy to operate place no awkward postures needed to put breaks on/off	Check design on postures, risk for awkward postures
	Use of mobile aids	Free space under bed	A minimum of 15 cm is described in EN 1970 for adjustable beds to enable all lifts to go under the bed without limitations	If this 15 cm free space is not present at all places, use of mobile lifts is limited
Power drive device for medical beds	Attaching to bed	Easy fit with all beds	If designed correctly to be attached without any effort/awkward position	Check safety
	Moving/manoeuvring	Operating handles	Facilitates easy/effortless moving/manoeuvring with medical beds	Check safety

Table C.1 (*continued*)

Aid/equipment	Activity	Feature	Benefit	Limitation
Couch/Stretcher	Transport/treatment	Several design options	Depending on the task to provide at a stretcher/couch it is important to make the right choices to enable mobile patients to move on/of independently and to support those who are not mobile enough without physical overload If working longer periods of time height/height adjustability can enable the caregivers to stand in a healthy position most of the time	Check task, height (lowest/highest), adjustability of back rest, leg/arm rest, etc. Length of stay of patient at surface needs attention too (risk of PU for patients with a high risk factor)
	Moving/manoeuvring	Weight and castors	Combination of the total weight and quality of castors determines the pushing and pulling forces while driving with the couch/stretcher (including the patient?)	Manoeuvring a medical bed often above pushing/pulling limits Extra attention needed
	Moving/manoeuvring	Pivoting castors	Facilitates direction changes	Manoeuvring a stretcher/couch can be above pushing/pulling limits. Extra attention needed
	Stable positioning	Brakes	If placed at an easy to operate place no awkward postures needed to put breaks on/of	Check design on postures, risk for awkward postures
Sliding sheet	Repositioning in bed	Tube	Reduces pushing/pulling forces for the caregiver while repositioning the patient. Reduces shear forces for the patient, less risk of PU	Tube design can limit the distance to move. Check if the design has enough power reduction capacity (slipperiness)
	Repositioning in bed	Separated sliding sheets	Reduces pushing/pulling forces for the caregiver while repositioning the patient. Reduces shear forces for the patient, less risk of PU	Check if the design has enough power reduction capacity (slipperiness)
	Lateral transfer	Tube	Reduces pull/push forces for the caregivers while moving a patient from i.e. a bed to a trolley	Tube design can limit the distance to move. Check if the design has enough power reduction capacity (slipperiness)
	Lateral transfer	Separated sliding sheets	Reduces pull/push forces for the caregivers while moving a patient from, i.e. a bed to a trolley	Check if the design has enough power reduction capacity (slipperiness)
	Applying slings	Separated sliding sheets	Used if patient can't be log rolled or is to heavy to log roll, slings will be sided under the patient in between two layers of sliding sheets, which reduces awkward positions and heavy puling/pushing forces	Check if the design has enough power reduction capacity (slipperiness)

Table C.1 (*continued*)

Aid/equipment	Activity	Feature	Benefit	Limitation
Sliding Board	Lateral transfer	Solid surface	Reduces pull/push forces for the caregivers while moving a patient from, e.g. bed to trolley Can overcome a gap Also used in combination with sliding sheets	Check if the design has enough power reduction capacity (slipperiness)
	Lateral transfer	Rolling surface	Reduces pull/push forces for the caregivers while moving a patient from, e.g. bed to trolley Can overcome a gap	Check if the design has enough power reduction capacity
Horizontal air device	Lateral transfer	Single mattress	Reduces pull/push forces for the caregivers while moving a patient from i.e. a bed to a trolley. Can overcome a gap	Check if the design has enough power reduction capacity
	Lifting from floor	Multiple layer mattress	Enables caregivers to lift from the floor without exceeding ergonomic standards	Check if highest position is adequate for the task
Stand aid	Transfer sitting ↔ Sitting	Several design options	For the B-level of patients who are not (yet) stable enough to transfer from sit ↔ sit independently a safe and encouraging aid	Limited group of users
Mobile active lift	Lifting sitting ↔ Standing	Electric operated	Enables caregivers to lift a C-level patient safely During the transfers patients own activity can be encouraged Avoidable dwindling of mobility is secured	D- and E-level of mobility can't be lifted safely in this aid.
	Moving/manoeuvring	Weight and castors	Combination of the total weight and quality of castors determines the pushing and pulling forces while driving/manoeuvring the lift (including the patient?)	Manoeuvring a mobile lift can come above pushing/pulling limits Surface is of high influence Extra attention needed
	Stable positioning	Brakes	No unintentional movements	Check ease of operation
	Walking exercises	Walking option	Combination of lift and walking aid reduces the risk of dynamic overload while lifting and supporting the patient Frequent exercises at care ward increases functional mobility	Use restricted to well trained care givers

Table C.1 (*continued*)

Aid/equipment	Activity	Feature	Benefit	Limitation
Aid for early mobilization	Lying ↔ standing position	Electric operated	Enables early mobilization of critically ill/ventilated patients without physical overload for the caregivers Respiratory function and mobility improved to reduce time at mechanical ventilation	Use restricted to well trained care givers
Mobile passive lift	Lifting lying ↔ sitting	Electric operated	All transfers from lying to sitting position can be carried out without dynamic overload with a D- and E-level patient Shear forces are diminished, comfort for the patient is secured	While used for a C-level patient risk to not use patient's own abilities enough, which can dwindle functional mobility
	Lifting sitting ↔ sitting	Electric operated	All transfers from lying to sitting position can be carried out without dynamic overload with a D- and E-level patient Shear forces are diminished, comfort for the patient is secured	While used for a C-level patient risk to not use patient's own abilities enough, which can dwindle functional mobility
	Lifting lying ↔ lying	Stretcher frame	If a patient can't bend hip and knees a stretcher frame + sling supports a safe an hazardous transfer	Check weight limit of stretcher frame
	Repositioning in bed	Repositioning sling	For heavy patients use of lift + repositioning sling can reduce the overload while repositioning patient in bed	Be aware of unintended shear forces
	Lifting from floor	Electric operated	After a fall, or exercises at the floor the patient can be lifted without dynamic overload to another surface (sitting/lying)	Check if lowest position is reaching the floor for a flat lying patient
	Walking exercises	Walking device	Combination of lift and walking aid reduces the risk of dynamic overload while lifting and supporting the patient Frequent exercises at care ward increases functional mobility	Use restricted to well trained care givers
	Moving/manoeuvring	Weight and castors	Combination of the total weight and quality of castors determines the pushing and pulling forces while driving/manoeuvring the lift (including the patient?)	Manoeuvring a mobile lift can come above pushing/pulling limits. Surface is of high influence. Extra attention needed
	Stable positioning	Brakes	No unintentional movements	Check easiness of operation

Table C.1 (*continued*)

Aid/equipment	Activity	Feature	Benefit	Limitation
Ceiling lift/wall-mounted lift	All passive transfers	Several design options	Same options for transfers as with mobile passive lift with the advantage that pushing and pulling forces are reduced to a minimum of effort	Transfers only carried out under the track
	Lifting sitting ↔ standing	Active lift device	Enables caregivers to lift a C-level patient safely During transfers patient's own activity can be encouraged Avoidable dwindling of mobility is secured	Transfers only carried out under the track
	Walking exercises	Walking device	Combination of lift and walking aid reduces the risk of dynamic overload while lifting and supporting the patient Frequent exercises at care ward increase functional mobility	Use restricted to well trained care givers
Sling	Transfers/lifting	Inexhaustible number of design options	For all patients a suitable and comfortable sling is available or from a standard range or as a patient/task specific design Different materials cater different needs too, for lifting in a wet environment, leaving a sling under the patient during a longer period of time, etc.	Choosing the right sling solution needs adequate knowledge Applying the sling especially for severe handicapped or sensitive patients needs enough skills to provide quality of care and safe transfers A well-trained peer leader/ErgoCoach can provide in this need (see also Annex E)
Shower chair	Showering/washing	Fixed height mobile/wall mounted	Showering immobile patients from B to D level From ergonomic perspective only a good solution for independent patients (A- and B-level)	Awkward positions while washing feet and perinea; area, static overload in a high percentage of the time if patient needs support for hygiene tasks
	Showering/washing	Height-adjustable	Showering immobile patients from B to D level without too much time in an awkward position, reduced static overload	No option for dressing/undressing if patient can't be brought to a standing position Check the minimum and highest position
	Showering/washing/dressing/undressing	Multipurpose hygiene chair	Showering immobile patients from D- and E-level. without too much time in an awkward position; reduced static overload	Needs enough space in wet area to work in healthy postures Check the minimum and highest position
	Moving/manoeuvring	Weight and castors	Combination of the total weight and quality of castors determines the pushing and pulling forces while driving/manoeuvring the lift (including the patient?)	Manoeuvring a mobile lift can come above pushing/pulling limits Surface is of high influence Extra attention needed
	Stable positioning	Brakes	No unintentional movements	Check easiness of operation

Table C.1 (*continued*)

Aid/equipment	Activity	Feature	Benefit	Limitation
Shower trolley	Showering/washing	Fixed height	Showering immobile patients from D- and E-level. without too much time in an awkward position; reduced static overload	Not adjustable for individual caregiver height and easy lateral transfers
	Showering/washing	Hydraulic height-adjustable	Showering immobile patients from D- and E-level. without too much time in an awkward position; reduced static overload and adjustable for individual heights and easy lateral transfers	Check lowest and highest position Due to the hydraulic pump an irregular vertical movement
	Showering/washing	Electric height-adjustable	Showering immobile patients from D- and E-level without too much time in an awkward position; reduced static overload and adjustable for individual heights and easy lateral transfers Height frequently adjusted due to easy operation	Check lowest and highest position
	Moving/manoeuvring	Weight and castors	Combination of the total weight and quality of castors determines the pushing and pulling forces while driving/manoeuvring the lift (including the patient?)	Manoeuvring a mobile lift can come above pushing/pulling limits. Surface is of high influence Extra attention needed
	Stable positioning	Brakes	No unintentional movements	Check easiness of operation

Table C.1 (*continued*)

Aid/equipment	Activity	Feature	Benefit	Limitation
Grips and Handles	Support and safety	Inexhaustible number of design options	Well designed/placed at right height handles and grips are very supportive to keep the A- and B- level patient as mobile as possible, also provides safety in the wet area	Limited to the more mobile patients
Height-adjustable bath	Bathing	Height-adjustable	Provides patients with feeling of well being and relaxation. Adaptable in height for safe transfers and appropriate working height for the caregivers	Check lowest and highest position
Bath Lift	Bathing	Chair design	Safe and effortless transfer from bed to bath and back for A- to C-level of patients	Check compatibility with bath
	Bathing	Stretcher design	Safe and effortless transfer from bed to bath and back for D- and E-level of patients.	Check compatibility with bath, can the patient brought deep/reclined enough?
	Moving/manoeuvring	Weight and castors	Combination of the total weight and quality of castors determines the pushing and pulling forces while driving/manoeuvring the lift (including the patient?)	Manoeuvring a mobile lift can come above pushing/pulling limits. Surface is of high influence Extra attention needed
	Stable positioning	Brakes	No unintentional movements	Check easiness of operation
Wheelchair	Sitting/moving/transport	Inexhaustible number of design options	Comfort, safety and mobility of patient need to be addressed. Dimensions has to accommodate the patient body measurements to avoid sliding downwards, shear forces at skin and avoidable repositioning in chair	Expert task to advise right solution
Compression stocking applicator	Getting on/of compression stockings	Several design options	Avoids too high forces at the finger joints for compression stocking with a grade >2	Individual use

For all mobile equipment the maintenance and cleaning of castors is important to reduce risk for physical overload while moving/manoeuvring equipment. For safety reasons preventative maintenance is also important. Regulations differ per country. In the UK lift equipment has to be inspected by a trained person every six months and preventative maintenance carried out every 12 months. The Lifting Operations and Lifting Equipment Regulations (LOLER) [SI 1998 No. 2307] imposes detailed duties on employers since the 5th of December 1998. In the Netherlands inspection and preventative maintenance is described in the technical directive NTA 7506:2006 (Inspection and maintenance of hoists for the transfer of patients), an initiative of NEN, healthcare facilities and the industry. This technical directive was changed in 2010 in a normative document.

C.3 International Standards patient handling aids and equipment

For medical equipment there are applicable several standards (see References [1] to [22]).

In these standards there is not a strong focus on ergonomic design although future developments could include this more in detail. There are some initiatives in different countries (NL, Nordic countries) to cover ergonomic aspects for several aids and equipment.

Aspects taken in consideration: sound level, pushing/pulling forces of mobile equipment, height and diameter of pushing/pulling handles, minimal/maximum height of height-adjustable aids and equipment, forces to operate foot, hand and finger controls, intuitive use of aids and equipment, etc.

C.4 Selecting the correct aid/equipment

C.4.1 General principles for aid selection

The process for aid selection should consider some preliminary issues as follows:

a) organizational issues (i.e. caregivers' distribution over 24 h);

b) type of patients needing handling;

c) frequency of handlings collected by type (i.e. bed–wheelchair, etc.);

d) environments where equipment is used;

e) definition of basic ergonomic requirements.

Stimulating and maintaining the patient's mobility is an important objective in the care sector. This not only applies to the moments when patients receive help for their transfers but to negative changes with patients who do not presently need help. Even when a patient needs help or will be transferred with a lift, it is important to keep on stimulating his/her mobility (Knibbe, 2008). Even so, it is important to keep the safety/physical load for the caregivers within acceptable limits.

C.4.2 Specific procedure for aid selection

Different models are used throughout the world to select the right technique, number of carers and the need and selection of the right equipment with quality of care and safety of the carer as the basic principles.

In the US and Canada the Safe Patient Handling algorithms [Nelson, 2009] is the most common used instrument to select the above mentioned elements. Key assessment criteria are:

— ability of the patient to provide assistance;

— ability of the patient to bear weight;

— upper extremity strength of the patient;

— ability of the patient to cooperate and follow instructions;

— patient height and weight;

— specific physician orders or physical therapy recommendations.

In 25 algorithms, which function as decision trees, the right aid/equipment can be selected. Also the number of caregivers is defined to carry out a specific patient handling task in a safe manner.

In the UK, US and Australia different tools are used for the selection of the six mentioned items:

— REBA (Hignett 2000);

— FIM (Granger 1993);

— Resident Assessment Instrument (RAI);

— Mobility Gallery (Knibbe 2006).

A good overview of the different tools can be found in *The Guide to The Handling of People*, 5th edition (Smith 2005).

In Italy the MAPO instrument is widely used (Battevi et. al. 2006), this risk assessment instrument is also a useful tool for planning effective preventive actions, among which the choice of adequate equipment and the right number of equipment related to the mobility of the patients.

In The Netherlands *Guidelines for Practice* (Knibbe and Knibbe 2006) has been developed and endorsed by the inspection for occupational health. It is based on ergonomic standards and formulated in “care language”, stating the do's and don'ts for daily practice in healthcare. This system is based on three mobility levels. In the “TilThermometer” (Knibbe 2006) the same guidelines and mobility levels are used to monitor the exposure of physical overload of the different healthcare facilities/settings. In Table C.2 there is an example of *Guidelines for Practice* and the underlying standards.

Table C.2 — Example of the *Guidelines for Practice* and the underlying standards Source: *Guidelines for Practice* NL, Working package tackling physical load [Knibbe J.J. 2002]

Sources of physical loads	Stage 1 The standard	Stage 2 How can we make this clearer? Operational tools	Stage 3 Practical criterion	Stage 4 The requirement
Source 1: Repositioning within the limits of the bed and horizontal transfers 	Do not lift more than 23 kg under ideal conditions [NIOSH standard] Do not push/pull more than 15 kg per hand, or 25 kg with two hands [Mital] Do not pull more than 5 kg if the force is through the fingers [Mital].	DynaDisc Mobility Gallery	The patient/resident can move themselves in bed with some help	Minor aids (a trapeze, for example) and an electric height-adjustable bed must be used
			The patient/resident has little ability to help during the transfer	A roll or sliding sheet and an electric height-adjustable bed must be used
			The patient/resident is totally passive	An electric height-adjustable bed must be used in combination with sliding sheets A turning bed/mattress is a good option for changing a lying position too

Table C.2 (*continued*)

Sources of physical loads	Stage 1 The standard	Stage 2 How can we make this clearer? Operational tools	Stage 3 Practical criterion	Stage 4 The requirement
Source 2: Patient transfers to and from bed, chair/wheelchair or toilet 	Do not lift more than 23 kg under ideal conditions [NIOSH standard] Do not push/pull more than 15 kg per hand, or 25 kg with two hands. Do not pull more than 5 kg if the force is through the fingers [Mital]	DynaDisc Mobility Gallery	Patient/resident can stand up, stand and walk more or less independently, but is uncertain	Assistance from a carer is necessary, possibly with an aid such as a standing and walking frame or a turning disc
			Patient/resident cannot stand up or stand independently, has some body balance and can support themselves a little with their legs	An active lift must be used
			Patient/resident has insufficient body balance and cannot support themselves with their legs	A passive lift must be used This can be a ceiling-mounted system
Source 3: Putting on and taking off support stockings 	Do not pull more than 15 kg in a favourable posture Do not pull more than 5 kg in an unfavourable posture or if the force is through the fingers. *And see Source 4* [Mital]	StatMan	Patient/resident wears therapeutic elastic stockings of Class 2 or higher	An aid for putting on and taking off must be used
Source 4: Static loads (working in difficult postures) 	Not longer than 1 minute with the trunk rotated, or with the trunk bent and/or rotated more than 30° [Chaffin]	StatMan	Patient/resident is showered sitting down	A height-adjustable shower chair must be used
			Patient/resident is washed/cared for in bed	An electric height-adjustable bed must be used
			Patient/ resident is showered lying down	A height-adjustable shower stretcher must be used
			Patient's/resident's wounds are dressed for more than 1 minute	A height-adjustable aid (bed, shower chair/stretcher) is required preferably with, in the case of dressing leg wounds, a wound dressing stool
			Patient/ resident is bathed	A height-adjustable bath must be used
Source 5 Manoeuvring rolling equipment 	Not more than 20–25 kg (when getting it moving) [Mital]	The six Cart questions	One or more of the six questions is answered with 'No'	The items answered with 'No' must be changed, so that all questions can be answered with 'Yes', or the force must be demonstrably less than 20 kg (200 N), or the manoeuvre must be mechanized.

C.4.2.1 Operational tools

DynaDisc: Tool for determining how a patient can be assisted in a healthy way in performing all the day to day movements that he or she is no longer able to perform unaided.

StatMan: Tool for determining whether or not the loads occurring during working in particular positions are acceptable from an occupational health perspective.

Six Cart questions: Six Cart Questions (Knibbe J.J. *Tackling Physical Loads*, Work package. 2002) have been formulated to clarify whether an action falls within the limits of healthy and safe working. The answers to the six questions must be YES. If any of the questions is answered with NO, then conditions relating to that topic will have to be changed.

THE SIX CART QUESTIONS ARE:

	YES	NO
1. Does the object have good and smooth-running wheels?	☐	☐
2. Are the wheels at least 12 cm in diameter?	☐	☐
3. Is the total mass of the object less than 300 kg?	☐	☐
4. Can it be moved all the way over smooth, hard and level floors?	☐	☐
5. Are all humps along the entire route removed?	☐	☐
6. Does the object have handgrips or suitable places to push at a good (adjustable or self-chosen) height? (The correct height varies per individual, but is usually between 100 and 150 cm for pushing, and a little lower for pulling).	☐	☐

Within the *Mobility Gallery*, *Catalogue of aids and equipment* (Knibbe, 2003) and *Handbook of Transfers* (Knibbe, 2008) the *Guidelines for Practice* are translated into a five-level mobility classification tool (see Table C.3). This enables caregivers to justify the right choices in a very simple and easy to use tool.

Table C.3 — Five level mobility classification tool (Images from *The booklet about aids for caregivers*, LOCOmotion, 2006)

					
Mobility level	• Ambulatory, but may use a walking stick for support • Independent, can clean and dress himself • Usually no risk of dynamic or static overload • Stimulation of functional mobility is very important	• Can support herself to some degree and uses walking frame or similar • Dependent on carer in some situations • Usually no risk of dynamic overload. A risk of static overload can occur if not using proper aids • Stimulation of functional mobility is very important	• Is able to partially weight bear on at least one leg. Often sits in a wheelchair and has some trunk stability • Dependent on carer in many situations • A risk of dynamic and static overload when not using proper aids • Stimulation of functional mobility is very important	• Cannot stand and is not able to weight bear. Is able to sit if well supported. • Dependent on carer in most situations • A high risk of dynamic and static overload when not using proper aids • Stimulation of functional mobility is very important	• Might be almost completely bedridden, can sit out only in special chair • Always dependent on carer • A high risk of dynamic and static overload when not using proper aids • Stimulation of functional mobility is not a primary goal
Repositioning in bed	—	—	Height-adjustable profiling bed + sliding material	Height-adjustable profiling bed + sliding material	Height-adjustable profiling bed + sliding material
Lateral transfers	—	—	—	—	Sliding material or passive lift + stretcher frame
General transfers	—	Stand-aid (occasionally)	Active lift	Passive lift	Passive lift
Hygiene care while seated	—	Hi-lo hygiene chair	Hi-lo hygiene chair	Hi-lo hygiene chair	—
Showering in supine position	—	—	—	—	Hi-lo shower trolley
Bathing	—	Hi-lo bath	Hi-lo bath	Hi-lo bath	Hi-lo bath
Transfers to/from bath	—	Bath lift seat	Bath lift seat	Bath lift stretcher	Bath lift stretcher
Care on the bed or couch	Care time > 1 minute: Hi-lo bed or Hi-lo couch				
Compression stockings on/of	If > grade 2: Compression stocking applicator				

C.5 Number of aids and equipment

The number of aids and equipment per ward/facility is not described at many places. Of course this has a lot to do with daily practice, which can differ, i.e. per facility, per type of ward, per working practice, hygiene restrictions.

In this section we find some examples:

The MAPO Index (Battevi, 2006) calculates with the following numbers:

— one lift per 8 non-cooperating patients (NCs);

— one sliding sheet per ward;

— 2× transfer disc, roller or ergonomic belt;

— number of wheelchairs = 50 % of the disabled patients per ward.

In the Netherlands the following number is often used as an index for number of aids and equipment

— electric height-adjustable bed for all patients who need care on bed (mobility level C-E);

— active lift per 30 transfers (mobility level C);

— passive lift per 25 transfers (mobility level D-E);

— one lifting sling for all D and E-level patients;

— one sliding sheet for all C, D and E-level patient.

The Washington Safe Patient Handling law (Washington House Bill 1672, 2006) states that the hospital must take measures, among which acquisition of their choice of either one readily available lift per acute care unit on the same floor, one lift for every ten acute care inpatient beds, or lift equipment for use by specially trained lift teams.

C.6 Patient handling activity

Irrespective of which method is used to define the aid/equipment to be used, it is important for each patient to record the relevant patient handling activities, how it has to be carried out, with what kind of aids and equipment and with how many caregivers.

For those patients whose mobility is changing, this procedure should be repeated. Working with peer leaders, or “ErgoCoaches”, who are especially trained to do a professional risk assessment has shown very good results in reducing physical overload and ensuring quality of care.

C.7 Training

Training of proper use of aids and equipment is essential. See Annex E

C.8 Interface with building

Adequate space to use aids and equipment in a proper way is essential. In practice it is often observed that caregivers do not use equipment due to a lack of working space, or are working in bad postures due to restricted or confined spaces. See Annex D for more details.

Annex D
(informative)

Buildings and environment

D.1 Introduction

The environments where patients are manually handled may be a hazard if inadequate. All spaces where patients are manually handled should be considered in view of equipment use and correct working postures.

The risk assessment should be able to be used to identify all deficiencies of the spaces where patients are handled and identify any barriers of the surface over which the patient is moved (with or without assistive devices). Furthermore, the risk assessment can provide information for a selection of equipment (i.e. encumbrance) that is appropriate to the specific reality.

Slopes, ramps and steps increase the physical effort needed to walk or push or pull equipment, thereby increasing the workload on the musculoskeletal system and consequently, the risk of injury. The surface over which the equipment is moved should be suitable and be well maintained. Wet or contaminated surfaces can present particular hazards to the operator when applying forces.

This annex presents recommendations that specifically address the “free space” required for manual patient handling (incompressible space which cannot be encroached on by built/fixed elements). Other parts of this annex give room/space dimensions and are indicated as *task-based dimensions* in Table D.1.

D.2 Definition of included environments

In general the environments for manual patient handling are locations in purpose built or adapted buildings where healthcare services are provided by caregivers. This annex excludes home care environments and vehicles (e.g. ambulances). Typically the environment will include treatment, caring and hygiene activities.

This annex includes information from international recommendations for

- adult bed space (general medical/surgical ward),
- hygiene facilities, e.g. toilet/shower,
- intensive care units, including
  - adult/paediatric/neonatal, and
  - high dependency units,
- operating rooms,
- ambulatory procedure unit,
- elderly care,
- obstetric,
- emergency departments,

— diagnostic departments,

— bariatric facilities, and

— primary care (including community care, residential, nursing homes).

D.3 Adult bed space (general medical/surgical ward)

Four archival documents were retrieved to plot the recommended dimensions for bed space width (distance between bed centres) in single bedrooms and multi-bed bay cubicles (Table D.1). The documents were dated from 1866 to 2005. The Nuffield Provincial Hospitals Trust (1955)1 reported four dimensions, with the earliest being a recommendation from 1866 from the Poor Law Board (1866-1867) recommending that “6 feet (1,82m) was sufficient spacing for the ordinary sick”. The second was from the General Nursing Council of England and Wales in 1946 that advocated that “the distance between the bed centres should not be less than 10 ft. [3,05 m] as an absolute minimum”, and the third in 1951 from Medical Research Council with a memorandum on *The Control of Cross Infection in Hospitals* recommending only a minimum of 8 feet (2,43m) between bed centres. The fourth dimension is derived from research carried out by The Nuffield Provincial Hospitals Trust concluding that “to satisfy the needs of nursing a 4-foot square space between beds (that is, bed centres at 7 feet (2,13 m) is adequate” (1955: 13).

The Nuffield Provincial Hospitals Trust (1955) was the only historical document to provide empirical research to support its recommendations. They used work-study techniques and simple cinematographic data collection, to measure the space required for nursing activities using floor-marked grid lines at 12 inch intervals. The activities included bed making, pressure care, manual handling (bed-wheelchair and bed-trolley), giving an intravenous infusion, arranging an oxygen tent over the bed, and taking an X-ray from the front and side. The recommendation for bed space width has gradually increased over the last 50 years and there now five international publications recommending a minimum of 3,6 m bed space width for both a cubicle and a room (Reiling et. al., 2003; Villeneuve, 2004; NHS Estates, 2005; Hignett and Keen, 2005; AIA, 2006).

Table D.1 — Bed space dimensions from archival documents

Source	Bed space width m	Bed space length m	Bed space area m^2
Poor Law Board (1866)	1,82	—	—
General Nursing Council of England and Wales (1946)	3,05	—	—
Medical Research Council (1951)	2,43	—	—
The Nuffield Provincial Hospitals Trust (1955)	2,13	—	—
HBN 4 – Ward Units (1961)	2,4	2,9 (assumed)	6,96
HBN 40, Common Activity Spaces Vol. 1 – Example layouts; Common components (1986)	2,5	2,9	7,25
HBN 4 – Adult Acute Wards (1990)	2,5	2,9	7,25
HBN 40, Vol. 2 – Treatment Areas (1995)	2,7	2,9	7,83
HBN 04, Vol. 1 – In-patient Accommodation (cubicle) (1997)	2,9	2,9	8,41

Table D.1 (*continued*)

Source	Bed space width m	Bed space length m	Bed space area m^2
HBN 04, Vol. 1 – In-patient Accommodation (room) (1997)	—	—	13,5
Adler. Metric Handbook (cubicle) (1999)	2,9	2,5	7,25
Adler. Metric Handbook (room) (1999)	3,1	3,3	10,23
American Institute of Architects (cubicle) (2001)	2,9	3,2	9,28
American Institute of Architects (room) (2001)	2,9	3,75	10,88
HFN 30 – Infection Control in the Built Environment (cubicle) (2002)	3,6	2,9 (assumed)	10,44
WorkCover, Australia (cubicle) (2003)	2,6	3,5	9,1
WorkCover, Australia (room) (2003)	2,75	3,3	9,1
ACC, NZ (cubicle) (2003)	2,4	2,85	6,84
ACC, NZ (room) (2003)	2,9	3,5	10,15
Reiling et. al. USA (room) (2003)	3,8	4,7	17,86
Villeneuve, Canada (2004)	4,0	3,5	14,0
NHS Estates (cubicle) (2005)	3,6	3,1	11,16
NHS Estates (room) (2005)	3,6	3,7	13,32
Hignett & Keen (cubicle/room) (2005)	3,6[a]	4,7[a]	16,92[a]
American Institute of Architects (cubicle). Clear floor area exclusive of toilet rooms, closets, lockers, wardrobes, alcoves or vestibules (2006)	—	—	9,29
American Institute of Architects (room) (2006)	—	—	11,15
American Institute of Architects (including family space) (2006)	3,66	3,96	14,86
American Institute of Architects (family-centred room) (2006)			23,22
Hignett et. al. (2008)	3,18[a]	3,41[a]	10,84[a]
HBN 04-01 Adult in-patient facilities (room) (2008)	3,6	3,7	13,32

[a] Task-based dimension.

AIA recommends a minimum of 0,914 m between beds and at the foot of the bed.

In multi-bed rooms, a clearance of at least 1,22 m at the foot of each bed should be provided to allow passage of equipment and beds.

There are fewer data available for bed space length. The most recent publication from NHS Estates (2005) recommends allowing 4,185 m for the bed space length (including 0,15 m for bed head services) to accommodation resuscitation activities. This includes 1 m at head end for staff, 2,235 m bed length and 0,8 m at foot end for equipment to pass.

D.4 Hygiene facilities

D.4.1 Toilet/Shower

Guidance for hygiene facilities are shown in Table D.2.

NHS Estates recommends that a shower/toilet room (en-suite or shared) needs to be either 4,5 m^2 (NHS Estates, 2005) or 7,2 m^2 (NHS Estates, 1995). The latter is shown in diagrams using a wheelchair turning space (2,25m^2) for a skilled independent wheelchair user based on NHS Estates guidance (1995). For an assisted wheelchair user the recommended dimension rises to 3,61 m^2, resulting in a minimum room space dimension of 8,56 m^2 (single side transfer access). The spatial recommendation to include a turning circle is stated at 4 m^2 (NHS Estates, 1995a), if the turning requirements the turning requirements for a mobile hoist are also included this increases the minimum area to over 9 m^2.

Hignett and Evans (2006) looked at two layouts to include a wheelchair as part of the equipment rather than a walking frame. However if the rooms were designed for independent wheelchair users then additional space would be needed as a turning circle (2,25 m^2). Both room layouts used the shower (wet) area of the floor space for the wheelchair turning circle. This may not be acceptable practice with respect to infection control and management (NHS Estates, 2002) and may introduce a slip hazard from wet wheels. A recommendation from Australia (Victorian WorkCover Authority, 2004) shows a layout for an overhead gantry system with a planned wheelchair position facing the toilet (no turning circle). The patient would then be transferred in the hoist from the wheelchair to either the toilet or shower. These room areas were recommended to be between 4,62 m^2–5,17 m^2.

Table D.2 — Adult hygiene space recommendations

Source	Task	Width m	Length m	Area m^2
NHS Estates (1995)	Toilet/shower in en-suite or shared facilities.	—	—	4,5
NHS Estates (2005)	Toilet/shower in en-suite or shared facilities. Wheelchair use	—	—	7,2
	Toilet/shower in en-suite or shared facilities. Wheelchair use assisted	—	—	8,56
Hignett and Evans (2006)	Toilet/shower Needs + 2,25 m^2 additional for independent wheelchair user	—	—	6,5–6,8
Victorian WorkCover Authority (2004)	—	—	—	4,62–5,17
Villeneuve (2004)	Toilet	2,09	2,15	4,49
Hignett et. al. (2008)	Toilet/shower	2,52[a]	2,01[a]	5,04[a]

[a] Task-based dimension.

D.5 Intensive care units

D.5.1 Adults

The first intensive care units (ICUs) were built in the early to mid 1950s, with open wards and no partitions except curtains/screens. The second and third generation ICUs (1970s and 1980s) had individual rooms, moving from walled cubicles to folding/sliding doors with increased level of control. It is predicted that future ICUs will have individual rooms with increased privacy (Fontaine et. al., 2001). The challenge is to design a unit that facilitates the provision of care but also provides a low stress environment for the patient and their

family/significant others (Jastremski and Harvey, 1998; Novaes et. al., 1997). In the USA there have been recommendations to decrease patient transfers through the use of adaptable acuity design (Hamilton, 1999; Hendrich et. al., 2004; Garvey and Allison, 2004; Runy, 2004). This allows the patient to be accommodated in the same single room throughout their stay with the room adjusted for the requirements of care and treatment. The dimensions and configuration of the room include a patient area, family area (including recliner bed etc.), caregiver area and hygiene area (Jastremski and Harvey, 1998; Hamilton, 1999). The critical case bed space needs to have working space for staff, the appropriate clinical equipment and furniture, and movement space for both routine and emergency care (Hamilton, 1999).

There is a difference in the professional space recommendations in the USA and the UK. In the USA the recommended space envelope has increased from 13,94 m^2 (room, AIA, 1996) in 1996 to 16,72 m^2 (room/cubicle, AIA, 2001) in 2001 and 36 m^2 for the universal (acuity adaptable) room (Hendrich et. al., 2004). In the UK the recommended space has increased from 20,25 m^2 (cubicle, NHS Estates, 1992) in 1992 to 26 m^2 (room/cubicle, NHS Estates, 2003) in 2003. Guidance for adult intensive care unit facilities is shown in Table D.3.

Table D.3 — Intensive care unit bed space recommendation

Source	Width m	Length m	Area m^2
HBN 27: cubicle (1992)	—	—	20,25
Marans: room (1993)	—	—	12
Wedel et. al.: room (1995)	—	—	25
Wedel et. al.: cubicle (1995)	—	—	20
AIA:room (1996)	—	—	13,94
Koay: room (1998)	—	—	15,75
Intensive Care Society: room (1997)	—	—	25,5
Intensive Care Society: cubicle (1997)	—	—	20
HermanMiller for Healthcare: room (1999)	—	—	23,23
Hamilton: room (2001)	—	—	33
AIA: room/cubicle (2001)	—	—	16,72
Stichler:room (2001)	—	—	39,48
Gallant & Lanning: room (2001)	—	—	25,08
Held:cubicle (2003)	—	—	18
HBN 57: room/cubicle (2003)	—	—	26
Sponsler: room (2003)	—	—	37,16
Hendrich: room without family space (2004)	—	—	22,5
Hendrich: room (2004)	—	—	36
Takrouri: cubicle (2004)	—	—	30
Takrouri: room with storage (2004)	—	—	40
AIA Critical Care unit room/cubicle excludes storage, toilet etc. Clearance of 1,52 m (foot and transfer side); 1,22 m (non-transfer side); 2,44 m between beds (2006)	—	—	18,58
Hignett and Lu: room/cubicle (2008)	4,86[a]	4,71[a]	22,83[a]

[a] Task-based dimension.

D.5.2 High-dependency units

Guidance for high-dependency unit facilities is shown in Table D.4.

AIA recommends clearance of 1,22 m at sides and foot of bed, clear from fixed obstruction.

Table D.4 — High-dependency care room recommendations

Source	Task	Width m	Length m	Area m^2
AIA (2006)	Patient room (cubicle in multiple occupancy room)	—	—	11,5
	Patient room (single occupancy)	—	—	13,94

D.5.3 Neonatal units

Guidance for neonatal unit facilities is shown in Table D.5.

Table D.5 — Neonatal intensive care cot space recommendations

Recommendations	Area of cot space	
	Multiple occupancy (ward) m^2	Single room m^2
Hignett, Lu and Fray (2009)	13,5[a]	13,5[a]
US 7th Consensus Committee (2007)	11,2	14
DH Estates and Facilities (2007)	12	—
AIA clearance 1,22m each side (2006)	11,2 [b c]	—
BAPM (2004)	12 [d e]	—
Mathur (2004)	—	18,58
AIA (2001)	11,2	
4th US Consensus Committee (1999)	11,2	14
DH Estates and Facilities (1996)	4,625	12

[a] Task-based dimensions.

[b] Add hand washing stations, columns, and aisles.

[c] Add aisle adjacent to each space with a minimum width of 1,2 m.

[d] Add central walkway for equipment (e.g. X-ray, ultrasound) to pass without intruding on space allocated to another family.

[e] Add storage space.

D.6 Operating rooms

Guidance for operating room facilities is shown in Table D.6. Nuffield reported developments from 1937 – 1952.

Table D.6 — Operating room dimensions

Date	Hospital/activity	Width m	Length m	Area (m^2)/shape
Nuffield (1955)	1937 Lille	—	—	23,6/circular
	1947 St Lô	5,38	6,55	35,24/ovoid
	1946 Lausanne	4,95	7,87	38,96/shaped rectangle
	1952 US	6,3	4,75	29,93/rectangle
	1955 Nuffield	6,1	6,1	37,21/square
AIA (2006)	Operating and procedure rooms	—	—	37,16
	Phase 2 recovery (seated, lounge chair)	—	—	4,65 1,22 m clearance sides and foot
	Cardiac catheterization lab	—	—	37,16
James and Tatton-Brown (1986)	UK St Thomas'	2,4	30	7

D.7 Ambulatory procedure unit

Guidance for ambulatory procedure unit facilities is shown in Table D.7. This includes outpatient clinics, endoscopy, general surgery, neurosurgery, ophthalmology, podiatry, pain management.

Table D.7 — Patient handling tasks for ambulatory procedure units
[NB Kliment et. al. use AIA26 for recommendations]

Source	Example	Width m	Length m	Area m^2
Kliment (2000)	Preoperative examination room	≈ 3 (10 ft)	≈ 3,7 (12 ft)	—
	Postoperative recovery room	≈ 3 (10 ft)	≈ 3,7 (12 ft)	—
	Caesarean/delivery room	≈ 6 (20 ft)	≈ 6 (20 ft)	—
	Delivery room	≈ 5,5 (18 ft)	≈ 5,5 (18 ft)	—
	Traditional labour room (excluding toilet)	≈ 3 (10 ft)	≈ 4,6 (15 ft)	—
	LDR/P (labour delivery recovery postpartum rooms (includes toilet & storage)	≈ 5,5 (18 ft)	≈ 6 (20 ft)	—

D.8 Elderly care facility

Guidance for activities in accommodation for elderly persons is shown in Table D.8, presenting task-based activities rather than room dimensions.

Table D.8 — Patient handling tasks for elderly persons

Source	Task	Width m	Length m	Area m^2
ARJO (2006)	Bed to chair (manual)	3,3	3	9,9
	Bed to walking frame (manual)	3,1	3	9,3
	Bed to stand aid	3,2	3	9,6
	Bed to chair with sit-stand device	3,5	3	10,5
	Bed to chair with hoist	3,5	3	10,5
	Bed to chair with ceiling hoist	3,2	3	9,6
	Bed to bath trolley	3,3	3	9,9
	Bed to shower trolley	3,5	3	10,5
	Toilet to wheelchair (bilateral access)	2,2	2,2	4,84
	Toilet to wheelchair with stand aid	2	2	4
	Toilet with hoist	2	2,2	4,4
	Toilet with ceiling hoist	2	1,5	3
Villeneuve (2006)	Transfer in single room	3,8	3,2	12,16
	Transfer to toilet	2,09	2,15	4,49
	Transfer to bathroom	3,55	3,35	11,89
	Transfer to shower trolley	2,75	3,15	8,66

D.9 Other

D.9.1 Bariatric facilities

Guidance for activities in accommodation for bariatric persons is shown in Table D.9.

NOTE Bariatric facilities are related to or specialized in the care of obese persons.

Table D.9 — Bariatric dimensions

Source	Activity	Width (m)	Length (m)	Area (m^2)
ARJO (2006)	Bed	4,04	4,87	19,68
	Toilet/shower	3	2,7	8,1
Hignett et. al. (2008)	Bed to trolley	3,93	4,23	16,61
Villeneuve (2004)	Transfer in single room	3,5	4,4	15,4
	Transfer to toilet	2,15	2,39	5,14
	Transfer to bathroom	3,65	3,85	14,05
	Transfer to shower trolley	3,45	3,05	10,52

NOTE Useful information can be found in “Space requirements for obese patients/bariatric patients” (can be downloaded from www.fa.rm.dk.

D.9.2 Obstetric

Guidance for activities in accommodation for obstetric patients is shown in Table D.10.

Table D.10 — Obstetric dimensions

Source	Activity	Width (m)	Length (m)	Area (m^2)
AIA (2006)	Examination/treatment room (single)	—	—	11,15
	Examination/treatment room (cubicle)	—	—	7,43
	Labour room	—	—	11,15
	LDR/LDRP rooms, excluding alcove, closet, toilet, vestibule	3,96 min.	3,96 min.	27,87

D.9.3 Emergency Dept.

Guidance for activities in emergency departments is shown in Table D.11.

Table D.11 — Emergency room dimensions

Source	Activity	Width	Length	Area (m^2)
AIA (2006)	Examination/treatment room (single)	—	—	11,15
	Examination/treatment room (cubicle)	—	—	7,43
	Trauma/Cardiac for emergency procedure (including surgery) Clear floor space	—	—	23,23

D.9.4 Diagnostic Departments

Guidance for activities in diagnostic departments is shown in Table D.12.

Table D.12 — Diagnostic accommodation

Source	Activity	Width m	Length m	Area m^2
Kliment (2000)	Assessment Patient room (observing/nursing)	≈ 4,3 (12 ft)	≈ 5 (14 ft)	—
	Radiography room (X-ray)	≈ 6 (17 ft)	≈ 5,4 (15 ft)	—
	Radiography/fluoroscopy Special procedure room	≈ 7,1 (20 ft) 28 ft	≈ 5,7 (16 ft) ≈ 7,9 (22 ft)	—
	Chest X-ray room (no in-room processing) In-room processing	≈ 4,3 (12 ft) ≈ 5,7 (16 ft)	≈ 3,9 (11 ft) ≈ 5 (14 ft)	—
	Mammography	≈ 3,9 (11 ft)	≈ 5 (14 ft)	—
	Ct scanning room	≈ 5,7 (16 ft)	≈ 6,8 (19 ft)	—
	MRI scanning room (size varies with strength of magnet, dimensions given for mid-strength magnet)	≈ 7,1 (20 ft)	≈ 9,2 (26 ft)	—
	Nuclear medicine room	≈ 6,4 (18 ft)	≈ 5,7 (16 ft)	—
	ECG	≈ 3,6 (10 ft)	≈ 3,6 (10 ft)	—
	EECG	≈ 3,6 (10 ft)	≈ 5,4 (15 ft)	—
	Nuclear Scan	≈ 5,7 (16 ft)	≈ 7,1 (20 ft)	—
	Exercise stress test lab	≈ 4,3 (12 ft)	≈ 5,4 (15 ft)	—
	Holter monitoring room	≈ 2,9 (8 ft)	≈ 3,6 (10 ft)	—
	Pacemaker verification room	≈ 2,9 (8 ft)	≈ 3,6 (10 ft)	—
	Peripheral vascular lab	≈ 4,3 (12 ft	≈ 5,4 (15 ft)	—
	EEG	≈ 4,3 (12 ft)	≈ 5,4 (15 ft)	—
	Sleep lab	≈ 4,3 (12 ft)	≈ 5,4 (15 ft)	—

D.10 Primary care

Guidance for activities in primary care departments is shown in Table D.13.

Table D.13 — Primary care accommodation

Source	Room	Width	Length	Area m^2
Noble (1999)	Consulting/exam room, bilateral access	—	—	17
	Consulting/exam room, unilateral access	—	—	14–15
	Treatment room, bilateral access	—	—	17

D.11 Circulation space, clearance (corridors, access/egress, turnings)

Guidance for circulation spaces and clearance is shown in Table D.14.

Table D.14 — Circulation spaces, clearance (corridors, access/egress, turnings)

Source	Room	Width m	Length m	Area m^2
Adler (1999)	Access at foot end of examination couch for wheelchair movement	0,8	—	—
	Access at one side of couch for wheelchair patient changing	1,4	—	—
AIA (2006)	Clearance at foot of bed in multi-bed room	1,22	—	—
	Patient room door width	1,12	2,13 (high)	—
HBN (2008)	Minimum clear corridor width for circulation of beds/trolleys if passing spaces are provided	2,15	—	—
	Minimum clear corridor width for 2 beds to pass on regular basis	2,96	—	—
	Minimum clear corridor width for use of a sling hoist with legs closed	1,35	—	—

D.12 Flooring surfaces, elevators, stairs

Guidance for surfaces, elevators, stairs is shown in Table D.15 (includes situation when there is no obstacle for instance to enter the elevator).

Table D.15 — Flooring surfaces, elevators, stairs

Source	Type	Recommendations
AIA (2006)	Floor/wall/ceiling surfaces	Floor materials should be appropriate for the location, for example, easily cleanable; wear-resistant; non-slip; joint free. Wall finishes should be appropriate for the location, for example, washable; smooth; water-resistant; free from fissures, open joints, crevices; rodent harbouring spaces. Ceilings should be appropriate for the location, for example, cleanable with routine housekeeping equipment.
HTM61 (2008)	Floor	—
HBN (2008)	Elevators	Minimum elevator size of 1800 mm × 2 700 mm for movement of patients on beds. Clear opening door width of 1 370 mm.
HBN (2008)	Stairs	Risers: maximum recommended number between landings is 12–14. Recommended riser height for healthcare buildings is 150–170 mm. Minimum recommended length of step is 280–300 mm. Handrails should be provided on both sides.

D.13 Doors, grab handles, handrails

Guidance for doors, grab handles and handrails is shown in Table D.16.

Table D.16 — Doors, grab handles, handrails

Source	Type	Recommendations
AIA (2006)	Grab bars	See 8.2.2.9
HBN (2008)	Doors	Effective clear opening width For hoist access = 1 150 mm For bed turning 90° into room with four attendants = 1 550 mm, or 1 740 mm in heavily trafficked areas
	Handrails	Recommended cross-sectional diameter of 40-45 mm, with a clearance of 60–75 mm (to wall or adjacent surface). Height of 900–1 000 mm above the surface of a ramp

NOTE Provide an open door for moving the bed through the door.

D.14 Existing standards relating to building design

Existing standards relating to building design are shown in Table D.17.

Table D.17 — Existing standards relating to building design

Code	Title	Information
ISO 7176-5	*Wheelchairs — Part 5: Determination of dimensions, mass and manoeuvring space*	Turning diameter Required width of angled corridor Required doorway entry depth Required corridor width for side opening
BS 8300:2008	*Design of buildings and their approaches to meet the needs of disabled people — Code of practice*	—
BS 9999:2008	*Code of practice for fire safety in the design, management and use of buildings*	Examples of evacuation strategies
ISO 10535:2006	*Hoists for the transfer of disabled persons — Requirements and test methods*	Ergonomic factors — grips, handles and pedals Requirements of moving forces for mobile hoist with the max load on the hoist on float surface (for testing) a) starting 160 N b) driving (pushing/pulling) 85 N Ergonomic factors
BS 5724-2-38:1997 IEC 60601-2-38:1996	*Medical electrical equipment* *Medical electrical equipment — Part 2: Particular requirements for the safety of electrically operated hospital beds*	See Annex C

Annex E
(informative)

Staff education and training

Information, education and training are intended to promote behavioural and attitudinal changes amongst staff in order to achieve safer working practices, less physical exertion when handling patients and to improve the quality of care. Although it is recognized that training and education is required and indispensable, alone it will never replace properly designed workplaces. Reduction of the physical exertion/extortion solely by training caregivers to use proper body mechanics has not been shown by research (Nelson & Baptiste 2004; Amick et. al. 2006; Bos et. al. 2006, Martimo et. al. 2008).

E.1 Patient handling training should be part of the risk management system of the organization

A systematic review of patient handling has found that interventions based solely on technique training have had poor effect on working practices and injury rates (Hignett et. al. 2003). Health and safety management research shows the need for identifying responsibility and accountability in order to create a positive environment for change. The use of policies and procedures helps the organization to direct its resources and staff behaviour to render optimal results (see Annex B). In the safer handling policy the organization commits itself to actions to reduce risks to staff, e.g. the responsibilities of line managers and staff. The training programme/plan requires management commitment and strong support; therefore, it should be part of the safety management system of the organization. As such, a periodical assessment of education and training effectiveness is recommended. The training programme should include all persons who carry out patient handling in the organization and include the training of link persons (e.g. clinical educators) who provide a link between the clinical setting and any affiliated university or college. Research shows that implementation of a full policy is cost-effective but takes from two to four years (Knibbe et. al. 1999); thus a long term plan is needed.

E.2 Planning and organizing of training programme

To plan and organize a successful training programme the following should be considered.

— Appropriate training: this should incorporate management and include all levels of staff who perform patient handling activities. First, management should receive training in how to comply with the programme, to facilitate change and set standards. It is also important that a method of auditing be included, to ascertain whether the standards have been met.

— The provision of appropriate equipment (see Annex C): equipment should be available before training.

— Co-workers to implement good practice: the establishment of a role to support trainees to implement good practice has proved to be beneficial in several organizations, e.g. key worker/ergo-coach/peer leader. It is recommended that each unit have one to three key workers.

— Definition of the competencies of trainer, key worker and healthcare worker, e.g. in publications such as the following.

  — In the UK, the Royal College of Nursing-published *Safer staff, better care*, RCN manual handling training guidance and competencies (2003).

  — In Wales, *All Wales NHS Manual Handling Training and Passport Information Scheme* (2008).

- In Finland, *Ergonomic Patient Handling card-training*, introducing the competencies and training guidance (2009).

- In Ireland, the development of the standards is at an advanced stage of completion. The working group set up by the Health and Safety Authority (HSA) is to develop 1) standards for *Manual Handling Instructors and for People Handling Instructors* and 2) standards for *Manual Handling Operative Training and for People Handling Operative Training*.

- In the Netherlands an ErgoCoach passport is in use (Knibbe et. al., 2008). This is a passport for healthcare workers in general that sets the standards and makes it possible to check for competencies, find deficiencies and promote regular training. The tasks and responsibilities of ergocoaches are written down in a manual and monitored on a yearly basis (Knibbe et. al., 2006 e.v.). Skill training and the descriptions of techniques are specified in detail, step by step and agreed upon and published by the organization for nursing homes, care homes and home care and adapted on a regular basis (GoedGebruik series, Knibbe et. al., 2006-2009).

- In Australia, national standards and guidelines for manual handling have been published, e.g. *Manual Handling Competencies for Nurses*. WorkCover NSW. 1998.

- Patient handling requires knowledge, skills and attitudinal change hence the training program should include theoretical and hands-on practice.

- The time allocated to skills training should take into consideration the learning needs of staff. New and untrained staff should receive more comprehensive education. Sufficient time should be allocated for staff to take part in training.

- The content of training should be tailored to the needs of staff and patients and based on risk assessment and the required competencies. Thus there should be training needs analysis integrated into all aspects of patient care.

- All new staff requires comprehensive training. Thereafter, training is an on-going process, and review or refresher training is required at least every three years for staff remaining in the same workplace under the same working conditions. In some countries the training requirement is every year. Greater frequency of training will be required if staff change workplace or if the working environment, protocols, policies or equipment in the workplace change or when effectiveness of training highlights.

- Key workers need retraining and support, more so than other workers. Appropriate records and supervision of training should be maintained.

E.3 Core competencies of healthcare workers

Few countries have official national guidance or standards. Instead, many countries have national guidance given by experts or a professional body, e.g. physician, nursing. This document proposes the following core competencies for the trainee

- Knowledge of legal responsibilities, local policy and procedures.

- Understanding potential risk factors in patient handling activities. Compliance with procedures for identifying and assessing manual handling risks in the work unit. Willingness to improve safe work performance in the unit.

- Acquired basic knowledge of ergonomics, anatomy and biomechanics of the musculoskeletal system, causes of injury and musculoskeletal disorders. Understanding ergonomics as a means to create a safe work environment and safe patient handling.

- Ability to carry out risk assessment of patient's condition: dependency level, size, weight, weight-bearing ability, cognitive status and willingness to cooperate.

— Ability to select and use appropriate equipment safely; minimization and, when feasible, elimination of manual lifting of patients, knowledge of aids and lifters available.

— Knowledge and skills to apply principles of normal human movement to achieve safer patient handling and maximize patient independence as part of the quality of patient care.

— Knowledge and skills to apply safe, ergonomic handling principles, i.e. stable base, spine in line and loads close to the body. Ability to know how these principles can be applied in various handling situations.

— Ability to use verbal and tactile interaction to optimise the patient's own resources and encourage their independence.

— Willingness to maintain individual physical capability and to practice body awareness to be able to demonstrate good work practices.

— Capability to deal with unpredictable occurrences such as handling a person who has fallen.

— Ability to problem-solve and willingness to enhance this skill.

— Ability to document the patient's condition, chosen method to assist a patient and needed aids in the care plan.

The trainer will formulate the content of training to achieve the competencies and to meet the training requirements identified in the training needs analysis.

If not already provided, it is recommended that the indicated educational contents be included in the teaching programmes of caregiver schools.

E.4 Effectiveness of training

For the effectiveness of training see also Annex F.

— Managers/supervisors of the organization monitor compliance with patient handling policies and procedures.

— Patient handling risk assessments are in place and are implemented.

— Managers audit and monitor practice in the workplace and correct unsafe practices of staff.

— Managers of the organization monitor the outcomes and effectiveness of the training as an integral part of a risk management system.

— Managers check whether lifting equipment is being stored, serviced and used correctly (e.g. MAPO, *BeleidsSpiegel*).

— Performance is measured against agreed-upon standards; competencies (e.g. SOPMAS) or the work technique (e.g. DINO) are assessed.

— Accidents/incidents which result from patient handling activities are reported, the circumstances of the accident/incident are reviewed and appropriate steps taken to prevent a subsequent occurrence of a similar accident/incident.

Annex F
(informative)

Relevant information regarding the evaluation of intervention effectiveness

The systems used for the control of patient handling risks in healthcare organizations are described in Annex B. Whenever a management system has been created the final part of any intervention is to measure the effect or outcome. This annex presents two aspects of the measurement of outcomes and the collection of evidence. Measurement methods are given to identify how each of the different styles of intervention can be evaluated. A review of the different intervention types is then made so that a comparison can be made between the strategies.

F.1 Intervention types and evaluation methods

The information presented in this Technical Report suggests the different intervention strategies that can be used to control the risks of patient movement. These interventions are regularly introduced to an organization as a complex multi-faceted approach. To measure the outcomes of complex intervention strategies a comprehensive system will be required. This section reports a comprehensive review of outcome measurement (Fray 2010) and includes the variety of methods available.

Different stakeholders involved in MPH interventions can benefit from the process. Their level in the organization indicates whether immediate benefits, such as changes in posture and force or longer term organizational or health related benefits can be measured. Some outcomes cross categories, so more than one beneficiary could be identified from the same intervention and measured by the same outcome measure. An example of this would be reduced musculoskeletal injury rates that could be considered as both an individual staff outcome and an organizational outcome. An inclusive review of patient handling studies shows that most of the benefits fit into the following categories (Fray and Hignett 2007):

a) Organizational outcome measures specifically relate to the wider collective, rather than the individual at risk from the tasks being completed. These include costs of accidents or injuries, or legal actions against the hospital or body involved and efficiency.

b) Manual patient handling interventions have mainly focussed on preventing musculoskeletal injury in staff groups. Measures are many and mostly focus on the physical exposure of the individual to lifting, force and posture risks.

c) Patient outcomes for the measurement of a succesful patient handling task include any form of physical or subjective feedback created by the patient being moved. This category includes clinical outcomes such as wound care, rehabilitation or mobility level.

The creation of new and improved practices to assist patients to move has been driven by the numbers of injuries to healthcare workers and the subsequent legislation or guidance in some countries e.g. EC Manual Handling Directive (1990). The number of patient outcomes is low and has in part hindered the development of best practice, as the priority of hospital management is in improvements in patient care and the cost efficiency of services.

This Technical Report gives guidance to create an “ideal” MPH management system where

— organizational inputs include a suitable risk assessment system, policies and procedures to create positive safety culture, a participatory approach to implementation of solutions, and suitable personnel to implement and control the patient handling risks,

— engineering inputs should provide both equipment and environmental solutions for space and movement of patients, and suitable numbers of staff must be available, and

— personal behaviours should be assisted by training and any injury or health deficit should be assessed and treated by a suitable occupational health system.

If all or parts of these systems are implemented then it is important to evaluate the intervention appropriately. Many different methods for assessing MPH interventions have been suggested.

F.2 Evaluation methods

Studies concentrating on patient handling interventions identify many different aspects of performance, risk and outcome. The following discussion explores the methods used both for the analysis of the risks of patient handling and outcome measures for intervention studies. The tools reviewed in this discussion have different formats and measure different criteria. This discussion contains only outcome measurement systems that have been created and evaluated for the investigation of MPH interventions. They are divided into the following categories:

F.2.1 Organizational measures

The focus of MPH interventions is the reduction of MSDs in healthcare staff. Thus the measurement of injuries/accidents, discomfort, pain and the ensuing absence and financial losses are well reported in the literature. Nelson et. al. (2006) showed the use of a comprehensive multifaceted program reduced injury numbers, Engst et. al. (2005) showed that the implementation of ceiling track hoists reduced staff absence and injuries, Charney (1997) concluded that reducing exposure by the use of a lifting team would also be successful. However, as with occupational interventions in general and those in healthcare organizations in particular, the evidence that MSD are actually reduced by MPH interventions is not very convincing. A number of systematic studies (Amick et. al., 2006, Dawson et. al., 2007, and Martimo et. al., 2008) show that the level of confounding factors and the difficulties of measuring long term effects in healthcare organizations limit the use of work induced MSD as an outcome measure. This indicates that it may be more appropriate to measure the reduction of exposure to known risks post intervention rather than the level of MSDs.

F.2.1.1 Organizational/management structure audit tools

Health and safety management systems have been widely developed to assess compliance with management regulations. The Patient Handling Observation Question Set (PHOQS) tool, developed by Hignett and Crumpton (2005), and based on the RCN competencies (RCN, 2003), was the only audit tool found in the public domain specific to the organizational and management factors involved to managing the MSD risks of patient handling. The question set includes compliance statements and cumulative scores for: policies and procedures, risk management, patient handling assessment, and organizational culture. Other audit processes have been located within other patient handling guidance documents. The Derbyshire Inter-Agency Group Guidelines (Fray et. al., 1999), the All Wales NHS Manual Handling Training Passport and Information Scheme (NHS Wales, 2003) and the *BeleidsSpiegel* (Knibbe, 2006), all identify organizational requirements that can be evaluated as a measure of performance.

F.2.1.2 Financial models

The need for an intervention to be economically viable is important in all areas of musculoskeletal injury prevention. Many studies consider the costing process and the comparison of cost versus benefit, but few have been specifically constructed as tools for patient handling interventions. A general outline was created by Siddarthan et. al. (2005) using three scores for measuring the profitability based on US models of accounting.

F.2.1.3 Individual patient handling risk assessments and plans

For any healthcare worker, the risk assessment process is an evaluation of the identified hazards, and the development of a safe system of work, to allow patient transfers to be repeatedly completed with controlled risks to the carer. The risk factors for a transfer are mostly based on a) the transfer type and location, and b)

the presenting of the physical, psychological and behavioural condition of the patient to be assisted. Identified hazards can be recorded as either a list of factors (Fray et. al., 1999; RCN, 2001; Smith (Ed), 2005 and ACC Worksafe, 2003) or developed as a score matrix (Radovanovic and Alexandre, 2004). The development of a safe system of work (SSOW) is not included in all risk assessment tools. In particular, the scoring systems have had a tendency to stop at the quantification of risk, using these values as a measure of the exposure to risk for a staff cohort, in a given area, based on patient need. As practical work-based documents, assuming a healthy and skilled workforce, the consensus for most SSOW designed for the completion of each task include as essential information: the transfer type, the number of staff required to complete the transfer, the equipment and environmental changes, and a method statement as to how the task is completed.

F.2.1.4 Physical environment risk assessments

In addition to risk assessments for the handling risks associated with an individual patient or handling task, some tools have been designed to assess the potential hazards for an environment or location.

a) **Criteria-based assessments**

This type of assessment looks at the needs for a specific situation, task or location. The individual assessments can be collated to give a risk summary for a building or facility. The criteria can be set as a specific need, a piece of equipment or other issue. The risk evaluation process in these tools is to accept or reject the chosen task based on the environmental situation. Scoring mechanisms vary from simple yes/no compliance statements (Fray et. al., 1999) to more complex environmental assessments giving a more complex score and summary total, e.g. the Lite Workplace Profile (ACC Worksafe, 2003). Two other tools are used to assess the equipment need for a given care environment. The Hoist Identification Tool, developed by Smith et. al. (2005) and Quick Scan (Arjo Ab a, 2007) assess the lifting need in any given environment, based on the Functional Independence Measure (Granger et. al., 1993) and the number of staff teams available. Summarized is the number of passive and active hoists required.

b) **Residual risk scores/evaluations**

A more complex risk scoring system can be found in two tools looking at the needs of an organization and comparing these with the level of controls in place to give a residual risk score. Both the MAPO tool (Battevi et. al., 2000) and the CareThermometer (Knibbe, 2011) use measures of the patient group, the tasks completed, the equipment and environment. The Care Thermometer is a derivation of a Dutch model that has been used in a central government implementation and evaluation process (Knibbe and Knibbe, 2005).

F.2.2 Staff measures (healthcare workers)

F.2.2.1 Individual observational tools for specific handling tasks

A review of outcome measures from patient handling interventions found that many different methods were used to identify the risks to the care giver carrying out the handling task (Fray and Hignett, 2007). These include measures of physical position, force and repetition or exposure (Putz-Anderson, 1988).

a) **Postural analysis tools**

The effect of body mechanics and shape on the risk level can be measured by certain tools. Some studies have looked at the specific joint angle or physical measures but most measured the risk scores with established posture analysis tools. Two common tools were REBA (Hignett and McAtamney, 2000) and OWAS (Karhu et. al., 1977). These consider a range of body part positions and movements and compare them with known MSD risks to develop an ordinal risk level score ranging from high to low risk.

Raine (2001) developed the People Environment Risk tool (PER) specifically for patient handling tasks. This used a similar methodology to REBA and OWAS but added several points of reference relating to the neuro-muscular approach to efficient movement (Vasey and Crozier, 1982; Crozier and Cozens, 1998).

b) **Biomechanical assessment tools**

Biomechanical load has long been associated with musculoskeletal risk and many studies use these measures to evaluate the outcome of interventions (e.g. Schibye et. al., 2003). The risks were primarily related to the calculation of load, torque or compressive forces in the joints of the lower back, e.g. NIOSH (Waters et. al., 1993) or IfADo (Jäger et. al. 2001b, 2010). The calculation methods, the level of detail, and the accuracy all showed differences. The observation methods varied from video taping with freeze frame analysis, photographic methods, and simple distance measures for turning moments to high technology methods using electronic goniometry (Skotte, 2001) or the Lumbar Motion Monitor (Marras et. al., 1999) or CUELA (Ellegast and Kupfer, 2000). A comparison of such tools can be found in Russell et. al. (2007).

c) **Exposure measures**

Measures of exposure are not common. Simple scores of time and total number of repetitions are used as measures of risk exposure. Knibbe and Friele (1999) examined the use of self-completing logs to identify levels of risk as a fieldwork tool. This was in some ways similar to the self-reported exposure methods described by Yeung et. al. (2002) and Warming et. al. (2009). Another tool was developed and evaluated by Janowitz et. al. (2006) to measure the physical demands of the hospital environment, but this was not specific to patient-handling scenarios. Dempsey and Mathiassen (2006) suggest that the methods of quantifying risk based on a single load or task approach has lost its relevance in modern ergonomics, and cumulative day/shift models of exposure might be an improved method. For this review it is felt that the overall load on the workforce relative to the work demands of each individual care area may be a useful tool to measure the success of any patient handling intervention. The level of MSD in a high dependency care ward should be different to an area where patients are more self caring and mobile.

d) **Subjective appraisal measures**

Subjective feedback has been used as a source of information to support interventions. No specific tools were found to measure the intervention effects on the patients, but subjective measures of comfort, security and dignity were recorded. In addition, there were many subjective assessments of the staff response to the task: the Borg scales for the rate of perceived exertion (Borg, 1998), likert scales for comfort (Nelson et. al., 2006), and ease of use for equipment (Connelly et. al., 2001).

e) **Methodological observation tools**

Observational tools have been the subject of much research in the patient handling field. These tools are developed to assess the safety or competency of an individual operator in completing the observed task. Simple checklist criteria were suggested by Alovosius and Sulzer Azarof (1985), Feldstein et. al. (1990), Kjellberg (2000 and 1998), St Vincent et. al. (1989), Engels et. al. (1997) and Raine's PER (2001). Some question sets have been developed to give more detailed analysis: Pate (Kjellberg, 2000); DiNO (Johnsson et. al., 2004) and a video analysis tool (Warming et. al., 2004). These tools evaluate each observed transfer based on scores for the completion of the task. Using a different assessment criterion, the Finnish development of the SOPMAS tool (Tamminen-Peter, 2004) evaluates the competency and learning levels required for task completion. The SOPMAS tool has been specifically developed for patient handling and includes reference to body movement and facilitation of the patient.

F.2.3 Patient outcomes

The latest research demonstrates that using mechanical devices for patient rehabilitation is beneficial for patient outcomes. For example:

— using the beds functions for repositioning and turning of the patient shortens length of stay, enhances clinical and rehabilitation outcomes, prevents or shortens the treatment time of complications (i.e. pneumonia, blood clots etc.) in addition to reducing staff back injuries;

— using a standing device for mechanically ventilated patients with acute lung injury (ALI) has positive respiratory effects (Dueck, 2010);

— gait training using mechanical devices (lifts) for supported gait training is more likely to result in independent walking than traditional training without these devices;

— incorporating this knowledge in a training program might motivate the staff to use mechanical aids to a greater extent (Garg and Owen 1994, Owen, 1999, Kjellberg, 2004).

F.2.4 Summary

The variety of methods that have been used to evaluate MPH interventions shows the complexity of the process, the interactions between intervention and result and the range of possible effects in the workplace. Two issues make the comparison of intervention studies difficult:

a) the outcomes are regularly measured using different tools, qualities and quantities;

b) there is little agreement between what is acceptable best practice for organizational, physical and personnel levels of intervention.

These issues indicate that comparison between studies and against standards is not possible at the present time unless measured by the same methods.

F.3 Comparison of relative success

The second section of this evaluation of effectiveness examines the different intervention types and the measurement of outcomes in each area. This will suggest the most suitable method for assessing each type of intervention, examine the possibilities for comparison and suggest a model for how future patient handling systems could be measured in future interventions. The benefits of MPH interventions can be described by the tools and systems described above. The range of different measurements makes the comparison of the success of these interventions difficult to analyse. The most common aim of MPH interventions is to reduce the prevalence and effects of MSD in staff. Much of the published evidence however shows that this primary aim is not being met. The summary of several published reviews investigating patient handling interventions shows that it may be more prudent to measure the reduction of risk exposure than to try to show the reduction in MSD.

F.3.1 Organizational interventions

Interventions that create organizational systems to assist in the reduction of losses could be measured at a strategic level by the frequency, severity and costs associated with MSD. Given the relationship between the measure of safety culture and health and safety performance it is most likely that a positive outcome from these interventions could be identified by the compliance of an organization with the best practice outlined in Annex B. This would identify that the organization had suitable processes and personnel in place to create, manage and review the risks of patient handling and to ensure that the system was providing adequate control. The structure of this assessment tool will also need to include reference to local legislative implications (e.g. PHOQS Hignett and Crumpton, 2005).

F.3.2 Physical and engineering interventions

Any outcome measures that record the provision of equipment and/or environmental changes are not certain of measuring changes in behaviour and the reduction of exposure to risk. Physical interventions or changes in practice that redefine a specific handling task or transfer are most effectively evaluated by postural/biomechanical methods. However these measures cannot be translated to the reduction of workplace exposure without the additional measure of frequency and transfer load. The evidence presented here suggests that that only the collection of log book registrations over an extended period of time (Knibbe and Friele, 1999 and Warming et. al., 2009) combined with the postural/biomechanical loading would give an accurate record of the reduction of exposure.

F.3.3 Personal level interventions

Training, education and behaviour based interventions at the individual level require two components to show correct behaviour. Firstly there is a competence measure which proves the ability of the healthcare worker to use equipment appropriately, set the environment correctly, use suitable body mechanics and understand the needs of the patient being transferred (e.g. DiNO, Johnsson et. al., 2004, SOPMAS, Tamminen-Peter, 2004). Secondly there is a compliance measure which shows that the risk assessment rules and guidance agreed and implemented by the organization in question have been followed by the individual healthcare worker. These two components measure the individual level qualities of safety culture and safety performance. To allow comparison and the development of worldwide standards there would still need to be a range of intervention studies that measured the effects of the intervention changes with these methods. Only Fray and Hignett (2009) have created a tool that measures all the different aspects of these measures and scores cumulatively in a single metric. The Intervention Evaluation Tool collects a complex set of measures from a ward or treatment area and returns 12 individual section scores and an overall management performance score. Percentage performance scores are created for the following outcomes using a standard data collection method and scoring protocol based on the most suitable academically proven methods from the published literature. The 12 outcomes measured by this process are set out below.

1	Safety culture	Measure of organizational behaviour and how its management systems control patient handling risk: an audit of procedures rather than behaviours, e.g. policy, risk assessment, records of training etc. Should measure the support for the prevention programme both financially and organizationally.
2	MS health measures	Measurement of the level of MSD in the working population, injuries, chronic conditions, fitness for work, staff turnover, work capacity, etc.
3	Compliance/competence	Measures of the staff's individual behaviour to complete patient transfers, competence, skill, compliance with safe methods and equipment use.
4	Absence or staff health	Measures that record the time away from work or lost productivity due to MSD, days/shifts lost, staff on reduced work capacity, staff turnover.
5	Quality of care	When patients are moved, are all their requirements for dignity, respect, safety, empathy, being met?
6	Incidents and accidents	Recording of incidents, accidents or near misses from patient handling where staff could have been injured in a central location as a performance measure.
7	Mental stress and strain	Measurement of the staff's mental health status, measures of psychological stress, strain, job satisfaction, etc.
8	Patient condition	Does the patient handling method affect length of stay, treatment progression, level of independence?
9	Patient perception	The subjective assessment of a patient when being moved in transfers or mobility situations, fear, comfort, etc.
10	MSD exposure measures	Physical workload factors that place the staff under strain, forces, postures, frequency of tasks, workload measures.
11	Patient injuries	Records of incidents, accidents or injuries to patients when being assisted to move, bruises, lacerations, tissue damage, etc.
12	Financial	Financial impact of MSD on an organization, lost staff time, lost productivity costs, compensation claims, litigation, all direct and indirect costs against costs of any prevention programme

With further development and validation it may be that this process becomes the standard for evaluating all types of interventions in all types of healthcare organizations, as any type of intervention can be measured using the same scales and datasets.

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