
DATE: 5 July 2010

CONTEXT AND POLICY ISSUES:

Health care workers have a high prevalence of musculoskeletal injuries, and manual patient-handling tasks such as lifting, transferring, and repositioning are considered to be high-risk occupational activities. Mechanical-lifting devices and policies designed to limit or reduce manual patient handling have been promoted as methods of reducing the incidence of musculoskeletal injuries in health care workers.

There is uncertainty regarding the impact of patient-handling equipment, such as ceiling lifts, floor lifts, sit/stand lifts, and lateral transfer devices, on the health outcomes of health care workers and patients and on the economic burden of work-related injuries. This report will review the clinical effectiveness, cost-effectiveness, and evidence-based guidelines regarding the use of mechanical patient-handling equipment.

RESEARCH QUESTIONS:

1. What is the clinical effectiveness of patient lifts and transfer equipment for the prevention of injury?

2. What is the cost-effectiveness of patient lifts and transfer equipment for the prevention of injury?

3. What are the guidelines for the use of patient lifts and transfer equipment?

METHODS:

A limited literature search was conducted on key health technology assessment resources, including PubMed, OVID’s Medline, the Cochrane Library (Issue 5, 2010), University of York Centre for Reviews and Dissemination (CRD) databases, ECRI (Health Devices Gold),
EuroScan, international health technology agencies, and a focused Internet search. The search was limited to English language articles published between January 1, 2005 and June 4, 2010. Filters were applied to limit the retrieval to health technology assessments, systematic reviews, meta-analyses, randomized controlled trials, non-randomized studies, economic studies, and guidelines. Internet links are provided, where available.

HTIS reports are organized so that the higher quality evidence is presented first. Therefore, health technology assessment reports, systematic reviews, and meta-analyses are presented first. These are followed by randomized controlled trials, non-randomized studies, economic evaluations, and evidence-based guidelines.

SUMMARY OF FINDINGS:

One systematic review,6 ten non-randomized clinical studies,7-16 and six economic evaluations4,17-21 were identified in the literature search. Studies that reported information regarding the cost benefit of patient-handling interventions are presented as economic evaluations. These studies are based on primary injury claims data and, therefore, also contain useful information regarding the clinical effectiveness of patient-handling interventions. One non-randomized study13 was summarized in the included systematic review and, therefore, is not reviewed separately. The interventions evaluated in the clinical and economic studies differed with regard to the inclusion of policy changes: eight studies evaluated patient-handling equipment in combination with additional safe-handling policies;8,12-14,17,19-21 and eight studies did not specify additional policy interventions.4,7,9-11,15,16,18 Two studies focused only on mechanical devices used for lateral patient transfers.8,15 There were no health technology assessments or randomized controlled trials identified in the literature review. Guidelines from the Registered Nurses' Association of Ontario22 and a policy statement from the Australian Nursing Federation5 are also summarized.

Systematic reviews and meta-analyses

Amick et al (2006)6 conducted a systematic review to assess the impact of a range of interventions to prevent musculoskeletal injuries in health-care settings. A literature review was performed to identify randomized and non-randomized studies published up to March 2010. The literature search was comprehensive involving multiple databases. Randomized and non-randomized studies were included if they: (1) involved an intervention in a health-care setting; (2) were published or in press in a peer-reviewed journal; (3) reported musculoskeletal symptoms/disorders/injuries as an outcome; (4) had a control group or measurement; and (5) was published in English, French, Spanish, or Swedish. Patient-handling devices were one of many interventions that were captured in this systematic review, and only the patient-handling interventions that are relevant to this review are summarized (i.e., mechanical-lifting devices with or without policy changes).

Overall, the systematic review was conducted with a rigorous methodology involving duplicate study selection, quality assessment, and data extraction. Quality assessment of studies was performed using a rigorous 23-item questionnaire. The authors conducted full data extraction on studies that were assessed at a rating of medium-high or high quality and partial data extraction was performed on studies of lower quality. No data were pooled in the analysis and the authors did not present effect sizes, p-values, or confidence intervals when describing the results of
individual studies. The results are only described categorically as being a "positive effect", "no effect", or "negative effect".

Forty studies met the inclusion criteria for this review and nine of these involved mechanical patient-handling interventions. The authors classified the interventions as “multi-component patient handling” (MCPH) or “equipment and equipment training” (EET). Both intervention groups included the acquisition of patient-handling equipment and the training of personnel in their use; however, the MCPH intervention also included a change in patient-handling policy. Five non-randomized studies evaluated the effect MCPH interventions and three non-randomized studies evaluated the effect of an EET intervention. Specific results are summarized in Appendix 1. Three of the MCPH studies and one of the EET studies were assessed at a rating of medium-high quality.

With regard to the clinical effectiveness of MCPH interventions, the authors concluded that there was moderate evidence to suggest a positive effect on musculoskeletal outcomes. This was based on the findings of two of the medium-high quality studies which reported positive effects of the intervention on injury incidence, worker’s compensation rates, lost work days, restricted work days, and reduced low back and shoulder pain. The third medium-high quality MCPH study reported no effect of the intervention on the prevalence of back pain. One of the lower quality studies reported a positive effect for injury rates and modified duty days and no effect for lost work day rate. The other reported that there was no effect on musculoskeletal injury rates and a positive effect for lifting and handling musculoskeletal injury. Three studies limited the intervention to EET and did not involve a policy change. One medium-high quality study reported no effect of the EET intervention on musculoskeletal injury rates at 24 months. The lower quality studies differed with regard to injury rates with one reporting a positive effect and the other reporting no effect. The authors concluded that there is insufficient evidence to determine whether the EET interventions have an effect on musculoskeletal outcomes.

The primary limitation of this systematic review is the lack of an appropriate measure of the effect size for the interventions of interest. Limiting the results to a categorical description of whether the intervention had a positive, negative, or no effect on the outcomes of interest does not provide information regarding the magnitude and uncertainty of the results.

Non-randomized studies

Alamgir et al (2009) conducted a study to explore the relationship between ceiling lifts and patient-care quality in extended, acute, and complex care facilities. Data regarding the occurrence of facility-acquired pressure ulcers, falls, incontinence, and patient assaults on hospital staff were obtained from databases and compared with the availability of ceiling lifts in each facility. The availability of ceiling lifts was divided into low, intermediate, and high coverage. Ceiling-lift coverage and fiscal year were used in univariate and multivariate regression modeling to assess the association between ceiling lift coverage and the outcomes of interest. Patient perspectives were assessed qualitatively using semi-structured interviews at the complex care facility housing patients with severe disabilities (e.g., traumatic central nervous system injuries, multiple sclerosis, and cerebral palsy).

Twelve extended care facilities were included in the analysis and the authors reported that ceiling lift coverage in these facilities increased from 0.9 per 100 beds in 2002 to 14.9 and 23.3
per 100 beds in 2005 and 2006, respectively. Univariate analysis demonstrated a significantly lower risk of pressure ulcers in 2005 and 2006 relative to 2002 with respect to both time (i.e., fiscal year) and ceiling-lift coverage (both p < 0.05). When fiscal year and ceiling-lift coverage were combined in a multivariate analysis the association between pressure ulcers and these variables was no longer statistically significant. There were no significant associations between ceiling-lift coverage and the risk of patient falls, patient assaults on staff, urinary infections, and urinary incontinence in the extended care facilities. Seven acute care facilities were included in the analysis. The ceiling-lift coverage at these facilities increased from 36.2 per 100 beds in 2004 to 47.6 in 2005 and 51.6 in 2006. Univariate analysis demonstrated that the relative risk of patient falls was both significantly higher with increased ceiling-lift coverage and significantly decreased over time; however, these associations were not statistically significant in the multivariate analyses. The location of the falls was not controlled for in the analysis; therefore, the significant increase in the risk of patient falls should be interpreted with caution because the falls may have occurred in multiple areas of the hospital and may not have involved the lifts.

The investigators conducted interviews with patients at the complex care facility (n = 12) and reported that nine patients preferred ceiling lifts, two were indifferent, and one preferred floor lifts. The patients scored ceiling lifts the highest in terms of overall satisfaction (average of 8.5/10; n = 10) followed by floor lifts (average 7.3/10; n = 4). The key findings from these interviews were that all patients indicated that they felt safe, were not afraid of being moved with ceiling lifts, and that they perceived the ceiling lifts to be safer for the staff. Among the limitations of this study are the fact that the study involved multiple facilities which may differ with regard to their inventory and use of lifting devices. The authors also noted that the study lacked statistical power with regards to both the analysis of ceiling-lift coverage and the interviews with patients.

Martin et al (2009)12 conducted a large retrospective analysis of implementing a No Lifting Policy on back injuries claims across all public health agencies in the Australian state of Victoria (N = 92). The intervention was called the Victorian Nurses Back Injury Prevention Project (VNBIPP) and involved an investment of A$8.35 million over a six year period (1998-2004) with a goal of eliminating or minimizing manual patient handling. The primary principles of the policy were the provision of patient-handling aids and equipment, education in no-lifting principles and techniques, and the promotion of a cultural change in the workplace. Compensation data were obtained from the Victorian WorkCover Authority. A longitudinal analysis was based on the following three time periods: pre-implementation (Sept. 1993-Sept. 1998); initial-implementation (Dec. 1998- Dec. 2000); and ongoing (Mar. 2001-June 2003). The results demonstrated statistically significant reductions in the rate of claims during the initial-implementation and ongoing periods relative to the pre-implementation period. A secondary analysis was performed to compare the trends in the rate of back injury claims with those of other musculoskeletal injuries (i.e., elbow, wrist, knee, and ankle). The results demonstrated that there were no significant changes in the rates of these injuries over time indicating that the reduction in back injuries was not off set by increases in other injuries.

The authors concluded that their study demonstrates that the VNBIPP has reduced back injury claims by an estimated 23% for nurses. However, they recommended that the results be interpreted with caution and highlight important limitations such as the retrospective study design and overall incompleteness of the data set. Another key limitation was the inability to isolate injury claims that occurred in units that received the VNBIPP intervention from those that occurred in other units, possibly decreasing the effect size of the intervention.
Hinton et al (2009)\textsuperscript{11} conducted a retrospective analysis of the number of low back injury claims for nurses and physical therapists in an inpatient rehabilitation facility one year before and one year after the installation of a mechanical patient-lift system. The lift system was installed in all patient rooms (n = 100) and the rehabilitation therapy gym in 2005; therefore, the authors compared the number of injury claims in 2004 with those from 2006. There was no statistically significant difference in the number of low back injury claims by nurses (3/48 versus 2/54; p = 0.46) and there were no claims filed by the physical therapists in the entire three year period. The authors concluded that additional long-term studies are warranted. It was noted that the lifting devices did not extend into the bathing and toileting areas and the authors suggested that the lack of a difference in injury claims may be due to patient handling in these areas. Additional limitations include the lack of statistical power due to the low number of clinical events and the short duration of the observation period, and the absence of a formal description of the methodology for this study in the available publication.

Nelson et al (2008)\textsuperscript{14} conducted a retrospective study to evaluate the impact of a patient-handling program on the quality of patient care in six nursing homes (n = 211). The patient-handling intervention involved acquisition of equipment, a no-lift policy, ergonomic assessment protocols, and decision algorithms. The study consisted of a retrospective analysis of patient data from Resident Assessment Instruments that were completed on a quarterly basis. The study evaluated a wide range of patient quality measures including: cognition, depression or anxiety, physical functioning, continence, patient safety and adverse events, activity patterns, health care utilization, discharge potential, and participation in therapy. Multivariate linear regression was used to analyze the pre- and post-intervention data. The authors reported that there were no statistically significant differences for the majority of outcomes assessed; however, there was a statistically significant decrease in the number of patient falls (reduced from 11 to 3 events). The study design is limited due to the natural aging and deterioration of health status that would occur in nursing home residents, and the authors stated that a large number of patients died before post-intervention data could be collected (proportion was not reported). The authors also noted that the quality measures available in the Resident Assessment Instruments were limited by a lack of clinical benchmarks and that the study was inadequately powered to detect differences in rare adverse events (e.g., hip fractures). Furthermore, this study involved a large number of statistical comparisons and the methods do not indicate if an appropriate statistical adjustment was made.

Miller et al (2006)\textsuperscript{9} conducted an evaluation of portable ceiling lifts in a 63-bed long-term care facility (intervention group) using a pre- and post-intervention analysis of staff preferences and injuries incurred while handling patients. A second 100-bed long-term care facility (comparison group) without portable ceiling lifts was used as a control group. Both facilities had access to mechanical floor lifts but only the 63-bed facility received the portable ceiling lifts. Patients in both facilities had similar physical and cognitive dependencies as well as similar patient-handling requirements.

Thirty-two front-line health care staff in the intervention (n = 17) and comparison (n = 15) facilities completed both pre- and post-intervention questionnaires. The intervention group reported a statistically significant decrease in their perceived level of discomfort when using the ceiling lifts as opposed to performing the lift manually by themselves (p = 0.0001) or manually with a co-worker (p = 0.002). The participants in the intervention group also reported that they
perceived themselves to be at less risk of injuring their low back, neck, shoulder, and arms when using the ceiling lifts as opposed to performing manual patient handling alone or with a co-worker (all p < 0.05). There were no statistically significant differences between the perceived risk of injury with a ceiling lift in comparison with a floor lift. Relative to the comparison facility, the participants at intervention facility perceived their job to be less mentally demanding (p = 0.045) and felt that their co-workers helped them more (p = 0.031). The number of injury claims was measured at one-year intervals and a comparison was made between the number of claims before and after implementation of the ceiling lifts. The authors reported a decrease of one patient-handling injury at the intervention facility (70% reduction in injury claim costs) and an increase of six patient-handling injuries at the comparison facility (241% increase in injury claim costs). The authors concluded that the introduction of ceiling lifts into long-term care facilities had a positive effect on reducing patient-handling injuries.

The are several limitations with this study including a substantial number of participants who were either lost to follow-up or refused to participate. A total of 74 health care workers were identified as subjects in the study; however, only 32 completed both the pre- and post-intervention questionnaires. In addition, only seven patients at the intervention facility required patient handling with the ceiling lifts on a regular basis. The ability to draw conclusions from this study is limited due to the small number of health care workers who completed the questionnaires and the few patients who required the ceiling lifts. Furthermore, the comparison group experienced a large increase in the number of injury claims, despite no reported changes to their patient-handling procedures. This may be partially attributable to Hawthorne effect where the attention given to the patient-handling issue has altered the behaviour of the participants. Finally, the questionnaires were not supplemented with interviews which can be useful in verifying the results.

Engkvist et al (2006) conducted a cross-sectional study comparing the implementation of a No Lift System (NLS) (n = 201) at a hospital with two control hospitals (n = 256). A questionnaire consisting of 107 questions was used to assess the use of transfer equipment, the number of injuries, pain and symptoms, and work absences by nurses. Nurses at the NLS hospital indicated that they used transfer equipment more frequently than those at the control facilities (median response value “60% of transfers” versus “none or nearly none”). Nurses at both the NLS and control hospitals had a similar rating for their physical exertion on a typical day and their level of mental tiredness; however, nurses at the NLS hospital had a lower perceived level of physical tiredness in comparison with those at the control hospitals (p < 0.001). In comparison with the control hospitals, nurses at the NLS hospital reported less back pain (52% versus 71%; p < 0.001), less ongoing pain/symptoms from any body part (59% versus 69%; p = 0.02), and less ongoing back pain/symptoms (50% versus 61%; p = 0.02). Nurses at the NLS hospital also had significantly fewer work absences than those at the control facilities (p = 0.02). Injuries occurring in wards where the NLS had been in place for at least 12 months were less common than the control facilities for injuries in one or more body parts (24% versus 44%; p = 0.001) as well as back injuries (p = 0.004).

The authors of this study concluded that their findings support the use of a NLS; however, a longitudinal study would be required before drawing conclusions. There were statistically significant differences between the participants at the two hospitals with nurses at the NLS hospital being older (p < 0.001) and having worked longer in the nursing profession (p < 0.001).
Similar to the study by Miller et al (2006), the questionnaires were not supplemented with interviews which can be useful in verifying the results.

Silverwood et al (2006) conducted a pre- and post-intervention analysis following the installation of ceiling lifts in the intensive care unit of a hospital in British Columbia. There were seven ceiling lifts installed covering eight beds in the facility. The study consisted of a survey to assess levels of fatigue, pain, frustration, doctors’ visits, medication usage, and time off due to injury. In addition to the survey, a pre- and post-intervention assessment of Workers Compensation Board claims was performed. The authors reported a decrease in the number of doctors’ visits, medication usage, and time off due to injury at 18 months post-intervention; however, there were no statistical comparisons provided. One Workers Compensation Board claim was filed in the first post-intervention year, representing a 70% reduction in claim costs. The number of claims filed in the previous years was not reported making it difficult to draw conclusions from these findings. Overall, the findings should be interpreted with caution due to poorly reported results and methodology.

**Evaluations of lateral transfer devices**

Baptiste et al (2006) conducted a comparison of lateral transfer devices with traditional draw sheet methods in acute care units. Seven commercially available lateral transfer devices and the draw sheet were evaluated in the study with each technique being used for a period of two weeks. The devices used in the study were: the AIRPAL (AIRPAL Patient Transfer Systems); The HoverMatt (HoverTech International); the Slipp (Inventive Products Inc); the Flat Sheet Set (Phil-E-Slide Inc.); the Resident Transfer Assist (Hill-Rom); the Maxi Slide (Arjo Inc.); and the MaxiTrans (Arjo Inc.). Seventy-seven care givers participated in the study and completed a five-question survey following each patient transfer. The survey evaluated overall comfort, overall ease of use, effectiveness in reducing injuries, efficient use of caregiver’s time and patient safety. A total of 179 transfers were performed during the study. The draw sheet method was ranked seventh out of the eight devices with only the Maxi Trans receiving a worse overall rank. The overall rankings for the remaining devices were: AIRPAL (1); HoverMatt (2); Resident Transfer Assist (3); Maxi Slide (4); The Slipp (5); and Flat Sheet Set (6). Survey results also demonstrated statistically significant differences in perceived injury reduction favouring the AIRPAL, HoverMatt, The Slipp, Resident Transfer Assist, and the Maxi Slide over the draw sheet methods.

This study is limited by the short duration of use for each device (two weeks), small number of transfers performed with each device (range: 15-30), and extensive training requirements for participants (i.e., required to learn a new device every two weeks). The authors caution that the results of this study may not be generalizable outside of an acute care setting. Furthermore, their evaluation did not take into account issues such as infection control, cleaning, storage, and cost-effectiveness of the different transfer devices. Overall, the authors concluded that mechanical lateral transfer devices can decrease exertion, require less staff and time, and are preferred by patients. It was not reported if the acquisition of the mechanical transfer devices was accompanied by any policy changes within the facility. In addition to the small sample sizes for the patient reported outcomes and timing of transfers, it is unclear what procedure was used for obtaining these samples. This is particularly concerning given that the numbers of participants and measurements are disproportionate between the comparators. For example,
manual transfers were more than twice as common as mechanical transfers, but patient preference was recorded twice as often for the mechanical transfers.

Pellino et al (2006)\textsuperscript{15} conducted a prospective study to compare mechanical-transfer devices with manual-transfer techniques in a sample of health care workers transferring patients in the supine position. The study evaluated physical exertion felt in the health care worker’s shoulders, upper back, lower back, and whole body; the number of personnel and the time required to perform the transfer; and patient comfort and perceived safety during the transfer. The mechanical devices used were the HoverMatt, AirMatt, and AIRPAL. Ratings were obtained for a total of 192 transfers of which 60 used a mechanical device and 132 were performed manually (90 using a transfer board and 42 using a draw sheet). There was a statistically significant difference favouring the mechanical devices over the manual techniques for all measures of physical exertion. The mean transfer time for the mechanical devices was less than the manual techniques (10.3 versus 14.9 minutes; n = 32); however, the difference was not statistically significant. Fewer personnel were required when using the mechanical devices (2.88 versus 2.08; p < 0.05). Patients reported (n = 39) that they were more comfortable (p < 0.05) and felt more secure (p < 0.05) when transfers took place using the mechanical lifts.

**Economic evaluations**

Knoblauch et al (2010)\textsuperscript{20} reported the results of a pilot study where patient handling equipment was purchased for medical, surgical, bariatric, and critically-ill patient needs in an acute-care setting. Musculoskeletal injury data from three-years pre- and post-acquisition of the patient-handling equipment was compared. The authors reported that the facility’s cost for patient-handling injuries over the three years prior to the pilot study was US$230,000. During the pilot study there were no injuries incurred and no costs due to patient handling injuries. This paper did not include a description of methodology, participant characteristics, sample size, or information concerning the number or type of transfers which occurred. The equipment purchase was a component of a safe patient-handling program (details were not reported) which may increase the effect of the intervention.

Hunter et al (2010)\textsuperscript{17} compared the number and cost of injuries occurring at the Northwest Texas Healthcare System prior to and after the implementation of a minimal or no lift strategy. The strategy involved education of staff in addition to the acquisition of patient-handling equipment. Prior to the implementation of the no lift strategy, the direct cost of injuries was US$548,040 annually (20 injuries X US$27,402). They noted a steady decline in the number and cost of patient-handling injuries following the implementation and reported that only five injuries occurred in each of 2007 and 2008 with associated costs of US$1,628 and US$2,050, respectively. The authors noted that the hospital was recouping the total cost of the intervention (US$582,081) within approximately one year.

Chhokar et al (2005)\textsuperscript{18} analyzed injury reports for the three years before and after the acquisition of ceiling lifts and the implementation of a no-unsafe lift policy in an extend-care facility in British Columbia. In 1998, the facility purchased 65 ceiling lifts servicing 125 beds and three bathtubs. Staff were provided education on using the ceiling lifts. Claims that were filed and accepted by the Workers’ Compensation Board from 1995 to 2001 were separated into three periods: pre-intervention (1995-1997); 6 month intervention period (April-September 1998); and post intervention (1998-2001). Linear regression models were used to identify trends
The authors reported a statistically significant decrease in the number of post-intervention injury claims relative to the pre-intervention period for injuries incurred during “lifting/transferring” (p = 0.006) as well as the total number of claims (p = 0.006); however, there was no significant difference for repositioning injuries (p = 0.142). These trends were also reported for claim costs and days lost. The authors performed the cost-benefit analysis using two methods: 1) assuming the injury claims in the pre-intervention period were representative of the number of claims expected in the absence of the intervention; and 2) assuming that the rate of injury claims would continue to increase in the absence of the intervention. Under the assumption that the number of claims remained constant in the intervention phase, the total cost savings was estimated to be C$412,754 during the three post-intervention years. This increased to C$1,257,605 saved when the assumption is made that the rate of injury claims would have increased in the post-intervention phase. The initial cost of the intervention was C$344,323 which would be recovered in 2.5 years or 0.82 years depending on the assumed baseline rate of injury claims. The authors concluded that their study demonstrates the longer-term effectiveness of ceiling lifts in reducing the risk of injury during patient handling. The intervention observed in this study consisted of the acquisition of ceiling lifts as well as the implementation of a safe lifting policy. The safe lifting policy introduces a confounding variable making it difficult to speculate on the true effect of the ceiling lifts alone. The authors also noted that the rate of injury claims increased during the pre-intervention; however, they were unable to speculate on the reason given the retrospective study design.

Alamgir et al (2008) conducted a longitudinal study to evaluate the impact of ceiling lifts in three long-term care facilities in Vancouver, British Columbia. The authors assessed all direct-care staff claims over a ten year period that was divided into pre-intervention (1996-2001) and post-intervention (2002-2005) periods. Claim costs were adjusted to the 2005 Canadian dollar and the total cost of the intervention was $1,081,410. In comparison with the pre-intervention period, there was a statistically significant reduction in the relative risk for musculoskeletal injuries per bed (p < 0.0001) and in the number of working days lost per bed (p < 0.0001) during the post-intervention period. The cost-benefit analysis of direct costs resulted in a payback period of 6.18 years or 6.39 years, depending on whether the reference period was composed of data from the years 1996 to 2001 or only 2001, respectively. When indirect costs were included in the analysis the pay-back period ranged from 2.1 years to 3.2 years depending on the assumptions used in the analysis (i.e., the amount of indirect costs and the reference period). The authors concluded that their study suggests that overhead ceiling lifts reduce the risk of musculoskeletal injuries and that the economic savings outweigh the cost required for acquisition and training. However, they note several limitations including the inability to isolate the effect of ceiling lifts from the combined effect of ceiling lifts, staff education, and safe-lifting policies that occurred over the ten year observation period.

Engst et al (2005) conducted a prospective study to evaluate the impact of ceiling lifts on staff perceptions, injury claims, and overall cost benefit. Pre- and post-intervention questionnaires were used to assess the perceived risk of injury for staff, job satisfaction, and preferred resident-handling methods. The frequency and type of resident-handling injuries were assessed using incident report forms and claim costs. A cost-benefit analysis was performed based on the difference in injury claim costs between the pre- and post-intervention periods. Two 75-bed
extended care units located in the same hospital were evaluated using a quasi-experimental design. One unit received ceiling lifts (intervention) and the other did not (comparison) with patients randomly assigned to either unit. Characteristics of the staff and patients were similar between the two units. The intervention unit also implemented a “no-unsafe manual lift” policy to promote regular use of the ceiling lifts. A similar policy was not implemented in the comparison unit, although the staff had access to three mechanical floor lifts and one sit-stand lift.

Pre- and post-intervention questionnaires were completed by 34 staff in the intervention unit and 16 from the comparison unit. A majority of staff (71%) in the intervention unit indicated that they preferred ceiling lifts in the post-intervention survey. Staff in the intervention unit also indicated a significant decrease in their perceived risk of injuries to their neck, shoulders, upper back, lower back, and arms/hands when transferring or repositioning patients using a ceiling lift relative to other methods (all p < 0.001). Staff in both groups indicated significant improvements in job satisfaction. Compensation costs for injuries related to lifting and transferring decreased by 68% in the intervention unit and increased by 68% in the comparison unit. However, compensation claims related to repositioning patients increased by 54% in the intervention unit and decreased by 34% in the comparison unit. The authors were unable to speculate on potential reasons for the disparity in repositioning injury claims.

The authors reported that the total cost of the intervention was C$284,297 including purchasing and installation of the equipment and hiring a program coordinator. The direct savings were estimated to be C$9,835 for all resident handling and C$14,493 for lifting and transferring; therefore, they estimated the pay-back period to be 9.6 years for all resident-handling claims and 6.5 years for lifting and transferring claims. The intervention observed in this study consisted of the acquisition of ceiling lifts as well as the implementation of a safe-lifting policy. The change in lifting policy introduces a confounding variable making it difficult to speculate on the true effect of the ceiling lifts alone. The was a large variation between the units with regard to the number of staff who responded to the questionnaires (34 versus 16) and the authors did not report the number of staff who were eligible to complete this aspect of the study. The relatively short duration of the study makes it difficult to make conclusions regarding the longer-term impact of the intervention program.

Charney et al (2006)19 evaluated the impact of no-lifting policies in rural hospitals on patient-handling injury claims. The authors evaluated the number of claims that occurred before and after the implementation of the no-lift policy at 31 participating hospitals. The no-lift policy was comprehensive and obligated hospitals to replace manual lifting with mechanical lifting; purchase patient-assist devices (not specified); participate in training provided by safety officers; and initiate an educational program regarding patient-lifting equipment. The authors reported the following changes from 1999 to 2004: patient-handling injury claims decreased by 43% (from 3.88 to 2.33 per 100 full time employees [FTEs]); time lost frequency rates decreased by 50% (from 1.91 to 1.03 per 100 FTEs); health-care only claims decreased by 41% (from 1.97 to 1.2 per 100 FTEs); and the total incurred loss per claim decreased by 25% (from US$6,510 to US$4,992). The authors concluded that the no-lift policy reduced patient-handling injuries in the hospitals that participated in the program. There was variation between the no-lift policies implemented at the different hospitals including the amount and type of equipment available. However, it is unlikely that this would affect the generalizability of the findings and may be representative of the real-world situation.
Guidelines and recommendations

The Registered Nurses’ Association of Ontario (2005) has published evidence-based recommendations regarding the risk assessment and prevention of pressure ulcers. These recommendations were produced using a rigorous methodology, based on criteria of the Appraisal of Guidelines for Research and Evaluation (AGREE) instrument. The use of lifting devices is addressed in the section devoted to practice recommendations as a mechanism to reduce friction on the patients’ skin and/or wound:

- Use proper positioning, transferring, and turning techniques. Consult Occupational IV Therapy/Physiotherapy (OT/PT) regarding transfer and positioning techniques and devices to reduce friction and shear and to optimize client independence. (page 9; recommendation 3.2)

It was also recommended that lifting devices be used to avoid dragging individuals confined to beds during transfer and position changes (recommendation 3.7). The guideline states that the evidence for these two recommendations was obtained from expert committee reports or opinions and/or clinical experiences of respected authorities. They also recommend that slings, sleeves, or other components of the patient-handling devices should not be left underneath the individual after repositioning.

The Australian Nursing Federation (ANF) adopted a comprehensive No Lifting Policy in 1998 and it was reviewed in 2006. The ANF policy statement indicates that elements of their No Lifting Policy are based on the policy established by the Royal College of Nursing in the United Kingdom (1996). The evidence and process used to develop the policy is not reported in the ANF policy statement. The key elements of the policy include:

- That the manual lifting of patients is to be eliminated in all but exceptional or life-threatening situations. Patients are encouraged to assist in their own transfers and mechanical handling aids must be used whenever they can help reduce risk. Methods and handling aids to move or transfer patients must provide the highest level of protection to nurses, patients and others in accordance with the Occupational Health and Safety Act 2004.

Limitations

The one systematic review identified in the literature search did not provide an appropriate measure of the effect size and summarized all findings categorically as a positive, negative, or no effect. This approach excludes valuable information concerning the magnitude and precision of the effect estimates for the patient-handling interventions. Key limitations of the primary studies identified in this review were the absence of random allocation, retrospective study designs, and a lack of comparable control groups in studies using pre- and post-intervention analysis. Eight studies introduced the confounding factor of coupling patient-handling equipment with an additional safe-handling policy. This approach makes it difficult to speculate on the true effect of the patient-handling equipment. However, institutions likely implement these policies to help ensure that newly acquired patient-handling equipment is fully implemented into the routines of health care workers and may be reflective of real-world practice.

Many of the economic evaluations lacked a full description of their research methodology. These studies are also limited by a lack of robust clinical data as the inputs were derived from pre- and post-intervention analyses of retrospective data. Although all economic evaluations were favourable for the patient-handling interventions, there was inconsistency in the magnitude...
of results and the corresponding estimated pay-back periods (range: 0.8-6.4 years). This may be attributable to differences in the cost of patient-handling interventions as well as differences in the key assumptions used when calculating the return on investment.

CONCLUSIONS AND IMPLICATIONS FOR DECISION OR POLICY MAKING:

Evidence from non-randomized studies supports the clinical and cost-effectiveness of mechanical patient-handling devices (e.g., ceiling lifts) and the adoption of minimal lift policies for reducing musculoskeletal injuries in health care workers. The mechanical-lifting interventions were consistently positive with regard to reducing injuries sustained during patient-lifting activities; however, the impact of these devices on the prevention of injuries occurring as a result of repositioning patients was not statistically significant. Non-randomized studies also demonstrated that health care workers perceived mechanical lateral-transfer devices to be superior to manual-transfer techniques; however, these studies lacked an assessment of clinical endpoints and cost-effectiveness. Overall, studies from Canada, the United States, and Australia have shown patient-handling interventions to be an effective option for reducing the incidence of musculoskeletal injuries in health care workers. Furthermore, cost-benefit analyses have also been favourable and shown that initial investments in patient-handling interventions can be recovered relatively quickly in savings resulting from reduced injury claims. The identified guidelines recommend the use of lifting devices. Higher quality studies with well-defined methodology, particularly with regards to the policy changes that often accompany the acquisition of mechanical-lifting devices, are required to obtain more robust estimates of clinical and cost-effectiveness.

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APPENDIX 1: Summary of findings for MCPH and EET studies from Amick et al, 2006

<table>
<thead>
<tr>
<th>Author, year</th>
<th>Comparison</th>
<th>Effect of intervention</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Multi-component Patient Handling Intervention (MCPH)</strong></td>
<td></td>
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<tr>
<td>Collins, 2004&lt;sup&gt;23&lt;/sup&gt;</td>
<td>Intervention vs. Control</td>
<td>• Positive effect for resident handling injury incidence</td>
</tr>
<tr>
<td></td>
<td>Pre- vs. Post-intervention</td>
<td>• Positive effect for resident handling worker’s compensation rate, injury rate from employer records, lost work days rate and restricted work days rate</td>
</tr>
<tr>
<td>Smedley, 2003&lt;sup&gt;24&lt;/sup&gt;</td>
<td>Pre- vs. Post-intervention</td>
<td>• No effect of on back pain prevalence</td>
</tr>
<tr>
<td>Yassi, 2001&lt;sup&gt;25&lt;/sup&gt;</td>
<td>Safe-Lifting vs. Control</td>
<td>• Positive effect on low-back pain and shoulder pain (12 months)</td>
</tr>
<tr>
<td></td>
<td>No-lifting vs. Control</td>
<td>• No effect on low-back pain and shoulder pain (12 months)</td>
</tr>
<tr>
<td>Nelson, 2006&lt;sup&gt;30&lt;/sup&gt;</td>
<td>Pre- vs. Post-intervention</td>
<td>• Positive effect for injury rates and modified duty days</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• No effect for lost work days rate</td>
</tr>
<tr>
<td>Ronald, 2002&lt;sup&gt;26&lt;/sup&gt;</td>
<td>Pre- vs. Post-intervention</td>
<td>• No effect on musculoskeletal injury rates</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Positive effect for lifting and handling musculoskeletal injury rates</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• No effect for repositioning musculoskeletal injury rates</td>
</tr>
</tbody>
</table>

| **Equipment and Equipment Training Intervention (EET)** | | |
| Li, 2004<sup>27</sup> | Intervention vs. Control | • No effect on musculoskeletal injury rates (24 months) |
| | Pre- vs. Post-intervention | • Positive effect for musculoskeletal discomfort (1 month) |
| Evanoff, 2003<sup>28</sup> | Pre- vs. Post-intervention | • Positive effect for injury rates, lost work days, and total lost days |
| Tiesman, 2003<sup>29</sup> | Pre- vs. Post-intervention | • Positive effect for lost work days rate and restricted work days rate |
| | | • No effect for injury rate |