ELECTRONIC PAPER

Intervention strategies to reduce musculoskeletal injuries associated with handling patients: a systematic review

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Aims: To report, analyse, and discuss the results of a systematic review looking at intervention strategies to reduce the risk factors associated with patient handling activities.
Methods: A search strategy was devised to seek out research between 1960 and 2001. Inclusion/exclusion criteria limited the entry of papers into the review process. A checklist was selected and modified to include a wide range of study designs. Inter-rater reliability was established between six reviewers before the main review process commenced. Each paper was read by two reviewers and given a quality rating score, with any conflicts being resolved by a third reviewer. Papers were grouped by category: multifactor, single factor, and technique training based interventions.
Results: A total of 2796 papers were found, of which 880 were appraised. Sixty three papers relating to interventions are reported in this paper. The results are reported as summary statements with the associated evidence level (strong, moderate, limited, or poor).
Conclusion: There is strong evidence that interventions predominantly based on technique training have no impact on working practices or injury rates. Multifactor interventions, based on a risk assessment programme, are most likely to be successful in reducing risk factors related to patient handling activities. The seven most commonly used strategies are identified and it is suggested that these could be used to form the basis of a generic intervention programme, with additional local priorities identified through the risk assessment process. Health care providers should review their policies and procedures in light of these findings.

Patient handling activities have long been acknowledged as being a major contributor to the high incidence of musculoskeletal injury, in particular low back pain, in health care staff.[1] A range of intervention strategies have been used over the years to try and reduce this problem,[2] and professional bodies continue to produce guidance on patient handling.[3–7] These guidance publications have tended to promote technique training as the main factor of the intervention programme, although more recently risk management programmes are evident.

This paper summarises a section of the results of a systematic review on patient handling tasks, equipment, and interventions that sought to develop a foundation from which evidence based guidelines could be developed. The following research questions were addressed:

(1) Can research be found on patient handling tasks, equipment, and interventions?
(2) What are the results from the research?
(3) How do these results compare with the current guidance available?

Main messages

- An international systematic review found 63 papers relating to intervention strategies to reduce the risk of musculoskeletal injuries associated with patient handling.
- There is strong evidence that interventions for patient handling based on technique training have no impact on working practices or injury rates.
- Multifactor interventions, based on a risk assessment programme, are most likely to be successful in reducing risk factors associated with patient handling activities.
- Seven strategies are suggested for inclusion in a generic intervention programme.

The review produced evidence statements in a similar process to that undertaken by the Faculty of Occupational Medicine.[8] The revision and development of new guidelines is currently being considered by the Royal College of Nursing Advisory Panel for Back Pain.

This paper summarises and analyses the results relating to intervention strategies.

METHODS

The systematic review process is described in detail elsewhere.[9 10] A search strategy was developed with assistance from the Trent Institute for Health Services Research, University of Nottingham and the NHS Centre for Reviews and Dissemination of Information, University of York. This included the following main search terms (in appropriate combinations): patient, manual, handl*, lift, mov*, transfer, carr*, toilet, hospital bed, bath, nurs*, (body region) injuries, ergonomic*, equipment and supplies etc. The search string was run on: Medline (1960–2001), AMED, Psychinfo, Ergonomics Abstracts, EMBASE, CINAHL, British Nursing Index, and Best Evidence. Additional references were sought by hand searching journals and exploding the reference list of identified papers, contacting expert informants (dissertations and theses), and searching personal collections.

The review intentionally included both quantitative and qualitative data sources. All languages were included in the

Policy implications

- Health care providers should review their policies and procedures in light of this systematic review.
- Interventions predominantly based on technique training are unlikely to be successful in reducing musculoskeletal injuries, so an alternative strategy should be considered.

Table 1 Evidence levels

++++	Strong evidence: provided by multiple (three or more), high quality (QR ⩾75%) studies
+++	Moderate evidence: provided by generally consistent findings in fewer (two or more), smaller or lower quality (QR = 50–74%) studies
++	Limited or contradictory evidence: provided by one study (QR ⩾50%), or findings in multiple (two or more) lower quality (QR = 25–49%) studies
+	Poor or no evidence: no studies or low quality score (QR ⩽24%)

search which resulted in 30 papers being translated from Chinese, Danish, Dutch, French, German, Italian, Japanese, Norwegian, Portuguese, Slovakian, and Spanish.

The data extraction/critical appraisal tool used was developed by Downs and Black[10] for randomised and non-randomised studies of health care interventions. This has four sections:

(1) General structure of paper to include 10 questions about the aims, sampling, method (description of intervention), outcome measures, confounders, findings, analysis, and discussion of adverse events.

(2) External validity is appraised using three questions about the representativeness of the sample and context of the study.

(3) Internal validity (bias) includes seven questions to look at blinding of subjects/data collectors, compliance with the intervention, choice of outcome measures, and statistical tests.

(4) Internal validity (confounding, selection bias) has six questions looking at the sampling strategy with respect to diversity within the recruitment population and chronology of the study. This section also addresses issues about the allocation to control/experimental groups and subject follow up.

This appraisal tool was further extended and modified to include observational studies without an intervention (cohort studies, case-control studies, cross sectional studies, surveys, and case series) and an additional section for qualitative studies. Before the review process started an inter-reliability study was carried out with the six reviewers. This resulted in an overall intra-class correlation (pairwise) of 0.95.[11]

Each paper was sent to two reviewers following a screening process to ensure that reviewers did not receive their own publications. If the difference in the quality rating scores exceeded an established limit the paper was sent to a third reviewer for conflict resolution. Owing to the heterogeneity of the study types, interventions, settings, participants, outcome measures, and comparison groups a quantitative analysis (meta-analysis) was not appropriate.

The data were synthesised in two stages. The first involved grouping papers into tasks, equipment, and interventions, with some papers being allocated to more than one section. The second stage involved combining the papers to produce summary statements and then allocating evidence levels. The evidence levels (table 1) were developed using concepts from Bernard[12] and the Faculty of Occupational Medicine.[8]

A total of 2796 papers were located. These were then checked to eliminate duplications (from the different search strategies) and papers which were inappropriate to the research topic based on their title (for example, working postures of dentists). The remaining 880 papers were included, and sent to the project team for review. Subsequent eliminations were based on the following inclusion/exclusion criteria, whereby a paper or document was:

(1) Included if it described a named task, piece(s) of equipment, or intervention relating directly to patient handling.

(2) Included as a professional opinion if it:

- had references
- critically appraised the literature
- provided a new interpretation of the literature.

(3) Excluded if it was related to epidemiology of musculoskeletal disorders (usually low back pain) and did not meet criterion (1) for the study.

(4) Excluded if it was not the primary source of a study. The primary source was sought and included.

(5) Excluded if it was a legal case law report.

A total of 225 papers were included in the full project review,[9] with the 63 papers relating to intervention strategies being reported in this paper.

RESULTS

The findings of the 63 papers (table 2) have been grouped into three categories for the summary evidence statements.

(1) Multifactor interventions.

(2) Single factor interventions.

(3) Technique training based interventions.

Any conflicting and negative evidence has been included in the evidence statement for categories (1) and (2). Category (3) is subdivided into three further subgroupings to present negative, mixed, and positive evidence.

Multifactor interventions

A decision was taken to present the data in this category as two groups to look at the role of risk assessment as part of an intervention strategy. This will be reviewed in the discussion.

+++ The evidence statement that *multifactor interventions based on risk assessment are successful* is supported at a moderate level by 10 studies,[13–22] and at a limited level with an additional four studies.[23–26]

+++ The evidence statement that *multifactor interventions (not based on risk assessment) can show improvements* is supported with moderate evidence from four studies.[27–30] Additional limited evidence is available from five studies.[31–35] However, there is also contradictory evidence from one high quality study[36] which found no improvement using a multifactor intervention.

Single factor interventions

+++ The evidence statement that *single factor interventions based on the provision of equipment can be effective* is supported with moderate evidence from two studies.[37 38]

+++ The evidence statement that *interventions using the lifting team approach can be effective* is supported with moderate evidence from three studies.[39–41] Additional support is available at the limited evidence level from two studies.[42 43]

Interventions predominantly based on technique training

++++ The evidence statement that *interventions based predominantly on technique training have no impact on working practices or injury rates* is supported with strong evidence from four studies.[44–47] Eight additional studies give a moderate level of support.[48–55] There are also five studies at the limited evidence level supporting this statement.[56–60]

+++ The evidence statement that *interventions based on technique training can have mixed (positive and negative) short term*

Table 2 Summary of interventions and critical appraisal (QR) scores

Author	Intervention subjects (n)	Outcome measures	Results	QR
Addington (1994)[63] USA	5, 22 Operating room staff (n=?)	No. of reported back injuries Restricted working days	No decrease in injuries Reduction in restricted days	37%
Aird (1988)[31] Canada	Hospital: 2, 5, 9, 12, 18, 20, 21 Home for the Aged: 1, 3, 5, 13 (n=?)	Lost time injury claims (Workers Compensation Board)	Hospital: Back injuries reduced by (a) number (8.4%), (b) frequency (18.8%) Home for the Aged: No back injuries in 12 months following intervention	44%
Alavosius and Sulzer-Azaroff (1986)[71] USA	5, 8 Direct care staff (n=6)	No. of safe transfers	Reduction in no. of unsafe transfers from 13 to 4	39%
Alexander (1996)[13] UK	1, 2, 6, 11, 13, 16 Community nurses (n=42)	Relationship between implementation of recommendations and level of sickness absence	Significant relationship between implementation of recommendations and reduction in sickness absence	50%
Best (1997)[67] Australia	5 Nursing Home (n=55)	Postural analysis Back pain (severity and frequency) Rated Perceived Exertion (RPE)	All reduced but not significantly	70%
Billin (1998)[48] UK	2, 5 Nurses, Occupational Therapists, Physiotherapists (n=?)	Moving and handling injuries	Increase in injuries over 5 year period	54%
Caska et al (1998)[39] USA	17 Medical ward (n=4)	Effectiveness of lifting team Injury rate	Team completed 94% of scheduled and paged lifts No musculoskeletal discomfort reported by the team	69%
Charney (1997)[40] USA	17 Hospital staff (n=10 units)	Incident rates Lost working time	Reduction in incident rates (by 63%) and lost work days (by 90%)	72%
Charney et al (1993)[41] USA	17 Orderlies (n=2)	Accident rate Sickness absence	Year 2 data: No injuries or sick leave for lifting team Nursing sick leave was reduced	61%
Charney et al (1991)[42] USA	17 Orderlies (n=2)	Accident rate	Year 1 data: Reduced from 39 to 2.4 cases (62%) with a projected saving of $65,000 per annum	37%
Collins (1990)[14] Australia	1, 5, 12, 13, 14 Nurses (n=?)	Sickness absence	Reduced from 17 to 11 working days per claim	52%
Daws (1981)[64] UK	5 Nurses (n=2000)	Injury rate	No change	31%
Daynard et al (2001)[27] Canada	2, 5 Hospital staff (n=36)	Compliance with intervention Biomechanical evaluation of spinal loading	Increased compliance Reduced spinal loading	50%
Dietz and Baumann (2000)[56] France	5 Nurses and physiotherapists (n=103)	Training impact	76% felt they had not learned the basic positions at the end of the course	33%
Dixon et al (1996)[32] UK	2, 5, 10 Ward staff (n=?)	Musculoskeletal sickness absence	No episodes of sickness absence after implementation	20%
Duggan (1995)[15] Ireland	1, 2, 5, 6, 7 Nurses (n=24)	Postural analysis RPE	Significant reduction in harmful postures and RPE	74%
Engels et al (1998)[65] Netherlands	5, 8, 10 Nurses (n=24)	Postural load Ergonomic and biomechanical errors RPE	Both postural load and errors decreased significantly RPE increased	44%
Engkvist et al (2001)[44] Sweden	2, 5 Nursing staff (n=292)	Interaction between risk factors for back injuries and training	No association with decreased risk of injury	100%
Entwhistle et al (1996)[33] UK	2, 5, 10, 13, 22 Nurses (n=900)	Lost working time	Reduction in certified illness from 35 to 8 episodes per annum	35%
Evanoff et al (1999)[16] USA	1, 3, 4, 6, 7, 9, 10 Hospital orderlies (n=67)	Reportable injuries (OSHA 200 log) Workers compensation insurance records Self-administered survey	Reduction in injury rate from 32.5 per 100 FTE to 16.3 per 100 FTE Relative risk reduced by 50% No significant findings for workers compensation records Significant reduction in proportion of employees with musculoskeletal symptoms	58%
Fanello et al (1999)[45] France	5 Non-clerical hospital staff (n=272)	Injury rate (musculoskeletal disorders) Amount of patient handling Postural analysis	No significant difference for all three measures	80%
Feldstein et al (1993)[68] USA	5, 18 Nurses, aids and orderlies (n=55)	Back pain Quality of patient transfers	Reduction (not significant) 19% improvement in transfers	68%
Paternoster et al (1999)[73] Italy	5, 18 Hospital workers (n=80)	Postural analysis	Incorrect postures reduced from 68% to 38%	31%

Table 2 continued

Author	Intervention subjects (n)	Outcome measures	Results	QR
Foster (1996)[69] UK	*5* Nurses (n=100)	Change in practice Use of equipment	*74% change in practice* *77% improved use of equipment*	57%
Garg and Owen (1992)[17] USA	1, 2, *5* Nursing Homes (n=*57*)	Incidence of back injuries	Reduced from 83 to 47 per 200,000 work hours	63%
Garrett and Perry (1996)[66] USA	1, 5, 10, 12, 15 Nursing and therapy staff (n=700)	Lost working time cases	Reduced from 42 to 23 per annum	46%
Goodridge and Laurila (1997)[23] Canada	2, 13 Nurses (n=?)	Injury rate	Reduction in injury rate from 6.7 to 4.1 patient handling injuries per staff member per month	44%
Gray et al (1996)[72] Canada	*5* Nurses (n=14 units)	Knowledge of procedures	Significant improvement	43%
Griffith and McArthur (1999)[57] UK	*5* Health care assistants (n=502)	Impact of training using questionnaire	No acquisition of transferable skills with respect to applying the techniques in different environments	42%
Harber et al (1994)[49] USA	*5* Newly qualified nurses (n=179)	Association between training and future back pain	No association	73%
Head and Levick (1996)[24] Australia	1, 2, 3, *5* Nurses and ambulance workers (n=?)	No. of back injury claims	Reduction in number (by 23%), lost time (by 38%) and average cost (by 56%) of back injury claims	28%
Hellsing et al (1993)[61] Sweden	*5*, 18, 19 Nursing students (n=51)	Nordic Questionnaire Observation of standardised work tasks	No short term effects on musculoskeletal problems Reduction of lifts (and shorter times) in extreme positions	58%
Hignett and Richardson (1995)[18] UK	1, 3, *5*, 6, *7*, 9, 10 Nurses (n=26)	Qualitative	Risk assessment model	81%
Holliday et al (1994)[37] Canada	2 Nursing staff (n=22)	No. of staff for a task RPE Comfort Time taken	Fewer staff needed and significant reduction in RPE No change in comfort or time taken	50%
Johnston (1987)[58] UK	*5* Student nurses (n=*7*)	Application of training principles	Only 28% of lifts were planned Assistance was used for 50% of lifts	43%
Kilbom et al (1985)[34] Sweden	2, 6, *7* Home care nurses (n=12)	Vertical force and duration of lift, weight distribution and no. of steps while carrying	The modern ward showed a reduction in: total weight (43%); no. of lifts per hour (53%); asymmetric lifts (60%); and no. of steps while carrying (73%);	27%
Knibbe and Friele (1999)[38] Netherlands	2 Home care nurses (n=378)	Prevalence of back pain (12 months) Lift Counter (self-administered log)	Significant reduction in back pain (from 74 to 64%) Reduction in total no. of transfers from 35 to 21 per nurse per week	83%
Lagerström and Hagberg (1997)[46] Sweden	2, 5, 18, 19 Nurses (n=348)	Questionnaire on musculoskeletal symptoms, physical fitness and physical workload	No reduction in neck, shoulder and back symptoms, increase in hip and upper back problems. Reduction in physical fitness. Increase in perception of work as physically strenuous	76%
Ljungberg et al (1989)[28] Sweden	2, 6, *7* Nursing staff (n=24)	Lifting rates, cumulative force; total lifting time, and no. of steps while carrying	Modern ward showed a reduction in: lifting rates (50%); cumulative force (57%); total lifting time (78%); no. of steps while carrying (72%)	65%
Lynch and Freund (2000)[62] USA	*5* Nursing staff (n=374)	Knowledge about back injury risk factors Change in work practices Lost time back injuries	No change in level of knowledge Repositioning in-bed tasks reduced 30% reduction in lost time back injuries over previous 3 years	50%
Menckel et al (1997)[19] Sweden	1, 2, 5, 8 Health care staff (n=122)	Implementation of feedback	42% of measures were implemented	63%
Miller and Johnson (1992)[20] UK	1, 5, 10 Home care staff (n=10)	Questionnaire	Increase in qualitative measures of carer confidence and feeling of control of situation	50%
Monoghan et al (1998)[25] UK	1, 2, 5, 10, 13 Nurses (n=28)	Training attendance Patient assessment plans	*59% attendance* *75% of patients had mobility plans*	31%
Nussbaum and Torres (2001)[50] USA	*5* Nurses (n=24)	RPE Postural analysis Biomechanical analysis	No significant change	59%
Nyran (1991)[21] Canada	1, 2, 4, 5 Nursing Homes (n=48)	Cost effectiveness Lost time claims (Compensation Board)	Net saving of $*57,439*	65%
Oddy (1993)[29] UK	3, 6, 10, 13 Continuing care ward (n=24)	Elimination of drag lift	Reduction over 6 months, with alternative techniques used	50%

Table 2 continued

Author	Intervention subjects (n)	Outcome measures	Results	QR
Paternoster et al (1999)[73] Italy	5, 18 Hospital workers (n=80)	Postural analysis	Incorrect postures reduced from 68% to 38%	31%
Peers (1998)[26] Canada	5, 10, 13, 15, 20 Nursing home staff (n=131)	Lost time and modified work duties	Lost time reduced from 249 to 30 days Modified work days reduced from 246 to 184	37%
Pohjonen et al (1998)[22] Finland	1, 2, 3, 7, 9, 10, 11 Home care staff (n=70)	Postural analysis Heart rate Psychosocial questionnaire (Work Ability Index)	Significant increase in proportion of straight back positions (from 59 to 75%) No change in heart rate data or psychosocial data for intervention group	58%
Rodgers (1985)[59] UK	5 Ward staff (n=4 wards)	Use of taught lifting techniques	Shoulder lift not used 30% of 2-person lifts carried out by one person	38%
Santoro (1994)[43] USA	17 Neurology staff (n=65)	Effectiveness of lifting team	90% of lifts achieved	35%
Scholey (1983)[70] UK	5 Nurses (n=4)	Intra abdominal pressure (IAP)	Significant reduction in IAP	78%
Scopa (1993)[51] USA	5 Nurses (n=49)	Evaluation of body mechanics	No significant difference	65%
Stubbs et al (1983)[52] UK	5 Student nurses (n=2)	Intra abdominal pressure	Minimal reduction in IAP at best, deterioration at worst	55%
St Vincent et al (1989)[53] UK	5 Orderlies (n=33)	Use of taught handling methods (6 principles)	Application of all 6 principles only in 1% of sample. Frequency of use of individual principles ranged between 11–33%	70%
Torri et al (1999)[30] Italy	2, 5 Hospital staff (n=approx. 900)	Sickness absence Use of hoists (lifters)	Reduction in sickness absence (39%) 71% used hoists regularly and correctly	50%
Tracz and Rose (1982)[35] Canada	2, 5 Rehabilitation ward staff (n=?)	Reported injuries Lost time for back injuries	Little change	33%
Trevelyan (2001)[36] UK	2, 5, 7, 10 Nurses (n=48)	Self-reported well-being questionnaire Task and postural analysis	No significant difference for any of the measures	78%
Troup and Rauhala 1987[54] UK and Finland	5 Student nurses (n=4 groups)	Use of taught techniques Back injuries	New skills were acquired and increased use of equipment No significant difference in prevalence or incidence of back pain and injuries	54%
Tuffnell (1989)[74] New Zealand	5, 10 Nurses (n=?)	Type of lifts	Increase in use of shoulder lift from 6 to 50%	30%
Videman et al (1989)[60] Finland	5 Student nurses (n=200)	Skill assessment Prevalence and incidence of back pain and injuries	Improvement in skills for techniques (63%) and lifting aids (53%) used No significant difference in prevalence or incidence of back pain and injuries	41%
Wachs and Parker (1987)[47] USA	5 Nursing staff (n=178)	13 point skills checklist (environmental factors and postural assessment)	Low level of prescribed lifting behaviours (17%), only 2% completed all 13 prescribed behaviours. 23% of postures were labelled 'at risk'	86%
Wood et al (2000)[75] USA	5 Nursing assistants (n=90)	Evaluation of transfer skills Audit of bedside information	Prescribed techniques were performed 68% of the time 37% of bedside information was accurate	46%
Wood (1987)[55] Canada	5, 8 Nursing staff (n=3 units)	No. of wage loss claims for back injuries caused by interactions with residents	No significant difference between expt. and control groups (both reduced)	56%

Key
Intervention strategy included:
1 = Risk assessment
2 = Equipment provision or/and purchase (including training in new equipment)
3 = Equipment design/evaluation
4 = Equipment maintenance
5 = Education and training
6 = Work environment redesign, space constraints addressed
7 = Work organisation/practices changed
8 = Feedback
9 = Group problem solving/team building
10 = Review and change of policies and procedures/safe systems of work
11 = Discussion of goals with clients
12 = Injury monitoring system with follow up. Return to work programme
13 = Change/introduction of patient assessment system
14 = Introduction of hazard register
15 = Audit of working practices/risk assessments
16 = Review of staffing levels. Increase in staffing level
17 = Introduction of lifting team programme
18 = Physical fitness training
19 = Stress management
20 = Medical examination and lifting skill assessment
21 = Task analysis, job design analysis
22 = Change in uniforms

Table 3 Most commonly used strategies in multifactor interventions

Intervention strategy (key reference number)	No. of occurrences	Average QR of studies
Equipment provision/purchase (2)	18	50%
Education and training (e.g. risk assessment, use of equipment, patient assessment) (5)	18	54%
Risk assessment (1)	13	55%
Policies and procedures (10)	10	50%
Patient assessment system (13)	8	43%
Work environment redesign (6)	7	58%
Work organisation/practices changed (7)	7	63%

results is supported with moderate evidence from two studies.[61 62] Additional support is given at the limited level from four studies.[63–66]

++ The evidence statement that *interventions based on technique training can have short term positive outcomes* is supported with moderate evidence from four studies.[67–70] Limited evidence is available from another five studies.[71–75] However, all these studies reported either procedural difficulties with a lack of control groups, use of different workers and/or patients pre/post intervention, or that statistical significance was not achieved.

DISCUSSION

International evidence was found for a range of intervention strategies. The results have been summarised as evidence statements to group the papers into three categories: multifactor interventions, single factor interventions, and interventions based on technique training.

Multifactor interventions

The multifactor intervention strategies included risk assessment, equipment provision, equipment evaluation/design, equipment maintenance, education and training, work environment redesign, work organisation/practices changed, feedback, group problem solving/team building, review and change of policies and procedures, discussion of goals with clients, injury monitoring systems (return to work programmes), patient assessment systems, hazard registers, audit of working practices/risk assessments, physical fitness training, and medical examinations.

The papers in this category were subgrouped to look at whether they included a risk assessment programme which, although not an intervention in itself, has an important role to play as an integral part of an intervention. The evidence statement for interventions, including a risk assessment is supported by 14 studies at the moderate and limited levels. The risk assessment programme could include feedback to staff and supervisors and the discussion of goals with clients. Some also gave evidence of audit of either working practices and/or the risk assessment programme. It is suggested that risk assessment (in the context of interventions to reduce risks associated with patient handling) provides the framework which is needed for an intervention to be embedded within an organisation's structure and culture.[76 77]

The second subgroup (no risk assessment) includes 10 studies, with an overall lower level of evidence (only four studies at the moderate level) and one contradictory high quality study.[36] These interventions were generally preplanned or expert led. Both subgroups included programmes as short as 6 months and as long as 3–5 years, so the duration of the intervention is unlikely to contribute to the different findings. The conclusion for this category is that although multifactor interventions may show some improvements, they are more likely to succeed if they are based on a risk assessment programme (involving the staff).

Single factor interventions

The single factor interventions are divided into the provision of equipment (moderate evidence from only two studies) and the lifting team approach. Although it is unusual to find only equipment provision without other factors, if the provision of hoisting equipment can be shown, in future high quality research, to have a significant impact on robust outcome measures (for example, local measures of physiological changes as well as organisational measures looking at sickness absence and incident reports), single factor interventions based on equipment provision might prove to be more cost effective than multifactor interventions.

The second single factor intervention is the lifting team approach which has an evidence statement supported at the moderate level. Currently the research for this approach is only available from the USA, so it might be interesting to see if the results can be replicated in other countries.

Technique training based interventions

Finally the third category, interventions predominantly based on technique training, has also been divided into three subgroups. The strongest support is for the evidence statement that interventions predominantly based on technique training have no impact on working practices or injury rates. This is supported with the highest level of evidence (strong) from four studies with an additional 13 studies at the moderate and limited levels. However, evidence was also found supporting the opposing statement for the use of training, but only to achieve short term changes, with four studies at a moderate level and five studies at the limited level.

Generic multifactor intervention programme

The 22 multifactor interventions from categories (1) and (2) included 19 strategies, in different combinations. These have been further analysed as shown in table 3, listing the seven most commonly used. The average QR score is given for each intervention strategy. Studies using work organisation/practice change have the highest average score (63%) and those incorporating a patient assessment system, the lowest (43%).

It is suggested that these top seven factors could form the basis of a generic programme, although it is likely that an intervention strategy and programme will need to be further developed and extended in order to be responsive to local organisational and cultural factors. The risk assessment process could facilitate the detailed design of the programme, and identification of additional appropriate strategies, with the allocation of priorities based on local negotiation with managers and staff.

Cost effectiveness

The cost effectiveness of interventions was only reported for two studies,[21 42] with $55 000–65 000 annual savings. These used a multifactor intervention programme, including risk assessment[21] and the lifting team[42] strategy.

Conclusion

This systematic review has drawn together international data relating to patient handling interventions from 1960 to 2001. There is strong evidence against interventions predominantly based on technique training. It is suggested that the seven most commonly used strategies from the multifactor interventions could form the basis of a generic programme, with additional strategies being identified through the risk assessment process. However, the programmes using single factor interventions (hoisting equipment and lifting teams) also provided a moderate level of evidence and it may be, with more high quality research, that these may be shown to offer more cost effective strategies. Unfortunately, as only two studies from the USA reported data on financial savings, it will be difficult for health care managers to draw conclusions from these data as the financial accounting systems (for example, workers' compensation and insurance) may be different.

The main recommendation from these findings is that health care providers should review their current approach to managing risks and injuries associated with patient handling activities. If their approach is predominantly based on technique training it is unlikely to be successful in reducing musculoskeletal injuries, and an alternative intervention strategy should be considered.

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