

A Systematic Review of Disability Management Interventions with Economic Evaluations

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Abstract *Introduction* We present the results of a systematic literature review of disability management interventions to answer the question: “what is the credible evidence that incremental investment in disability management interventions is worth undertaking?” *Methods* We identified studies through searches in journal databases and requests to content experts. After assessing the quality of studies that met content requirements, we employed a best-evidence synthesis approach. Studies were stratified across several dimensions for evidence synthesis, with industry as the core stratification criterion. *Results* We identified 17 disability management interventions with economic analyses, of which eight were of high or medium quality. We found strong evidence supporting the economic merits of multi-sector disability management interventions, but could not make a positive statement about the remaining five industry clusters with studies. For stratification by intervention components, we found moderate evidence for interventions that included an education component, moderate evidence for those with physiotherapy, limited

evidence for those with a behavioural component, and moderate evidence for those with a work/vocational rehabilitation component. For stratification by intervention features, we found moderate evidence for interventions that included a work accommodation offer, contact between health care provider and workplace, early contact with worker by workplace, ergonomic work site visits, and interventions with a return-to-work coordinator. *Conclusions* We found credible evidence supporting the financial benefits of disability management interventions for one industry cluster and several intervention components and features.

Keywords Disability management interventions · Economic evaluation · Systematic review · Secondary prevention · Cost–benefit analysis · Cost-effectiveness analysis

Introduction

Over the last few years, workers’ compensation insurers and authorities have increasingly focused on disability management issues, and specifically on return-to-work initiatives. Many of these include some workplace-based component, such as the inclusion of the injury employer in the return-to-work transition. Some initiatives have been undertaken directly by employers, though the complexity of disability management programs generally involves the expertise of various specialities from outside the firm. Hence many such initiatives are undertaken at the system level by a workers’ compensation insurance authority or public administrator and provide disability management services to multiple industries. Disability management has been regarded as good practice since it promotes improved

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recovery time, and preliminary evidence suggests that it can lead to lower resource costs [1]. In most cases, workers return to their injury employer, often initially to modified work, while concurrently receiving some kind of medical treatment and rehabilitation services.

While there have been advancements in the evaluation of the effectiveness of workplace-based interventions, the same cannot be said about the economic analysis component of evaluations. Tompa et al. [2] found that the quality of application of economic evaluation methodologies in primary and secondary prevention interventions is rather weak. This finding suggests that, in general, economic evaluation of workplace-based interventions is an underdeveloped area within the occupational health and safety (OHS) literature.

Franché et al. [1] conducted a systematic review of quantitative research on workplace-based return-to-work (RTW) interventions. The authors' primary goal was to review the effectiveness of these interventions. They considered three types of outcomes: work disability duration, associated costs, and quality of life of workers. The latter outcome category included measures of general health, condition-specific functional status, symptom severity, and pain levels. The review found moderate evidence that workplace-based RTW interventions decrease both duration and costs of disability, and mixed evidence that they have a positive impact on workers' quality of life.

MacEachen et al. [3] undertook a qualitative systematic review of RTW interventions in order to better understand the dimensions, processes, and practices of RTW. The review found that RTW interventions are quite complex in that they involve the beliefs, roles, and perceptions of many players. Goodwill and trust were highlighted as central elements for successful RTW arrangements. Additionally, it was found that there are often social and communication barriers to RTW. Intermediary players such as rehabilitation or occupational health care providers and workplace supervisors may have the potential to help overcome the barriers and facilitate the process.

The above noted systematic reviews of the disability management intervention literature have focussed on the evidence on effectiveness and the nature of processes, rather than on the financial merits of such interventions. Hence, we undertake a systematic review focussed expressly on assessing the quality, quantity, and strength of evidence on the financial merits of disability management interventions. Specifically, the objectives of this review are two-fold: to synthesize the existing evidence on the costs and consequences of disability management interventions that included some workplace-based component, and to provide recommendation pertaining to economic analyses to guide future research in the field.

In what follows, we describe the materials and methods employed in this study, specifically detailing the literature search strategy, the quality assessment and data extraction tools employed, and the criteria used to synthesize the evidence. We then present our results and discuss the implications of our findings. We conclude with a summary of our findings and recommendations for future research.

Materials and Methods

Literature Searches

This review is a sub-set of a systematic literature review that included all types of OHS interventions [4]. Thus, the literature search we describe draws on the methods from that study.

We identified relevant studies through four sources: (1) structured searches in journal databases; (2) other systematic reviews on OHS intervention topics [1, 5]; (3) a summary table of studies on office ergonomics (Goggins, R. 2006. Table prepared for Washington State Department of Labor and Industries, personal communication); and (4) studies identified by content experts.

Several journal databases were searched for relevant articles: MEDLINE, EMBASE, BIOSIS, Ergonomic Abstracts and Business Source Premier. We developed a keyword search for use with MEDLINE based on four criteria: (1) the type of study (e.g. intervention); (2) the setting (e.g. workplace); (3) the outcome measure (e.g. work injury); and (4) the type of economic analysis or outcome measure (e.g. cost–benefit analysis). At least one keyword from each of the four categories needed to be included in the title, abstract or classification terminology of a citation. This framework was subsequently customized for each of the other databases.

Several additional inclusion/exclusion criteria were part of the study selection process. First, studies had to be published in the year 1990 or later. We chose this date because we had identified few workplace studies with economic evaluations published prior to 1990 in a scoping review undertaken by the author group to test the feasibility of this systematic review. In addition, we were concerned that studies from the pre-1990 time period would be less relevant to current workplace settings and would likely have used economic evaluation methods of lower quality, since methods were less advanced prior to that period.

Quality Assessment

Articles that passed subject matter and other inclusion criteria were scored for quality. To assess the quality of

each study, we developed a quality assessment tool based largely on criteria published in a recent review of economic evaluation methods issues [2]. The quality assessment tool consisted of 14 specific content questions. Each item was ranked on a five-point Likert scale with 1 as the lowest score and 5 as the highest. The quality assessment tool was tested with a sample of five studies by two reviewers. The final version of the quality assessment tool can be found in Table 1.

Two reviewers assessed the quality of each study. The average score across the 14 items constituted the overall score for a study given by a reviewer. The average of the overall scores between the two reviewers constituted the final score for a study. A study with a final score between 1 and 2.4 was considered to provide low quality evidence related to the economic analysis. A final score between 2.5 and 3.4 represented medium quality, and a score between 3.5 and 5 indicated high quality.

Table 1 Quality assessment tool

<i>Overarching questions that frame the purpose of the study and the nature of the intervention</i>
(1) Was the conceptual basis of, and/or the need for the intervention explained and sound?
(2) Was the intervention clearly described?
(3) Were the study population and context clearly described?
<i>Study design and issues related to evaluation of the intervention's effectiveness</i>
(4) Rank the means by which selection and confounding are controlled for through study design?
(5) Were appropriate statistical analyses conducted?
(6) Were exposure, involvement, and intensity of involvement in the intervention appropriate?
(7) Were the outcomes included in the analysis appropriate?
<i>Measurement and analytic issues related to the economic evaluation</i>
(8) Were all relevant comparators explicitly considered?
(9) Was the study perspective explicitly stated and appropriate?
(10) Were all important costs and consequences considered in the analysis, given the perspective?
(11) Were the measures of costs and consequences appropriate?
(12) Was there appropriate adjustment for inflation and time preference?
(13) Was there appropriate use of assumptions and treatment of uncertainty?
<i>Discussion and interpretation of results</i>
(14) Did the presentation and discussion of study results include all issues of concern?

Each question is ranked on a five-point Likert scale with 1 = low and 5 = high. The average score across the 14 items constituted the total score for a study. The average of the total scores between the two reviewers constituted the final score for a study. A study with a final score between 1 and 2.4 was considered to provide low quality evidence related to economic analysis. A score between 2.5 and 3.4 represented medium quality, and a score between 3.5 and 5 indicated high quality.

Data Extraction

A data extraction tool was developed that focused on four areas of the study: (1) contextual factors such as jurisdiction, industry, and occupational group targeted; (2) details about the intervention; (3) characteristics of the epidemiologic study design and related statistical analyses; and (4) characteristics of the economic evaluation. As with the quality assessment tool, the data extraction tool was tested with a sample of five studies by two reviewers. Through several meetings, the tool was reviewed and refined to better capture the key aspects of studies that were critical for evaluation and synthesis.

The most challenging aspect of developing and refining the data extraction tool was determining how much epidemiological information to extract. Establishing effectiveness is a necessary prerequisite for an economic evaluation. The key concern was that the focus of this review is on economic analysis rather than on effectiveness/epidemiologic analysis. We found that many studies had detailed and lengthy effectiveness analyses that did not directly feed into the economic analyses. In fact, in many cases, the economic analysis component was a very minor part of the study.

Evidence Synthesis

To assist us with the development of the methods and analysis of results, we consulted with a stakeholder group consisting of representatives from the policy arena, business, and OHS researchers on three occasions. At each of these meetings we discussed the synthesis criteria to solicit stakeholders' feedback on the most relevant dimensions by which to cluster data. Stakeholders noted patterns in types of interventions in different industries and felt that clustering around these two dimensions (i.e., industry and type of intervention) would be most useful.

We also synthesized evidence across two other dimensions, namely components of the intervention, and features of the intervention. It is important to note that the components and features considered are not necessarily the factors driving the economic evaluation findings. Rather, the clustering by these characteristics provides insight into the strength of evidence on the financial merits of disability management interventions with similar characteristics. The components dimension includes four categories: ergonomics and other education (including back school), physiotherapy, behavioural therapy, and work/vocational rehabilitation. The features dimension is based on Franche et al. [1], which identified six key features: early contact with worker by the workplace, work accommodation offer, contact between health care provider and workplace, ergonomic work site visits,

supernumerary replacements, and RTW coordination. For interventions with multiple arms, we considered the components and features of the arm with the greatest number of these characteristics (this was usually the primary arm of interest in the intervention evaluation).

The evidence synthesis method was based on Slavin's best-evidence synthesis approach [6, 7]. This is a qualitative approach that bases the strength of a relationship on the quality, quantity and consistency of evidence available to support a relationship between variables. We ranked the evidence supporting the hypothesized relationship on a five-level scale consisting of strong evidence, moderate evidence, limited evidence, insufficient evidence and mixed evidence. Evidence was tested against the criteria for the highest level, and if it was not met, the criteria for the next highest level were considered. The process continued cascading down the three levels of strong, moderate and limited evidence until a set of criteria was met. If the evidence met none of the criteria, it defaulted to one of the two categories, insufficient/no evidence or mixed evidence. The former arose if there was only one medium quality study and no high quality studies, only low quality studies or no studies. The latter arose if there was more than one high and/or medium quality study and the studies provided conflicting evidence. The evidence ranking algorithm can be found in Table 2.

Results

Literature Searches

The MEDLINE search resulted in 6,381 hits, EMBASE in 6,696 hits, BIOSIS in 2,568 hits, Business Source Premier in 687 hits, Ergonomic Abstracts in 25 hits, and other sources in 199 hits. Once these citations were merged and duplicates were removed, the total number of citations was 12,903. These citations resulted in 72 studies with economic analyses, 17 of which were disability management interventions. A count of the relevant studies classified by industry can be found in Table 3.

Of the 17 disability management interventions identified, only eight were of sufficient quality (i.e., high or medium quality) to be retained in the synthesis. The eight studies were in five industry sectors, namely: health care, manufacturing and warehousing, mining and oil and gas extraction, multi-sector, and utilities. The interventions in these studies were undertaken either in North America (Canada and the United States) or in Scandinavia (Finland and Sweden). Table 4 provides details about each of the eight studies. (Note: The appendix containing the full results of the literature review is available in the electronic supplementary material.)

Table 2 Best evidence synthesis guidelines

Strong Evidence

Minimum Study Quality High

Minimum Number of Studies 3

- (1) If there are only three high quality studies, all high quality studies must report consistent findings
- (2) At least three-quarters ($\geq 3/4$) of high and medium quality studies must concur on findings

If the above criteria are not met, then the criteria for establishing moderate evidence are applied

Moderate Evidence

Minimum Study Quality Medium

Minimum Number of Studies 2 high quality studies, or 3 of medium and high quality

- (1) The 2 high quality studies must agree, or the 3 studies constituting a mixture of medium and high quality must agree
- (2) If there are four or more studies of medium and high quality, more than two thirds ($>2/3$) of all studies must report consistent findings

If the above criteria are not met, then the criteria for establishing limited evidence are applied

Limited Evidence

Minimum Study Quality Medium

Minimum Number of Studies 1 high quality study, 2 medium quality studies, or 2 studies one of which is medium quality and the other is high quality

- (1) If there are 2 studies, the studies must agree
- (2) The majority ($>50\%$) of medium and high quality studies must report consistent findings

If the above criteria are not met, then there is no evidence or mixed evidence

Mixed Evidence

Findings from medium and high quality studies are contradictory

Insufficient/No Evidence

No high quality studies

One or no medium quality studies

Any number of low quality studies

Summary of the Eight High and Medium Quality Studies by Geographical Location

The high quality Canadian study by Loisel et al. [8] evaluated four disability management options: (1) a standard care arm, (2) a clinical intervention arm, (3) an occupational intervention arm, and (4) a combined clinical and occupational intervention arm (the Sherbrooke model). At 6.4 years mean follow-up, the three intervention arms had positive incremental net-present-values compared to standard care (i.e., the interventions were less expensive than standard care). The incremental costs per day on full benefits were negative for the three intervention arms compared to standard care (i.e., a day on full benefits was less expensive), at 6.4 years mean follow-up. The combined clinical and occupational intervention arm was shown to be most cost-beneficial.

Table 3 Number of studies by industry

(1) <i>Health Care</i> : 5 interventions (1 medium and 4 low quality)
(2) <i>Manufacturing and Warehousing</i> : 3 interventions (1 medium and 2 low quality)
(3) <i>Mining and Oil and Gas Extraction</i> : 2 interventions (1 medium and 1 low quality)
(4) <i>Multi-sector</i> : 5 interventions (4 high and 1 low quality)
(5) <i>Public Administration</i> : 1 intervention (low quality)
(6) <i>Utilities</i> : 1 intervention (medium quality)

One of the high quality Swedish studies was by Jensen et al. [9, 10]. It too considered four disability management options: (1) a standard care arm, (2) a behavioural-oriented physiotherapy intervention, (3) a cognitive behavioural therapy intervention, and (4) a combined behavioural-oriented physiotherapy and cognitive behavioural therapy intervention. At 3-year follow-up, the combined intervention arm was the most cost-beneficial in terms of wage cost of sick absences and disability pension per subject net of intervention costs (i.e., costs per subject were the lowest for this intervention) though all three experimental arms were less expensive than standard care. The second high quality Swedish study was by Arnetz et al. [11]. It evaluated a disability management program that consisted of early medical, rehabilitation and vocational services, as well as ergonomic improvements and workplace accommodation. The program was compared to standard care. At 1-year follow-up, there were net savings for the intervention group compared to the control group based on reduced indemnity and medical care payments net of intervention costs, with a benefit-to-cost ratio of 6.8.

A third Swedish study by Linton and Bradley [12] was of medium quality. It evaluated a 5-week physical and behavioural prevention intervention consisting of (1) physiotherapy, including ergonomic education, and (2) behaviour therapy to help workers better control pain and maintain a healthy, low-risk lifestyle. The intervention proved to be cost-beneficial based on the wage value of sick days due to pain. It was estimated that employers saved twice the cost of the program over an 18-month period.

The high quality Finnish study by Karjalainen et al. [13, 17] considered three disability management options: (1) a standard care arm; (2) a mini-intervention arm consisting of an interview with a physician to provide information and encourage physical activity; and (3) an arm consisting of the mini-intervention along with a worksite visit by a physiotherapist to provide practical worksite instruction to the patient on appropriate ways of using the back at work and to encourage the involvement of the supervisor and company health care professionals in the rehabilitation process. At 1-year follow-up, both intervention arms

had significantly fewer days on sick leave than the usual care group. The costs of sick leave and direct health care were lower for the intervention arms compared to standard care, but these cost differences were not statistically significant.

There were three medium quality studies on interventions undertaken in the US. Greenwood et al. [14] evaluated a very early intervention program consisting of health evaluation, psychosocial evaluation, and recovery management. The intervention was found to be as costly as standard care and was not more effective (i.e., no statistically significant difference found between the intervention and control group in terms of disability benefits and medical care payments). Hochanadel and Conrad [15] evaluated an on-site physiotherapy program for work-related and non work-related injuries. Services included evaluation, treatment, physiotherapy referrals, and education in the form of a back school. Over a 10-year period reduced wage costs associated with disability absences resulted in an estimated net savings of \$8.3 million or a benefit-to-cost ratio of 9 to 1. Lastly, Wiesel et al. [16] evaluated an intervention consisting of an injury surveillance system with the use of quality-based standardized diagnostic and treatment protocols. Over a 10-year period there were savings from reduced time-loss and light-duty work when compared to a base year prior to the intervention.

Descriptive Statistics

The eight studies contained various mixes of intervention components and features listed in the materials and methods section. Table 5 provides some details. Some interventions had an ergonomics and other education component sometimes provided through a back school, some included physiotherapy, some behavioural therapy and others vocational work/rehabilitation. The interventions covered a range of features, though none included all the features considered. Most had two or more, and two had only one feature.

Seven of the eight studies undertook full economic evaluations (i.e., considered both costs and consequences), with one undertaking a partial evaluation (i.e., considering only consequences in monetary terms). The majority of these studies employed a cost-benefit analysis, where the costs and consequences (benefits) of the intervention were compared in monetary units. The predominant outcomes of focus in the economic analysis component of the studies were the wage-replacement expenses associated with injury absence (e.g., wage cost of the absence, workers' compensation wage-replacement cost, or disability indemnity costs) and/or health care expenses associated with the injury. In terms of study perspective taken, one

Table 4 Study details

Study	Loisel [8]	Jensen [9, 10]	Arnetz [11]	Karjalainen [13, 17]
Quality level	(High)	(High)	(High)	(High)
Country	Canada	Sweden	Sweden	Finland
Intervention details	<p>Four arms:</p> <p>(1) Standard care</p> <p>(2) Clinical intervention: clinical examination by a back medical specialist, back school after 8 weeks of absence from regular work, and, if necessary, a multidisciplinary work rehabilitation intervention after 12 weeks of absence</p> <p>(3) Occupational intervention: visits to an occupational medicine physician, and a participatory ergonomic intervention with an ergonomist, the injured worker, the supervisor, and management and union representatives</p> <p>(4) Sherbrooke model intervention: clinical intervention combined with occupational intervention</p>	<p>Four arms:</p> <p>(1) Behaviour-oriented physiotherapy to enhance physical functioning and facilitate a lasting behaviour change</p> <p>(2) Cognitive behavioural therapy to improve ability to manage pain and resume a normal level of activity</p> <p>(3) Behavioural medicine rehabilitation consisting of behaviour-oriented physiotherapy and cognitive behavioural therapy</p> <p>(4) Standard care</p>	<p>Two arms:</p> <p>(1) Standard care</p> <p>(2) Early medical, rehabilitation and vocational interventions, as well as ergonomic improvements and adaptation of workplace conditions</p>	<p>Three arms:</p> <p>(1) Mini-intervention group consisting of an interview with a physician specializing in psychiatry to reduce concerns about back pain by providing accurate information and to encourage physical activity</p> <p>(2) Mini-intervention described above and worksite visit by the physiotherapist to ensure adaptation to the information, to provide practical instructions of appropriate ways of using the back at work, to involve the supervisor and company health-care professionals, and to encourage their cooperation</p> <p>(3) Standard care, consisting of treatment by general practitioner in primary health care</p>
Type of study	Randomized controlled trial	Randomized controlled trial	Randomized controlled trial	Randomized controlled trial
Intervention measurement time period	77 months	36 months	12 months	12 months
Type of economic evaluation	Cost–benefit analysis and cost-effectiveness analysis	Cost–benefit analysis	Cost–benefit analysis	cost-consequence analysis
Perspective	System (provincial workers' compensation agency)	Societal	System (national insurance agency)	Unclear
Key outcome measure	Workers' compensation expenses and days on full benefits	Wage value of sick days and disability pension	Indemnity and medical care expenses	Wage value of sick days and medical care expenses

Table 4 continued

Study	Loisel [8]	Jensen [9, 10]	Arnetz [11]	Karjalainen [13, 17]
Quality level	(High)	(High)	(High)	(High)
Country	Canada	Sweden	Sweden	Finland
Economic evaluation results	<p>At mean 6.4 years follow-up, the incremental net-present-value per claim (compared to standard care) was \$16,176 for the clinical arm, \$16,827 for the occupational arm, and \$18,585 for the Sherbrooke arm (1991 Canadian dollars)</p> <p>At mean 6.4 years follow-up, the relative cost per day of full benefits (compared to standard care) was (–\$67.50) for the clinical arm, (–\$88.40) for the occupational arm, and (–\$63.50) for the Sherbrooke arm (1991 Canadian dollars)</p>	<p>Compared to the control group, the full-time behavioural medicine program was the most cost-effective program, since it decreased sick leave and disability pension expenses by about 137,509 Euros per subject in the female group during the first 3 years after rehabilitation. The least reduction in expenses (compared to the control group) was with the behaviour-oriented physiotherapy (reduction of 54,452 Euros)</p>	<p>The net-present-value (direct savings) was 972,900 Skr (\$162,150 USD) or 7,164 Skr (\$1,195 USD) per case/person, with a benefit-to-cost ratio being 6:8</p>	<p>The intervention groups had significantly fewer days on sick leave than usual care, and the cost of sick leave and direct health care were lower, but these cost differences were not statistically significant</p>
Study	Greenwood [14]	Hochanadel [15]	Linton [12]	Wiesel [16]
Quality level	(Medium)	(Medium)	(Medium)	(Medium)
Country	Sweden	United States	United States	United States
Intervention details	<p>(1) Standard care</p> <p>(2) A very early intervention consisting of health and psychosocial evaluation post-injury (8 days after injury) and recovery management/case management</p>	<p>On-site industrial physiotherapy program for all injuries, both work-related and not. Services include evaluation, treatment, physical therapy referrals, and education in the form of a back school</p>	<p>Five-week physical and behavioural preventive intervention consisting of physical therapy, including ergonomic education in the form of a low-back school, practising high-risk manoeuvres on the job; behaviour therapy to help workers learn to better control their pain and maintain healthy, low-risk lifestyles, which included group meetings with a psychologist and training on pain control, lifestyle management, risk analysis, and application training</p>	<p>An intervention consisting of an injury surveillance system with the use of quality-based standardized diagnostic and treatment protocols. All occupational injuries were to be reported within 24 h; workers were examined at a central medical facility as soon as it was practical, and data on the injury was added to the computerized database. Based on clinical data, a diagnosis was obtained and a course of management was recommended according to the standardized diagnostic and treatment algorithm specific to the injury's anatomic region. Time-loss injuries were reviewed on a weekly basis during the acute phase</p>

Table 4 continued

Study	Greenwood [14]	Hochanadel [15]	Linton [12]	Wiesel [16]
Quality level	(Medium)	(Medium)	(Medium)	(Medium)
Country	Sweden	United States	United States	United States
Type of study	Randomized controlled trial	Uncontrolled (before-after)	Uncontrolled (interrupted time series)	Uncontrolled (before-after)
Intervention measurement time period	27 months	120 months	24 months	108 months
Type of economic evaluation	Cost-consequence analysis	Cost-benefit analysis	Cost-benefit analysis	Partial analysis (considered only consequences in monetary terms)
Perspective	System (state workers' compensation agency)	Employer	Unclear	Employer
Key outcome measure	Disability benefits and medical care expenses	Wage value of sick days	Wage value of sick days	Cost of lost time and light-duty time
Economic evaluation results	The intervention was as costly as standard care and was not more effective	Net savings from the intervention were \$8.3M USD. The benefit-to-cost ratio was 9:1	The intervention resulted in savings of at least twice the costs of the program (\$9,715 USD, or 61,198 krona)	For low-back injuries, savings from lost time and light duty for the 10-year period were \$2,655,728 (average savings were 59% compared to the base year). For knee injuries savings were \$1,369,803 (average savings of 65%). Total savings for low-back and knee injuries were more than \$4M dollars. All other MSK injuries were shown to have decreased, resulting in a cumulative 10-year savings of more than \$4.1M (1990 USD)

study took a societal perspective, three a systems-level perspective, two an employer's perspective, and two were unclear.

Evidence Synthesis

With eight high and medium quality studies distributed across five industry clusters, in most cases there were not enough studies in a particular industry to support or refute the hypothesis that the financial merits of disability management interventions in that industry. Four industry clusters had one study each, and were deemed to have insufficient evidence. We identified only one industry in which there were a sufficient number of high and medium quality studies. Specifically, we found strong evidence to support undertaking disability management interventions in a multi-sector setting, based on their financial benefits. This finding is based on four intervention studies. One of the studies was undertaken in Canada [8], two in Sweden [9–11], and one in Finland [13, 17]. Three of the studies took a systems level perspective, and in one study the perspective was unclear. For the latter, it was not stated who paid for costs, such as worksite visits and clinical/rehabilitation services, and who gained from reduced health care and sick

leave benefits. It appeared to be a systems level initiative involving 36 primary health care centers in the Helsinki metropolitan area, but this perspective was not explicitly articulated. This study is the only one amongst the four that did not find evidence to support the financial benefits of the intervention.

As noted, we also synthesized the evidence across studies with specific intervention components and key features. Regarding the four intervention components, we found moderate evidence that interventions with an ergonomics and other education component were worth undertaking based on their financial merits (based on five studies with this component), moderate evidence for interventions with physiotherapy component (based on three studies), limited evidence for interventions with a behavioural component (based on two studies), and moderate evidence for ones with work/vocational rehabilitation component (based on two studies). With regards to key features of interventions, we found moderate evidence supporting the financial merits of interventions based on clusters of studies with: (1) early contact with worker by the workplace, (2) work accommodation offer, (3) contact between health care provider and workplace, (4) ergonomics work site visit, and (5) RTW coordination. No component or key feature surfaced as a dominant



Table 5 Intervention components and features

	Loisel [8] (High)	Jensen [9, 10] (High)	Arnetz [11] (High)	Karjalainen [13, 17] (High)	Greenwood [14] (Medium)	Hochanadel [15] (Medium)	Linton [12] (Medium)	Wiesel [16] (Medium)
<i>Intervention components</i>								
Ergonomics and other education (including back school)	✓	–	✓	✓	–	✓	✓	–
Physiotherapy	–	✓	–	–	–	✓	✓	–
Behavioural therapy	–	✓	–	–	✓	–	✓	–
Work rehabilitation or vocational rehabilitation	✓	–	✓	–	–	–	–	–
<i>Intervention features</i>								
Early contact with worker by workplace	✓	–	✓	–	✓	–	–	✓
Work accommodation offer	✓	–	✓	–	–	✓	–	✓
Contact between health care provider and workplace	✓	✓	–	✓	✓	✓	✓	✓
Ergonomic work site visits	✓	–	✓	✓	–	✓	–	–
RTW coordination	–	–	✓	–	✓	✓	–	✓

characteristic amongst the eight studies, hence only moderate evidence was found for most. This is likely due to the modest number of studies and the fact that two of the studies did not support the financial merits of the intervention being evaluated [13, 14].

Discussion

Previous reviews have synthesized the evidence on effectiveness [1] and process [3] of disability management interventions. What is missing is an understanding of the strength of evidence on their financial merits. This systematic review begins to fill this gap in the literature. The research question we posed was, “what is the credible evidence that incremental investment in disability management interventions is worth undertaking?”

The substantive findings based on industry are as follows: while there is strong evidence in support of the financial merits of disability management interventions in multi-sector initiatives, there is insufficient evidence in other industries. The multi-sector interventions were primarily system-level initiatives, hence the reason why they served multiple industries. Most of the economic analyses took a system, insurer, or public sector perspective. Given the complexity of many disability management programs, which often involve the coordination of various specialities from outside a firm, it appears reasonable that they would be managed at the system level where economies of scale may be had.

With studies clustered by intervention components, we found moderate evidence in support of the financial merits

of interventions with an education component. Three of the four high quality studies had an education component, though one of them did not find the intervention worth undertaking based on its financial merits. For interventions that included physiotherapy component we found moderate evidence of support. We also found moderate evidence in support of interventions with work/vocational rehabilitation. There was only limited evidence for interventions with a behavioural component.

For the specific intervention features, we found moderate evidence supporting the financial merits of interventions with the following features: early contact with the worker by the workplace; work accommodation offer; contact between the health care provider and the workplace; ergonomic worksite visits; and RTW coordination. Three high quality studies had contact between health care provider and the workplace, as well as ergonomic work site visits, but one of the studies with each of these features did not find the intervention worth undertaking based on the economic analysis.

Though the high quality studies had strong economic analyses relative to the medium quality studies, overall most studies had much room for improvement. From the group of high quality studies, Loisel et al. [8] stood out as exemplary. This was one of only two studies that undertook sensitivity analysis. As well, it adjusted costs and consequences for inflation and time preference. Furthermore, the fact that it included a cost-effectiveness analysis in addition to cost-benefit analysis provided readers with greater insight into the health consequences of the intervention than solely a monetary measure of consequences.

In general, we found that few intervention studies undertook economic analyses, so we strongly encourage all

researchers planning disability management intervention evaluations to seriously consider including an economic evaluation component in their analysis plan. Effectiveness evaluation and economic evaluation go hand-in-hand, and should complement each other. Undoubtedly, the financial benefits of a disability management intervention is an important piece of information for firms, insurers, and policy makers, so it is to the detriment of an intervention evaluation study to leave economic analysis out of the study plan.

Recommendations

Our recommendations pertain to measurement and analytic issues related to the economic analyses of the disability management interventions identified in this systematic review. For a more complete discussion of methodological issues and recommendations pertaining to the economic complete discussion of methodological evaluation of OHS interventions, we refer readers to Tompa et al. [2].

In our search of the literature, we found that few intervention studies undertook economic analyses, and for those that did, the quality was generally quite low. Furthermore, we often found a disconnect between the effectiveness and economic evaluations. Specifically, one set of analyses fed into the effectiveness evaluation, and a separate set of analyses were undertaken for the economic component. For many studies the economic analysis was not the principal focus of the investigation, and for some it was a very small component. Another concern is that studies employed different approaches to the computation and analysis of costs and consequences, making it difficult to compare results across studies. We would suggest a standard approach to computations.

Most studies that undertook economic analyses focused on work absence costs (wage costs or workers' compensation wage replacement costs) and medical care costs. One concern with using workers' compensation claims costs as the sole or primary outcome measure is that it is a poor measure of the value of health improvements attributable to an intervention. Workers' compensation costs are simply transfers and do not capture the full set of costs and consequences experienced by different stakeholders. Furthermore, workers' compensation claims do not reflect the full extent of work-related injuries and illnesses. Many compensable injuries and illnesses go unreported, and others are not compensable [18].

Most of the high- and medium-quality studies undertook cost–benefit analysis, and used some variant of a human capital approach (a measure of productivity) to valuing health, but no studies considered on-the-job measures of productivity. Though financial outcomes and productivity issues may be of primary interest to most firms, the human capital approach does not adequately capture the full value

of health. Missing in this measure is the intrinsic value of good health to workers, and the value of health associated with the ability to better perform other social roles. Studies might consider other measures of health and their associated costs, either through primary data collection or exploitation of other administrative data sources (e.g., first aid reports, modified duty, and private indemnity claims).

With regards to the valuation of costs and consequences, three issues in particular merit attention: identifying prices that correctly reflect the value of resources embodied in costs and consequences under consideration; identifying prices that are consistent with the perspective taken; and measuring incremental costs and consequences attributable to an intervention, rather than the total costs incurred and consequences realized. For example, in Loisel et al. [8] the researchers made efforts to distinguish between standard expenses incurred by the insurer for treatment of back injuries from incremental expenses attributable to the particular back pain management intervention under study.

When the costs and/or consequences of a study are realized over more than a year, one should adjust for inflation and time preference. Data on inflation rates are readily available from most national statistical bureaus. To adjust for time preference, discounting is required for both costs and consequences, even if consequences are not measured in dollars. Many jurisdictions stipulate the discount rate at which public sector investments are to be discounted. For the private sector, firms may have their own specific rate used for project investments. The real discount rates (net of inflation) commonly used in the literature are 3 and 5% [19]. Thus, we suggest considering both rates in an analysis, and possibly undertaking a sensitivity analysis using a range of rates. In fact, sensitivity analysis should be undertaken with all key assumptions to test the robustness of results to these assumptions.

Related to the issue of considering broader measures of health is the issue of the perspective taken. Many of the studies in this review took a system perspective, though most of the intervention studies we identified in the broader review took a firm perspective. There is a strong case to be made for considering a broad societal perspective as well as for a disaggregation of the costs and consequences in order to better understand their composition and distribution across stakeholders.

Summary

To summarize, we found strong evidence supporting the economic merits of multi-sector disability management interventions. We also found studies on the economic merits of such interventions in five other industrial sectors but the quantity and quality of studies was not sufficient to

confirm or refute their economic merits for these sectors. Clustering studies by intervention components, we found moderate evidence for interventions with each of education, physiotherapy, and work/vocational rehabilitation, and limited evidence for behavioural therapy. Clustering by intervention features, we found moderate evidence for studies with each of the five features considered.

Our findings are of value to workplace parties, OHS practitioners, and policy-makers who are interested in knowing not only if disability management interventions are effective, but also if they are worth undertaking based on their financial benefits. The findings are also of value to OHS researchers who might seek to fill some of the gaps in the intervention evaluation literature by including economic analyses in their evaluations and strive to improve the quality of economic evaluation in this literature.

Previous reviews confirmed the effectiveness of disability management interventions [1] and analysed their dimensions, processes and practices [3], while our review complements these with confirmation of their economic merits. Our review also highlights the need for more systematic consideration of the economic merits of disability management interventions, and further development of standardized analytic methods in order to ensure a larger and reliable evidence base in this domain.

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