

Early Patient Screening and Intervention to Address Individual-Level Occupational Factors (“Blue Flags”) in Back Disability

William S. Shaw · Danielle A. van der Windt ·
Chris J. Main · Patrick Loisel · Steven J. Linton ·
the “Decade of the Flags” Working Group

Published online: 12 December 2008
© Springer Science+Business Media, LLC 2008

Abstract *Objective* To develop a consensus plan for research and practice to encourage routine clinician screening of occupational factors associated with long-term back disability. *Methods* A 3-day conference workshop including 21 leading researchers and clinicians (the “Decade of the Flags Working Group”) was held to review the scientific evidence concerning clinical, occupational, and policy factors in back disability and the development of feasible assessment and intervention strategies. *Results* The Working Group identified seven workplace variables to include in early screening by clinicians: physical job demands, ability to modify work, job stress, workplace social support or dysfunction, job satisfaction, expectation for resuming work, and fear of re-injury. Five evaluation criteria for screening methods were established: reliability,

predictive performance, feasibility, acceptability, and congruence with plausible interventions. An optimal screening method might include a stepped combination of questionnaire, interview, and worksite visit. Future research directions include improving available assessment methods, adopting simpler and more uniform conceptual frameworks, and tying screening results to plausible interventions. *Discussion* There is a clear indication that occupational factors influence back disability, but to expand clinician practices in this area will require that patient screening methods show greater conceptual clarity, feasibility, and linkages to viable options for intervention.

Keywords Back pain · Back disability · Occupational factors · Screening · Early intervention

W. S. Shaw (✉)
Liberty Mutual Research Institute for Safety, 71 Frankland
Road, Hopkinton, MA 01748, USA
e-mail: william.shaw@libertymutual.com

W. S. Shaw
Department of Family Medicine & Community Health,
University of Massachusetts Medical School, Worcester,
MA, USA

D. A. van der Windt
EMGO Institute, VU University Medical Center,
Amsterdam, The Netherlands

D. A. van der Windt · C. J. Main
Arthritis Research Campaign National Primary Care Centre,
Keele University, Staffordshire, UK

P. Loisel
Centre for Action in Work Disability Prevention
and Rehabilitation, Hôpital Charles LeMoine,
Longueuil, QC, Canada

P. Loisel
Université de Sherbrooke, Longueuil, QC, Canada

S. J. Linton
Department of Behavioral, Social and Legal Sciences—
Psychology & Örebro Medical Center Hospital, Örebro
University, Örebro, Sweden

S. J. Linton
Department of Occupational and Environmental Medicine,
Örebro, Sweden

the “Decade of the Flags” Working Group
Staffordshire, UK

Low back pain (LBP) continues to be a leading cause of suffering and work disability in the industrialized world. While most working-age adults with acute back pain appear to fully recover or manage their condition with few work absences, others experience chronic or recurrent back pain with significant periods of work disability [1, 2]. Considerable controversy remains about the most appropriate forms of treatment [3], whether diagnostic tests and specialty referrals should be recommended [4, 5], and how to provide patients with helpful advice and support to prevent disability [6–9]. Most remarkable is the failure of anatomic and physiologic information to provide a dependable physical basis for prognosis once any serious underlying pathology has been ruled out [10]. Instead, epidemiologic evidence suggests personal circumstances, pain beliefs, and other non-medical factors are more important in the perpetuation of chronic pain and disability [11, 12]. One important grouping of prognostic variables for back disability is that of occupational factors. The following article summarizes recommendations of an expert panel that was convened to address a number of prognostic variables for back disability, including occupational factors.

Characteristics of work and the work environment have emerged as predictors of back pain and disability, even after controlling for a host of other psychosocial, demographic, and health variables [11–14]. Although consensus treatment guidelines for back pain have underscored the importance of occupational factors [15], the development and dissemination of specific methods for clinicians to assess and intervene on these factors have been limited [16]. Even among specialists in occupational medicine and rehabilitation, many obstacles exist for intervening in the workplace, including barriers to employer communication, limited information about job tasks and prospects for modifying work, and employers unwilling or unable to provide modified or transitional work [17–19]. Thus, more research is needed to support optimal methods for interpreting and intervening on occupational factors. In particular, authors have emphasized the need to reduce the growing list of workplace variables to a manageable set of core factors, improve the accuracy and utility of patient screening, and develop effective and plausible intervention strategies to address workplace concerns [17, 20–22].

The Concept of “Flag identification”

One clinical assessment method for LBP that has gained particular attention and includes occupational factors is the “yellow flags” screening approach developed by Kendall, Linton, and Main [23], which builds on the concept of

medical “red flags”. The goal of this method was to draw clinical attention to the psychosocial and workplace factors contributing to back disability after pain onset [24]. While medical red flags (e.g., fever, widespread neurological symptoms, violent trauma, Cauda equina syndrome, structural deformity) were familiar to clinicians as possible signs of more serious spinal pathology (e.g., spinal tumor and infection, inflammatory disease), yellow flags were conceived as important prognostic factors among patients with typical, non-specific episodes of LBP. The original list of yellow flags encompassed many domains, including attitudes and beliefs about back pain, behaviors, compensation issues, diagnosis and treatment, emotions, family, and work [23].

In recent years, this system has been refined in scope and concept [25], and workplace factors that were previously included as yellow flags now occupy two separate categories: “black flags”, actual workplace conditions that can affect disability; and “blue flags”, individual perceptions about work, whether accurate or inaccurate, that can affect disability. As shown in Table 1, blue flags have been conceptualized as worker perceptions of a stressful, un-supportive, unfulfilling, or highly demanding work environment. Black flags include both employer and insurance system characteristics (Category I) as well as objective measures of physical demands and job characteristics (Category II).

While the flags system of assessment has been helpful to translate a large body of epidemiological evidence into a single clinical assessment method, questions still remain about the most reliable and effective means of assessing prognostic factors, how to use this information in clinical decision-making, whether it improves patient outcomes, and how to disseminate this approach for widespread use [26, 27]. Differences between health care systems and insurance benefit structures can also impact decisions about patient screening and early intervention [28].

Further refinement of methods to assess clinical, workplace, and policy factors in back disability might be facilitated by formal discussions among leading researchers and clinicians. To provide such a forum, a 3-day conference (“Decade of the flags: Identifying and managing modifiable risk factors in musculoskeletal disability”) was held with 21 participants (the “Decade of the Flags Working Group”) at Keele University, Keele, UK, September 18–20, 2007. As a result of the conference, a number of papers have been initiated to provide updates concerning clinical, psychological, organizational, and policy factors in chronic back pain and disability. The following article focuses on individual-level occupational factors that might be assessed through brief interactions with patients or employers (i.e., “blue flags”). Objectives of the authors were: (1) to identify a core set of

Table 1 A summary of workplace factors in the existing “flags” method for screening patients with LBP

Item	Type of assessment	Flags categorization	Description
1	Clinical interview	Blue flag	Work history, including patterns of frequent job changes, experiencing stress at work, job dissatisfaction, poor relationships with peers or supervisors, lack of vocational direction
2	Clinical interview	Blue flag	Belief that work is harmful; that it will do damage or be dangerous
3	OMPQ	Blue flag	Fear of re-injury (“I should not do my normal work with my present pain”)
4	OMPQ	Blue flag	Expectations of RTW (“In your estimation, what are the chances that you will be working in 6 months?”)
5	OMPQ	Blue flag	Job satisfaction (“If you take into consideration your work routines, management, salary, promotion possibilities and work mates, how satisfied are you with your job?”)
6	OMPQ	Blue flag	Physical job demands (“Is your job heavy or monotonous?”)
7	Clinical interview	Blue flag	Unsupportive or unhappy current work environment
8	Clinical interview	Black flag—Category I	Low educational background, low socioeconomic status
9	Clinical interview	Black flag—Category I	Minimal availability of selected duties and graduated return to work pathways, with unsatisfactory implementation of these
10	Clinical interview	Black flag—Category I	Negative experience of workplace management of back pain (e.g., absence of a reporting system, discouragement to report, punitive response from supervisors and managers)
11	Clinical interview	Black flag—Category I	Absence of interest from employer
12	Clinical interview	Black flag—Category II	History of manual work, notably from the following occupational groups: fishing, forestry, and farm workers; construction, including carpenters and builders; nurses; truck drivers; labourers
13	Clinical interview	Black flag—Category II	Job involves significant bio-mechanical demands, such as lifting, manual handling heavy items, extended sitting, extended standing, driving, vibration, maintenance of constrained or sustained postures, inflexible work schedule preventing appropriate breaks
14	Clinical interview	Black flag—Category II	Job involves shift work or working unsociable hours

Notes: OMPQ Örebro Musculoskeletal Pain Questionnaire; Category I black flags, job context and working conditions; Category II black flags, content-specific aspects of work; Blue flags, perceptions of a stressful or unsupportive work environment

occupational factors for further study; (2) to assess existing screening methods with respect to occupational factors; (3) to establish key criteria for evaluating the usefulness of screening methods; and (4) to offer recommendations for improving screening methods.

Recent Reviews of Occupational Factors in Back Pain and Disability

A growing number of prospective cohort studies of back pain have evaluated the effects of various factors on the progression from acute to chronic LBP. Most studies have included some combination of predictive factors comprised of demographic variables, workplace concerns, psychosocial variables, and clinical exam findings. Results have shown a trend for psychosocial variables (both individual and workplace) to be overall better prognostic indicators than either demographic or clinical exam findings; however, methodological differences

among studies have led to some discordant conclusions among reviewers. Clearly more work is necessary to sort out the unique and overlapping effects of various workplace and psychosocial variables on the risk of chronic pain and disability.

It was beyond the scope of the Working Group to conduct an updated systematic literature review to synthesize results across existing patient cohort studies. However, to define a core set of occupational factors for further study, we compared the results of several existing literature reviews on this topic. Several systematic reviews have been conducted in recent years to summarize prognostic factors in back disability, and five of these have included workplace factors within their scope of review [11, 12, 29–31]. The scope, methodology and conclusions of these five systematic reviews are shown in Table 2. All five reviews were based on systematic keyword searches of the (English language) medical and psychological literature, but variable criteria led to inclusion of from 10 to 26 overlapping studies. The published reviews also applied different

Table 2 A comparison of five systematic literature reviews summarizing occupational factors in back disability

Review	Inclusionary criteria		Articles reviewed	Review methodology	Conclusions (occupational factors only)		
	Data source	Inclusionary criteria			Supported	Not supported	Insufficient evidence
Shaw et al. [12]	MEDLINE (1970–2000)	Prospective cohort studies of prognosis for RTW within 6 months after onset of work-related LBP	22 of 340 studies met inclusion criteria; quality of study methods was not assessed	For factors assessed in at least three studies, conclusions were based on a majority of studies showing supporting evidence	Co-worker support; self-reported physical demands; recent hire; delayed report of injury; RTW expectations; fear of re-injury	Objective measurement of physical demands; job satisfaction	Company size, availability of modified work, unscheduled breaks
Crook et al. [11]	MEDLINE, PsycINFO, EMBASE (1965–2000)	Prospective cohort studies of prognosis for RTW within 6 months after onset of non-specific, work-related LBP	68 of 2,170 abstracts met initial screening criteria; 19 met criteria for high quality studies	Conclusions based on supporting evidence from any of the 19 high-quality studies	Job satisfaction, co-worker support, unscheduled breaks, work tempo, work quantity; recent hire; availability of modified work	(not reported)	(not reported)
Waddell et al. [29]	MEDLINE, PsycINFO, EMBASE, subject experts, citation tracking	Large ($n > 500$) longitudinal studies assessing prognostic factors for RTW or work incapacity for any health reason (majority of studies focused on LBP)	18 literature reviews and eight prognostic studies were consulted to assess overall level of evidence	Strong, moderate, or weak evidence was determined from number and overall quality of studies	Strong evidence for job satisfaction, RTW expectations, type of occupation. Weaker evidence for job stress, co-worker support, physical demands	(not reported)	(not reported)
Hartvigsen et al. [31]	MEDLINE, PsycINFO, OSHROM (1990–2000)	Prospective cohort studies assessing risk factors for consequences of non-specific LBP in a working population	40 of 1,005 titles met inclusionary criteria; ten met criteria for high quality studies	Strong, moderate, or insufficient evidence was determined from consistency of results, relative risk, and study quality	None supported	Strong evidence for organizational aspects (e.g., job demands); moderate evidence for social support, job stress	Perception of work (e.g., job satisfaction)
Steenstra et al. [30]	MEDLINE (1966–2003)	Prospective cohort studies of prognosis for sick leave duration within 6 months of initial work absence	18 of 1,063 titles (14 studies) met inclusionary criteria	Strong, moderate, or insufficient evidence was determined from consistency of results and study quality	Strong evidence for heavy work; Moderate evidence for availability of modified work	Strong evidence for occupation type, company size, overtime work	Vibration, work tempo or quantity, awkward postures, job difficulty, sitting and walking

methods for synthesizing results, and this may have contributed to variable conclusions, as shown in the last three columns of Table 2. For example, job satisfaction was supported in two reviews [11, 29], not supported in one review [12], and had insufficient evidence in a fourth review [31]. Another notable difference was that job stress and social support were supported in some reviews and not by others. Only one review took magnitude of effect (relative risk) into account when drawing conclusions [31]. When methodological rigor of studies was given greater emphasis, the reviewers tended to conclude weaker associations or concluded insufficient evidence.

Though not conclusive, these literature reviews provide a tentative shortlist of workplace variables that might be included in the further development of patient screening methods. If all factors supported by at least one review are included, then the preliminary core set of workplace factors would include the following seven variables: heavy physical demands, ability to modify work, job stress, social support, job satisfaction, RTW expectation, and fear of re-injury. These variables suggest that occupational factors in back disability include physical and psychological demands, as well as social/managerial factors and worker perceptions and beliefs.

Reviews of prognostic factors in LBP chronicity have also noted heterogeneity/variety across studies in the selection of prognostic variables, assessment methodology, and choice of outcome measures, and this has limited the ability to pool results across studies. Several variables (e.g., monotonous work, conflicts at work) have been assessed in only one or two prospective cohort studies; thus, these variables have had insufficient evidence in most systematic reviews. Other notable problems include differences in statistical modeling techniques, duration of follow-up, population setting and sampling strategy, and the inclusion of different sets of covariates when testing independent associations with outcomes [32, 33]. Research in this area might be strengthened by adopting greater consistency in variable selection and methodology among researchers designing future patient cohort studies.

Reviewers also noted the absence of a conceptual framework for creating meaningful and uniform categories of workplace variables. In the review by Hartvigsen et al. [31], efforts to group and analyze variables within four clusters (perception of work, organizational aspects, social support, and stress) appeared to diminish associations with outcomes, which led to mostly inconclusive or negative findings. Some authors have made distinctions between physical and psychological/organizational workplace variables [30, 34], between those factors controlled by worker, workplace, healthcare providers, or insurers [35], between individual-level and workplace-level variables [36], between modifiable and non-modifiable variables [22], or

between subtypes of high-risk patients [37, 38]. Although these distinctions have been incorporated in various conceptual models for return-to-work [35, 39, 40], most existing cohort studies have included variables of convenience (e.g., from administrative datasets) rather than variables chosen from an a priori conceptual framework.

Screening Methods for Assessing Workplace Factors

Although there are increasing numbers of prospective cohort studies of back pain prognosis, only a few researcher groups have attempted to translate prognostic findings into clinical screening tools. In addition to the Yellow Flags method described in Table 1, a number of other questionnaires, interview guides, and assessment procedures have been developed to assess prognostic factors in back disability, including occupational factors. Rather than provide an exhaustive review of these measures, we have chosen six that provide a representative sampling of other approaches. These include the Örebro Musculoskeletal Pain Questionnaire (OMPQ) [41], the Psychosocial Risk for Occupational Disability Instrument (PRODI) [42], the Back Disability Risk Questionnaire [43], the Work Disability Diagnosis Interview (WoDDI) [44], the Obstacles to Return-to-Work Questionnaire (ORQ) [45], and a Participatory Ergonomics (PE) approach described by Loisel et al. [46, 47]. Each of these screening methods is described in Table 3.

Types of workplace factors identified in the systematic literature reviews and assessed using the seven screening methods are illustrated in Table 4 where it can be seen that a total of 27 occupational variables are included in at least one of these screening methods. We have categorized these 27 variables into four groups that connote different intervention strategies. Four variables describe physical demands of work, five describe psychological demands, twelve represent social/managerial factors, and six include general workplace perceptions. While workplace physical demands might be addressed through temporary work restrictions or modifications, psychological factors may require cognitive-behavioral strategies to cope with job strain. Social/managerial factors suggest a stronger role of providers in communicating with employers, coordinating the return-to-work process, and suggesting administrative forms of job accommodation. Personal perceptions that work is dissatisfying, dangerous, or likely to cause re-injury may be important mediators of back disability, but it's unclear whether interventions should strive to modify these beliefs in the absence of other workplace modifications or coordination efforts.

It's important to note that most of the prognostic variables within these four domains represent opportunities for

Table 3 Descriptions of several existing patient screening methods for LBP in relation to occupational factors

Title	Description	Overall assessment domains	Occupational factors included	Key findings
Örebro Musculoskeletal Pain Questionnaire (OMPQ) [41]	24-item patient self-report questionnaire for risk stratification	Patient background, physical functioning, fear-avoidance beliefs, experience of pain, reactions to pain, work	Heavy or monotonous work, RTW expectation, unable to work with current pain level	Sensitivity 77%, specificity 75%. Workplace predictors are heavy or monotonous work, RTW expectation, and unable to work with current pain level
Psychosocial Risk for Occupational Disability Instrument (PRODI) [42]	122-item patient self-report questionnaire for risk stratification	Sociodemographic, medical history and physical exam, psychosocial, pain behavior, work	Skill discretion, decision authority, job security, co-worker and supervisor support, control, overall support, resources, RTW expectation, employer response	Sensitivity 61%, specificity 89%. Workplace predictors are RTW expectations and employer response
Back Disability Risk Questionnaire (BDRQ) [43]	16-item patient self-report questionnaire for risk stratification	Health perception, psychosocial factors, work factors	Physical work demands, RTW expectation, availability of modified duty, delay in reporting problem, negative supervisor responses	Sensitivity 74%, specificity 70%. Notable workplace predictors are modified duty availability, delay in reporting to employer, and physical job demands
Guide to assessing psychosocial yellow flags [23]	OMPQ questionnaire followed by clinical interview for screening and targeting patients	Pain attitudes and beliefs, behaviors, compensation issues, diagnosis and treatment, emotions, family, work	Manual work, bio-mechanical demands, shift work, negative employer response, modified duty, unsupportive work environment, belief that work may be harmful, fear of re-injury, work history	Inter-rater agreement fair or better. Work psychosocial risk factors predict likelihood of future work absence, but not duration of work absence
Obstacles to RTW Questionnaire(ORQ) [45]	55-item patient self-report questionnaire Main objective: risk stratification	Physical and psychosocial factors affecting musculoskeletal pain in the workplace	Difficulties at work return, physical workload and harmfulness, social support, worries about sick leave, work satisfaction, RTW expectation	Sensitivity 68%, specificity 68%. Notable workplace predictors are RTW expectation, social support, physical workload and perception that work is harmful
Work Disability Diagnosis Interview [44]	6 patient questionnaires followed by a 3-hour clinical interview Main objective: risk stratification	Demographics, work history, pain syndrome, general health and health history, family and social history, medical history and physical examination, work environment, patient perception of disability status	Job satisfaction, work history, occupation and industry type, prior attempts to RTW, absence duration, job demands, ergonomic risk factors, work schedule, job control, environmental conditions, diversity of work tasks, working relationships	Prediction of outcomes still under study. Most frequently reported workplace problems are job demands, mismatch with physical capacities, long duration absence
Participatory Ergonomics (PE) approach [47]	On-site inspection and worker interview Main objective: risk stratification	Physical job demands, ergonomic factors, perspectives of worker and supervisor, perceived barriers to RTW	Physical job demands, ergonomic risk factors, perspectives of worker and supervisor, perceived barriers to RTW	Intervention involving PE assessment shown to generate more work modifications and improve RTW outcomes

Table 4 Workplace factors affecting back disability within four domains as indicated by past literature reviews and patient screening methods

Variables by domain:	Evidence from systematic literature reviews					Workplace factors assessed by seven screening methods						
	Shaw [12]	Crook [11]	Waddell [29]	Hartvigsen [31]	Steenstra [30]	OMPQ [41]	PRODI [42]	FLAGS [23]	WoDDI [44]	ORQ [45]	BDRQ [43]	PE [47]
Physical demands												
Heavy physical demands	X		X		X	X	X	X	X	X	X	X
Ability to modify work	X	X			(no effect)							X
High-risk industry					X							X
Driving					X							
Psychological demands												
Monotonous work						X	X	X	X			
Job stress	X			(no effect)		X	X	X				
Lack of control		X				X						
Emotional effort of work						X						
Poor work environment						X						
Social/managerial factors												
Social support/dysfunction	X		X	(no effect)	X		X	X	X			
Short job tenure	X		X				X	X		X		
Frequent job changes							X	X				
Delayed notice to employer	X											
Lack of vocational direction							X					
Inflexible work schedule							X	X				X
Night shift/unsociable hours							X	X				
No gradual RTW pathways							X	X				X
Absence of employer interest							X					
Negative employer response							X					
Small firm size							(no effect)					
Overtime work							(no effect)					
Workplace beliefs												
Job satisfaction		X			(no effect)	X	X	X	X	X	X	
Belief work is dangerous							X		X			
Expectation for RTW						X	X	X	X	X	X	
Fears of re-injury		X				X	X	X	X	X	X	X
Worries about work absence									X			
Barriers/facilitators for RTW								X				X

Notes: OMPQ Örebro Musculoskeletal Pain Questionnaire; WoDDI Work Disability Diagnosis Interview; PRODI Psychosocial Risk for Occupational Disability Instrument; ORQ Obstacles to Return-to-Work Questionnaire; BDRQ Back Disability Risk Questionnaire; FLAGs yellow flags assessment method; PE Participatory Ergonomics approach; RTW return to work

intervention both at the individual and organizational policy level. In this article, we focus on interventions for individual workers, although workplace interventions at the organizational level have also shown promise [48]. One question is whether workplace factors that are not modifiable (e.g., job tenure, company size) should be included in patient screening efforts. While these variables may be helpful to identify patients at greatest risk for disability, they provide no obvious opportunities for intervention. Perhaps modifiable factors should be separated from other prognostic indicators when interpreting screening results. Another question is whether workplace beliefs are truly modifiable. Intervention trials have typically reported disability outcomes (return-to-work or sickness absence) without assessing changes in workplace beliefs that might explain improved outcomes. Thus, it's unclear whether it's necessary to alter these beliefs in order to prevent back disability.

Several conclusions can be drawn from the existing efforts to develop and validate patient screening methods for assessing back pain prognosis. Firstly, accuracy of self-report questionnaires to predict disability outcomes has been moderate (generally from 70 to 80%) in initial patient cohorts, but there have been few efforts to reproduce these findings in different settings or among subsequent patient cohorts. One exception is the OMPQ, which has been translated into several languages and applied in different settings with similar results [49]. This questionnaire, however, includes only five questions related to the workplace.

Secondly, is the observation that interview methods have generally covered a larger range of workplace topics than are covered by patient questionnaires, and interviews would presumably lead to a greater level of detail about problem areas that might be the focus of intervention. However, there have been few efforts to establish the reliability or predictive accuracy of interview results.

Thirdly, a distinction can be made among the various assessment methods. Some were designed to provide a quantification of disability risk in research cohorts, whereas others were designed as practical tools to guide clinical interviewing. While predictive performance provides a useful metric for evaluating the validity of a risk stratification measure, other methods may be necessary to evaluate whether "screening and targeting" tools actually improve clinical decision-making or lead to more appropriate types of intervention. Perhaps risk stratification questionnaires might be more appropriate during the acute stage and more detailed methods should be used when there is a more prolonged absence from work (sub-acute or chronic back pain). The more detailed methods may be better equipped to detect idiosyncratic problems that are obstacles to RTW, while this level of detail may be

impossible to achieve using only brief patient questionnaires. Therefore, a stepped method of screening involving multiple methods (questionnaire, interview, worksite visit) may provide an effective and efficient approach to identifying obstacles to recovery in the workplace.

The Nature of Intervention Strategies

Intervention strategies for preventing back disability have emerged from a number of fields including ergonomics, occupational medicine, kinesiology, occupational and physical therapy, psychology, and rehabilitation science. While there is evidence that long-term disability risk increases substantially with each additional week away from work [50], recommended strategies for facilitating RTW have varied considerably [51]. Some interventions have focused on employer efforts to reduce ergonomic exposure or improve support from supervisors and co-workers [52–55]. Others have focused on managing or coordinating medical care or modifying provider behavior [18, 56]. Still others have focused on improving patient readiness through physical training, education, or counseling [57, 58]. Ideally, patient screening methods should not only identify high-risk patients, but provide some indication of the type of intervention that might be most beneficial.

Discussions of the Working Group concerning workplace-focused interventions led to the identification of four principal categories: (1) physical (e.g., work simulation); (2) psychological (e.g., counseling and education); (3) organizational (e.g., employer support and communication); and (4) ergonomic (e.g., temporary job modifications). Given these principal intervention categories, it seems feasible that screening methods might be designed to provide clinicians with guidance in selecting from these alternatives. One approach would be to design a screening method that produces a score within each of these principal domains. For example, a patient who reports average levels of organizational support, but describes highly physical and inflexible work demands might be a good candidate for an ergonomic form of intervention. Another patient who describes average physical workplace conditions but reports high level of job stress and dissatisfaction might be a better candidate for a psychological form of intervention. Although this concept has merit, it's unclear whether patients can be typified in this way, and these problems may be highly inter-correlated. Although there is some preliminary evidence for sub-typing of high-risk patients [37, 38], there is substantial overlap among groups, and the benefits of channeling patients to early workplace intervention based on screening profiles are unknown.

How can Screening Methods and Results be More Useful to Clinicians?

Although existing questionnaires and interview techniques have shown some degree of success in identifying patients at risk for developing chronic pain and disability, the measures have seen limited dissemination in clinical practice, perhaps because the predictive performance of some tools has not been sufficiently demonstrated, or more importantly, screening results have not been linked to appropriate early intervention strategies. Other problems include errors in classifying patients, the time and effort required to administer and score assessment measures and discuss results with patients, and limited treatment options for addressing workplace and psychosocial concerns. Some providers may feel reluctant or unprepared to explore these non-medical domains, despite their prominence in published medical guidelines for treatment of LBP.

The Development of Screening Criteria

To chart a course for future work in this area, it's important to establish key evaluative criteria that might be used for the design and testing of future assessment methods. Although much has been reported about the methodological shortcomings of risk prediction studies for LBP [11, 33, 59], we are aware of no publications that have summarized practical issues that may be of primary concern to stakeholders (workers, clinicians, insurers, and employers) in the design of screening instruments. To provide both a practical and technical set of specifications for the development of future assessment methods, the Working Group identified five evaluative criteria: reliability, predictive performance, feasibility, congruence with plausible interventions, and acceptability. Each of these criteria is explained in the following sections:

Reliability

Patient screening methods must have some demonstrated level of consistency, both in terms of inter-observer agreement and repeat administrations. Test-retest reliability has been rarely reported for LBP screening questionnaires [33], and level of inter-observer agreement on ratings of patient prognosis has been fair or poor [13].

Predictive Performance

Although most screening questionnaires have reported 70–80 percent correct classification of patients who will go on to experience chronic pain and disability, positive

predictive value (PPV), or the ratio of true positives to test positives, may be a more meaningful parameter for evaluating classification accuracy. For example, the BDRQ correctly classified 74.3% of those unable to return to work after 1 month, but the PPV was only 44 percent [43]. Thus, of patients identified as high-risk, only 44 percent of this group would have failed to return to work. With a higher PPV, costs for treating false positives are more likely to be offset by improved outcomes among true positives.

Feasibility

With the increasing demands being placed on health care providers to provide efficient care, it's important that any additional patient questionnaires, interviews, meetings, or observations within the clinical or workplace setting be easy to administer, interpret, and apply. Besides time demands, other feasibility issues are whether screening methods can be routinely administered, the training required to conduct screening protocols, and the cost of special equipment, meetings, or professional expertise.

Congruence with Plausible and Effective Interventions

One shortcoming of existing screening methods is that they fail to generate specific recommendations for early intervention. While screening may provide some indication that workplace factors are a reason for concern, it's not clear whether these problems should be solved through patient counseling and education, a telephone call to the employer, a change in work restrictions, or an ergonomic job analysis. Also, some screening items represent demographic or non-modifiable factors. The design of patient screening methods should take into account existing options for early intervention or propose alternative intervention strategies that might link to positive prognostic factors. The real test of an effective clinical screening tool is that it not only identifies high-risk patients but also leads to improved outcomes as a result.

Acceptability

The subject matter of screening methods should appear reasonable and appropriate to patients, and screening should convey a central interest in adapting treatment plans to the personal beliefs, concerns, and expectations of the patient. In some insurance or health care systems, confidential patient data may be shared with employers, and this may limit the willingness of patients to share personal information. Also, patients may find screening unacceptable if there is an implication that pain and disability are attributed to personality flaws, aberrant views, or poor coping skills.

Consideration of Types of Assessment

Although brief patient questionnaires and semi-structured clinical interviews have been the primary mode of screening patients for risk of chronic disabling LBP, other modes of assessment might be considered as additional alternatives. To evaluate potential assessment modes for identifying high-risk patients, we examined six possible modes of assessment (patient questionnaire, interview, worksite meeting, objective measurement, administrative data, and clinical impressions) with respect to our five evaluation criteria. The results of this comparison are shown in Table 4, and the primary findings described below:

Patient Questionnaire

A patient questionnaire represents a highly feasible method with good reliability and predictive performance. A questionnaire is acceptable to most patients if administered routinely. Primary disadvantages are a lack of detail in describing potential problems and no link to plausible interventions.

Semi-structured Clinical Interview

An interview is a feasible and reliable method that provides individual-level detail and may generate tentative options for intervention. This would be acceptable to most patients if included as a part of routine clinical interviewing. The predictive performance of clinical interviews for LBP has rarely been studied, and the ability of interviews to produce more effective intervention strategies has not been tested.

Worksite Meeting and Inspection

Worksite meetings can provide an opportunity to inspect the physical work environment, observe job demands, assess organizational and social support, and understand idiosyncrasies of individual work settings. They are a moderately feasible, yet more costly, method with unknown reliability and unknown predictive performance. A worksite meeting might provide individual-level job detail, engage multiple stakeholders, and facilitate collaborative problem-solving. A worksite meeting would be acceptable to most patients if facilitated or mediated by an independent third party. This option requires significant staffing resources and specialized training.

Objective Measurement

Objective or instrumented assessment of job demands (e.g., recording workstation dimensions, taking load or force measurements, or videotaping jobs for task analysis of

ergonomic risk factors) provides a highly reliable and accurate method for assessing physical workload, but with poor predictive performance compared with self-report. This level of assessment is rarely feasible for routine use in patient screening due to the need for specialized professional expertise and instrumentation Table 5.

Administrative Data

Collecting screening data from administrative data of employers, insurers, or health care systems is potentially feasible, but the information would be limited in scope, and accessing these data may raise privacy concerns.

Clinical Impressions

Allowing clinicians to screen patients based on initial impressions after a physical exam is a highly feasible method, but with poor reliability and predictive performance, and subject to personal bias. This method would be acceptable to most patients (status quo). It's not clear whether clinical history-taking of occupational factors could be improved with brief coaching or instruction.

How can Research Provide a Stronger Evidence Base for Patient Screening?

In light of the aforementioned advantages and disadvantages of various assessment methods, how can future research efforts be improved to address some of these concerns? There are a sizable number of longitudinal studies examining prognostic factors for LBP chronicity, but most have been designed to identify new prognostic factors or create more accurate prediction models for stratifying patient risk, not to suggest an appropriate basis for early intervention. The following is a discussion of future research directions that might provide a stronger evidence base for patient screening:

Improve Reliability and Prediction Accuracy

Because the strongest workplace predictors of LBP disability appear to involve subjective ratings by patients, several questions may be necessary to reduce the random error inherent in measuring perceptions of hypothetical constructs like physical work demands, perceived organizational support, and fears of re-injury. Many existing questionnaires have included only a single item to describe rather complex constructs, sacrificing reliability in order to assess many disparate factors in a single questionnaire. Other problems are the lack of external validation for screening tools across diverse settings and populations, and

Table 5 Advantages and disadvantages of various modes of assessment for routine screening of occupational factors in back disability

Mode of assessment:		Evaluation criteria			
	Reliability	Predictive performance	Feasibility	Congruence with plausible interventions	Acceptability
Patient questionnaire	Good. But improving reliability of individual factors may require a larger number of items, and this has implications for feasibility	Fair to good. 70–80% prediction accuracy, but greater sensitivity and specificity may be required for clinical decision-making	Very good. Feasibility is greatest if the patient questionnaire is brief (<10 min) and can be self-administered in primary care settings	Poor. Existing questionnaires have been designed to establish risk, not to provide treatment recommendations	Fair. Some patients may be reluctant to share opinions about the workplace due to confidentiality concerns and fears of reprisal
Semi-structured interview	Fair. Inter-rater agreement (kappa) has been 0.41 or above	Not evaluated	Good. Feasibility depends on level of training and expertise necessary to conduct effective interviews	Good. Open-ended, in-depth discussion likely to generate tentative options for overcoming problems related to pain at work	Good. Interviews must be conducted routinely to avoid perceptions that some have been singled out for greater scrutiny
Worksite meeting	Not evaluated	Not evaluated	Fair. Requires significant staffing resources and coordination, but preliminary evidence that costs may be offset by improved outcomes	Very good. Worksite visit may help to initiate discussions about ways to modify work or overcome problems related to pain at work	Good. Worksite visits with supervisors and other stakeholders have been well accepted in intervention trials, but some employers or workers may object
Clinician impressions	Poor. Inter-observer disagreement low due to variations in training, expertise, pain beliefs, and clinical setting	Poor. Clinician impressions of long-term prognosis are less accurate than self-report questionnaires	Very good. Clinical impressions can be easily generated from patient exam and interview results	Good. Patient interviewing may generate tentative options for overcoming specific work problems	Very good. Establishing prognosis for recovery is a commonly accepted goal for patient interviewing
Objective measurement	Very good. The reliability of instrumented or observational assessments of job demands has been high	Poor. Objective assessments of physical work demands have been generally poor predictors of RTW	Poor. Requires significant staffing resources and technical expertise	Fair. Although useful for job modifications, other organizational and administrative factors may be overlooked	Very good. Both employers and workers recognize the significance of physical work demands
Administrative data	Good. Administrative databases maintained by employers and insurers are typically focused on factual information, not subjective assessments	Poor. Administrative data sources typically lack sufficient detail and key variables necessary to accurately predict back outcomes	Very good. Information may be easily accessed from existing employer or insurance company records	Poor. Administrative records have been designed to document, rather than guide, intervention efforts	Poor. Exchange of confidential records between employers and clinicians may be objectionable to workers and organized labor

the failure to amend or supplement existing measures when preliminary findings are disappointing.

Improve the Theoretical and Conceptual Framework for Risk Identification

The majority of screening questionnaires have included a large number of disparate factors, and this may reduce credibility of the hypotheses underlying screening efforts for a clinical audience. Perhaps a smaller number of factors could be identified as the most crucial in LBP disability, and screening methods could be focused on measuring these factors as completely or reliably as possible, rather than attempting to uncover problem areas from a long laundry list of potential concerns. The recommendation of the Working Group is that future studies focus on the seven key factors supported by systematic reviews: heavy physical demands, ability to modify work, job stress, social support, job satisfaction, RTW expectation, and fear of re-injury. Another issue is what outcome should be used to test the accuracy and utility of screening methods. Although a full-duty return-to-work has been the gold standard in many studies, this outcome variable may underestimate persistent patterns of pain and physical dysfunction among those with less physical work. Choosing a duration of outcome (1 month, 3 months, etc.) is another critical factor in assessing the predictive performance of a patient screening method. If the goal of patient screening is to reduce the likelihood of chronic pain and disability, then it seems unlikely that outcomes need to be assessed beyond three to 6 months (the usual demarcation for “chronic” pain).

Adopt Consistent Scales and Screening Procedures

With the possible exceptions of work demands, job satisfaction and social support, the lists of workplace variables included in prospective studies of LBP have varied tremendously. This has complicated efforts to synthesize findings across studies and has led to seemingly contradictory conclusions among researchers. Another issue that could be answered empirically is when in the course of LBP assessment of prognostic factors is optimal in terms of reliable assessment and effective intervention? Repeated assessments (say, first week and second week after pain onset), may also provide a very useful prognostic tool, although this approach has not been evaluated.

Establish and Validate Normative Data and Cut-off Scores

If screening methods are to be feasible for widespread clinical use, then a numerical rating system of some sort

may be necessary to facilitate easy interpretation of assessment results. While such quantification methods are simpler for patient questionnaires than for other modes of assessment (e.g., interviews, worksite meetings), such a system can simplify clinical decision-making considerably. The disadvantage is that some important patient idiosyncrasies may be lost in a quantification of risk. The purpose of the screening tool needs to be carefully defined so that optimal trade-offs between can be made between depth of screening and net improvement in outcomes.

Integrate with Workplace Intervention Strategies

Perhaps most disconcerting to clinicians is that efforts to estimate prognosis for LBP disability have not been coupled with new strategies for reducing risk factors or informing treatment decisions. For a patient who is classified as high-risk, should intervention focus on changing the workplace environment, modifying individual patient beliefs, or simply improving communication among stakeholders? Results of screening might indicate scores within several key domains, where each domain is linked to a list of possible interventions.

Strengths and Limitations

The goal of this “expert panel” approach was to address challenges and opportunities in patient screening based on the shared experience of a number of researchers and clinicians in the field of back disability. Strengths of this approach are the diversity and experience of the Working Group, as well as the opportunity to discuss a variety of viewpoints and suggestions over a 3-day conference. Obvious limitations of the expert panel approach include its subjective nature and the potential for personal biases among participants. Although five existing literature reviews were provided to conference participants as a pretext for the meeting, an updated systematic review of the literature was not conducted as a part of this endeavor, and future systematic reviews of LBP patient cohorts may provide new information and insights.

Conclusions and Recommendations for Research

The first goal of the Working Group was to build some consensus as to the core occupational factors that should, as a minimum, be included in a patient screening method. Participants identified seven core factors based on existing research: physical job demands, ability to modify work, job stress, social support or dysfunction, job satisfaction,

expectation for return-to-work, and fear of re-injury. Future cohort studies should strive to measure these factors reliably, to establish some uniformity across studies, and to analyze the unique and shared effects of these overlapping constructs. In terms of intervention, stronger efforts should be made to link various workplace intervention strategies to these prognostic factors and to create feasible tools to aid in clinical decision-making. Communication between healthcare providers and employers about transitional duty work might be improved with the routine screening of occupational factors among patients with new onset LBP.

A second goal of the Working Group was to develop a preliminary concept for patient screening that might show some advantages over existing methods. The recommendation was to consider a stepped approach to workplace assessment that might strike a balance between assessment detail and feasibility concerns. This stepped approach to early screening and managing of occupational factors in back disability is described in Table 6. At Step 1, all

patients suffering acute low back pain who feel unable to perform all of their usual work tasks would complete an initial screening questionnaire to determine the severity and nature of workplace concerns that might affect recovery. Based on questionnaire results (and continuing work absence or limitations), those who report significant workplace barriers or concerns would complete a follow-up clinical interview one week later to provide more individual-level details, to engage the worker in early problem-solving, and to generate a tentative list of possible solutions. Those who report significant workplace problems and concerns in the interview would be scheduled to attend a follow-up worksite meeting. The goal of the meeting would be to compare physical job demands with perceived work limitations, to assess levels of organizational and supervisor support, and to develop a plan and timeline for job accommodation and workplace re-integration. Such a stepped approach requires further evaluation in terms of improved patient outcomes and feasibility and acceptability for routine use by clinicians.

Table 6 A hypothetical stepped-care approach for early screening and managing of occupational factors in back disability

Level of screening	Targeted patients	Time of assessment	Tool	Goals of assessment	Workplace-focused intervention
Step 1	All patients with acute LBP who feel unable to perform or resume usual work	Initial medical evaluation for acute low back pain	Brief screening questionnaire	To identify patients with most significant workplace concerns	For patients with greatest workplace concerns, initiate employer contact, assess relative ease of accommodation, estimate level of employer support, and schedule more detailed patient interview
Step 2	All patients with lingering pain and work dysfunction (>2 weeks) and reporting significant workplace concerns in Step 1	First or second follow-up medical visit	Clinical interview	To provide a more detailed description of workplace concerns and engage worker in early problem-solving	Develop tentative list of workplace problems and possible solutions, and schedule worksite visit
Step 3	All patients with persistent pain and work dysfunction (3–4 weeks) and significant workplace concerns in Steps 1 and 2	Sometime between initial evaluation and full duty RTW	Worksite meeting and observation	To assess observed physical job demands, perceived work limitations, work environment, and levels of supervisor and co-worker support	Analyze job tasks with respect to physical limitations, tailor work restrictions or job modifications based on observed physical job demands, work environment, and levels of supervisor and co-worker support; Develop plan to implement job accommodations, assign responsibilities, agree on tentative timeline and follow-up

Conclusions and Recommendations for Implementation

A number of practical barriers remain for screening of workplace factors (“blue flags”) to be adopted on a large scale by health care providers, to be integrated with medical and disability management guidelines, and to be endorsed by insurers and payers of medical benefits. With regard to blue flags, recommendations of the Working Group for more widespread implementation are to: (1) expand the responsibilities of clinicians (or their agents) to include workplace concerns; (2) design easily administered tools that require minimal time and interpretation; (3) improve access to early intervention for high-risk cases; and (4) avoid stigma to workers identified as “high risk”.

Medical providers in most disability systems have been assigned a central role in making disability determinations, issuing physical restrictions, and recommending when normal job responsibilities should be resumed. Yet, clinicians rarely communicate with the workplace, few assess workplace concerns, and there are only infrequent attempts to facilitate early intervention targeting the workplace [19]. This is particularly the case for acute low back pain, when symptoms are expected to abate with little or no intervention for the majority of patients. Other reasons that clinicians might be reluctant to explore workplace matters include personal style, clinical training background,

perceived conflicts of interest, or the policies and procedures of insurance or government benefit systems [60]. The use of allied health professionals (e.g., case managers) to coordinate or facilitate return-to-work is one method that may provide a very important and necessary link between clinicians and employers when back-injured workers are at high risk for long-term disability [61].

Given the significant time pressures in primary care and the probabilistic nature of back outcomes, screening methods will not be adopted by providers unless they require minimal time and interpretation. The average initial consultation for work-related low back pain lasts 15 min. Thus, both questionnaires and interviews should be designed to get critical information quickly, and the results should suggest a specific provider action like calling an employer, short-listing problematic job activities from the patient’s perspective, or enlisting a RTW coordinator. If clinicians believe that inquiries into workplace concerns will involve a long and complicated lifestyle discussion with patients that exceeds their scope of services and expertise, then these changes will not be implemented in most practice settings.

Once a high-risk case can be accurately identified based on workplace concerns, clinicians must have a list of possible alternatives to improve the trajectory of such a case. Some practical advice for addressing “blue flags” in

Table 7 Identifying and responding to workplace factors in back disability

Workplace factor:	Sample interview question:	Possible actions:
Heavy physical demands	Are you concerned that the physical demands of your job might delay your return to work?	<ul style="list-style-type: none"> • Assemble list of problem job tasks • Conduct work site walk-through • Identify temporary sources of help
Inability to modify work	Do you expect your work could be modified temporarily so you could return to work sooner?	<ul style="list-style-type: none"> • Modified or alternate duty program? • Brainstorm with injured worker • Assess job flexibility
Stressful work demands	Are there stressful elements to your job that might be difficult when you first return to work?	<ul style="list-style-type: none"> • Modify speed or time pressures • Recognize stressful job elements • Assess usual coping strategies
Lack of workplace social support	What kind of response do you expect from co-workers and supervisors when you return?	<ul style="list-style-type: none"> • Establish more contact with co-workers • Encourage employer communication • Involve trusted co-workers
Job dissatisfaction	Is this a job you’d recommend to a friend?	<ul style="list-style-type: none"> • Assess whether career goals have changed • Clarify worker options and responsibilities • Motivational interviewing
Poor expectation of recovery and return to work	Are you concerned that returning to work may be difficult given your current circumstances?	<ul style="list-style-type: none"> • Clarify nature of concerns • Realistic messages conveyed by all medical providers? • Employer encouragement and reassurance
Fear of re-injury	Are you worried about any repeat episodes of back pain once you return to work?	<ul style="list-style-type: none"> • Develop action plan if symptoms recur • Plan for a more gradual return to work • Counter belief that activity is dangerous

practice are shown in Table 7. Although early intervention would generally involve workplace communication and job task assessment, there are few tools available for providers to recommend more effective and individualized job modifications. Another barrier is the reluctance of insurance companies and other payers of medical benefits to authorize early forms of intervention (e.g., early case management, graded-activity physiotherapy, cognitive-behavioral therapy) that might be more cost-effective if provided only to high-risk patients. Perhaps adoption of screening methods (where early intervention would be recommended in only a small minority of cases) might improve the availability of potential early intervention strategies. Another practical challenge for patient screening is to avoid the unintentional stigmatization of patients who are screened as high risk for back disability. Screening methods should be transparent to patients, and the results should be considered a summary of their workplace concerns and expectations, with the goal of providing better advice and more patient-centered care.

Summary

Results of the conference appear to provide a useful framework for future research and development in this area. All participants acknowledged that while clinicians universally recognize the importance of occupational factors that affect sickness absences due to LBP, there are few tools available to help clinicians identify and address typical workplace problems that can complicate functional recovery. Thus, communication with the workplace rarely occurs, and opportunities for preventing disability may be overlooked. Conclusions of the Working Group suggest a clear link between occupational factors and back disability, but expanding clinician practices in this area will require that patient screening methods show greater conceptual clarity, feasibility, and linkages to viable options for intervention. In addressing this challenge we need an approach linking individually focused worker-centered interventions with interventions at an organizational level. In this process, early identification of modifiable risk factors is a key first step. Designing interventions targeted on such factors, and thereby turning potential obstacles into opportunities for change requires a “systems approach” such as that advocated by the Flags framework.

Acknowledgments The authors would like to acknowledge other members of the “Decade of the Flags” Working Group who contributed to the discussions and conclusions presented in this article: Mansel Aylward, Kim Burton, Peter Croft, Michael Feuerstein, Charles Greenough, Elaine Hay, Nick Kendall, Clement Leech, Michael Nicholas, Ceri Phillips, Glenn Pransky, Mick Sullivan, Johan Vlaeyen, Michael von Korff, Gordon Waddell, and Paul Watson.

Also, special thanks to the Conference Organizing Committee at Keele University: Jo Bailey, Jan Cohen, Kate Dunn, Zoe Mayson, Sue Weir, Ross Wilkie, and Gwennllian Wynne-Jones. Sponsors of the 3-day conference included HCML, Healthcare RM, Ceridian, Rolls-Royce, and Rehab Works, Ltd.

References

1. Von Korff M, Saunders K. The course of back pain in primary care. *Spine*. 1996;21(24):2833–7. doi:10.1097/00007632-199612150-00004.
2. Wasiak R, Kim J, Pransky G. Work disability and costs caused by recurrence of low back pain: longer and more costly than in first episodes. *Spine*. 2006;31(2):219–25. doi:10.1097/01.brs.0000194774.85971.df.
3. Quittan M. Management of back pain. *Disabil Rehabil*. 2002;24:423–34. doi:10.1080/09638280110108850.
4. Deyo RA. Diagnostic evaluation of low back pain: reaching a specific diagnosis is often impossible. *Arch Intern Med*. 2002;162:1444–7. doi:10.1001/archinte.162.13.1444.
5. Tacci JA, Webster BS, Hashemi L, Christiani DC. Clinical practices in the management of new-onset, uncomplicated low back workers' compensation disability claims. *J Occup Environ Med*. 1999;41:397–404. doi:10.1097/00043764-199905000-00008.
6. Hagen KB, Hilde G, Jamtvedt G, Winnem MF. The Cochrane review of advice to stay active as a single treatment for low back pain and sciatica. *Spine*. 2002;27:1736–41. doi:10.1097/00007632-200208150-00010.
7. Hazard RG, Reid S, Haugh LD, McFarlane G. A controlled trial of an educational pamphlet to prevent disability after occupational low back injury. *Spine*. 2000;25:1419–23. doi:10.1097/00007632-200006010-00015.
8. Waddell G, Burton AK. Concepts of rehabilitation for the management of low back pain. *Best Pract Res Clin Rheumatol*. 2005;19:655–70. doi:10.1016/j.berh.2005.03.008.
9. Waddell G, O'Connor M, Boorman S, Torsney B. Working Backs Scotland: a public and professional health education campaign for back pain. *Spine*. 2007;32:2139–43. doi:10.1097/BRS.0b013e31814541bc.
10. Waddell G. *The back pain revolution*. New York: Churchill Livingstone; 2004. p. 153–77.
11. Crook J, Milner R, Schultz IZ, Stringer B. Determinants of occupational disability following a low back injury: a critical review of the literature. *J Occup Rehabil*. 2002;12(4):277–95. doi:10.1023/A:1020278708861.
12. Shaw WS, Pransky G, Fitzgerald TE. Early prognosis for low back disability: intervention strategies for health care providers. *Disabil Rehabil*. 2001;23:815–28. doi:10.1080/09638280110066280.
13. Hoogendoorn WE, van Poppel MN, Bongers PM, Koes BW, Bouter LM. Systematic review of psychosocial factors at work and private life as risk factors for back pain. *Spine*. 2000;25:2114–25. doi:10.1097/00007632-200008150-00017.
14. Linton SJ. Occupational psychological factors increase the risk for back pain: a systematic review. *J Occup Rehabil*. 2001;11:53–66. doi:10.1023/A:1016656225318.
15. Staal JB, Hlobil H, van Tulder MW, Waddell G, Burton AK, Koes BW, et al. Occupational health guidelines for the management of low back pain: an international comparison. *Occup Environ Med*. 2003;60:618–26. doi:10.1136/oem.60.9.618.
16. Waddell G, Burton AK. Occupational health guidelines for the management of low back pain at work: evidence review. *Occup Med (Oxford, England)*. 2001;51:124–35. doi:10.1093/occmed/51.2.124.

17. Costa-Black KM, Durand MJ, Imbeau D, Baril R, Loisel P. Interdisciplinary team discussion on work environment issues related to low back disability: a multiple case study. *Work* (Reading, Mass.). 2007;28:249–65.
18. Loisel P, Durand MJ, Baril R, Gervais J, Falardeau M. Interorganizational collaboration in occupational rehabilitation: perceptions of an interdisciplinary rehabilitation team. *J Occup Rehabil*. 2005;15:581–90. doi:10.1007/s10926-005-8036-x.
19. Pransky G, Shaw WS, Franche RL, Clarke A. Disability prevention and communication among workers, physicians, employers, and insurers—current models and opportunities for improvement. *Disabil Rehabil*. 2004;26:625–34. doi:10.1080/09638280410001672517.
20. Cedraschi C, Allaz AF. How to identify patients with a poor prognosis in daily clinical practice. *Best Pract Res Clin Rheumatol*. 2005;19:577–91. doi:10.1016/j.berh.2005.03.002.
21. Feldman JB. The prevention of occupational low back pain disability: evidence-based reviews point in a new direction. *J Surg Orthop Adv*. 2004;13:1–14.
22. Shaw WS, Linton SJ, Pransky G. Reducing sickness absence from work due to low back pain: how well do intervention strategies match modifiable risk factors? *J Occup Rehabil*. 2006;16:591–605. doi:10.1007/s10926-006-9061-0.
23. New Zealand Accident Compensation Corporation. Assessing yellow flags in acute low back pain: risk factors for long-term disability and work loss. 1997, p. 23–66.
24. Kendall NA. Psychosocial approaches to the prevention of chronic pain: the low back paradigm. *Best Pract Res Clin Rheumatol*. 1999;13:545–54. doi:10.1053/berh.1999.0044.
25. Main, C.J. Concepts of treatment and prevention in musculoskeletal disorders. In: Linton, S.J., editor. *New avenues for the prevention of chronic musculoskeletal pain and disability. Pain research and clinical management*, 2002, vol. 12 (p. 47–63).
26. Bartys S, Burton K, Main C. A prospective study of psychosocial risk factors and absence due to musculoskeletal disorders—implications for occupational screening. *Occup Med*. 2005;55:375–9. doi:10.1093/occmed/kqi052.
27. Frost P, Haahr JP, Andersen JH. Reduction of pain-related disability in working populations: a randomized intervention study of the effects of an educational booklet addressing psychosocial risk factors and screening workplaces for physical health hazards. *Spine*. 2007;32:1949–54. doi:10.1097/BRS.0b013e3181342659.
28. Loisel P, Buchbinder R, Hazard R, Keller R, Scheel I, van Tulder M, et al. Prevention of work disability due to musculoskeletal disorders: the challenge of implementing evidence. *J Occup Rehabil*. 2005;15:507–24. doi:10.1007/s10926-005-8031-2.
29. Waddell G, Burton AK, Main CJ. *Screening to identify people at risk of long-term incapacity for work: a conceptual and scientific review*. London: Royal Society of Medicine Press; 2003.
30. Steenstra IA, Verbeek JH, Heymans MW, Bongers PM. Prognostic factors for duration of sick leave in patients sick listed with acute low back pain: a systematic review of the literature. *Occup Environ Med*. 2005;62:851–60. doi:10.1136/oem.2004.015842.
31. Hartvigsen J, Lings S, Leboeuf-Yde C, Bakketeig L. Psychosocial factors at work in relation to low back pain and consequences of low back pain; a systematic, critical review of prospective cohort studies. *Occup Environ Med*. 2004;61(1):e2.
32. Pransky G, Shaw WS, Fitzgerald TE. Prognosis in acute occupational low back pain: methodologic and practical considerations. *Hum Ecol Risk Assess*. 2001;7:1811–25. doi:10.1080/20018091095410.
33. Linton SJ, Gross D, Schultz IZ, Main C, Cote P, Pransky G, et al. Prognosis and the identification of workers risking disability: research issues and directions for future research. *J Occup Rehabil*. 2005;15(4):459–74. doi:10.1007/s10926-005-8028-x.
34. Loisel P. Pain in the workplace, compensation, and disability management. In: Schmidt RF, Willis WD, editors. *Encyclopedia of pain*. New York: Springer; 2007. p. 1703–05.
35. Loisel P, Durand MJ, Berthelette D, Vezina N, Baril R, Gagnon D, et al. Disability prevention—new paradigm for the management of occupational back pain. *Dis Manag Health Outcome*. 2001;9:351–60. doi:10.2165/00115677-200109070-00001.
36. Sullivan MJ, Feuerstein M, Gatchel R, Linton SJ, Pransky G. Integrating psychosocial and behavioral interventions to achieve optimal rehabilitation outcomes. *J Occup Rehabil*. 2005;15:475–89. doi:10.1007/s10926-005-8029-9.
37. Boersma K, Linton SJ. Screening to identify patients at risk: profiles of psychological risk factors for early intervention. *Clin J Pain*. 2005;21(1):38–43. doi:10.1097/00002508-200501000-00005.
38. Shaw WS, Pransky G, Patterson W, Linton SJ, Winters T. Patient clusters in acute, work-related back pain based on patterns of disability risk factors. *J Occup Environ Med*. 2007;49:185–93. doi:10.1097/01.jom.0000254205.47334.c3.
39. Young AE, Roessler RT, Wasiak R, McPherson KM, van Poppel MNM, Anema JR. A developmental conceptualization of return to work. *J Occup Rehabil*. 2005;15(4):557–68. doi:10.1007/s10926-005-8034-z.
40. Schultz IZ, Stowell AW, Feuerstein M, Gatchel RJ. Models of return to work for musculoskeletal disorders. *J Occup Rehabil*. 2007;17(2):327–52. doi:10.1007/s10926-007-9071-6.
41. Linton SJ, Hallden K. Can we screen for problematic back pain? A screening questionnaire for predicting outcome in acute and subacute back pain. *Clin J Pain*. 1998;14:209–15. doi:10.1097/00002508-199809000-00007.
42. Schultz IZ, Crook J, Berkowitz J, Milner R, Meloche GR. Predicting return to work after low back injury using the psychosocial risk for occupational disability instrument: a validation study. *J Occup Rehabil*. 2005;15:365–76. doi:10.1007/s10926-005-5943-9.
43. Shaw WS, Pransky G, Patterson W, Winters T. Early disability risk factors for low back pain assessed at outpatient occupational health clinics. *Spine*. 2005;30:572–80. doi:10.1097/01.brs.0000154628.37515.ef.
44. Durand MJ, Loisel P, Hong QN, Charpentier N. Helping clinicians in work disability prevention: the work disability diagnosis interview. *J Occup Rehabil*. 2002;12(3):191–204. doi:10.1023/A:1016846712499.
45. Marhold C, Linton SJ, Melin L. Identification of obstacles for chronic pain patients to return to work: evaluation of a questionnaire. *J Occup Rehabil*. 2002;12:65–75. doi:10.1023/A:1015056429505.
46. Anema JR, Steenstra IA, Bongers PM, de Vet HCW, Knol DL, Loisel P, et al. Multidisciplinary rehabilitation for subacute low back pain: graded activity or workplace intervention or both? A randomized controlled trial. *Spine*. 2007;32(3):291–98. doi:10.1097/01.brs.0000253604.90039.ad.
47. Loisel P, Gosselin L, Durand P, Lemaire J, Poitras S, Abenham L. Implementation of a participatory ergonomics program in the rehabilitation of workers suffering from subacute back pain. *Appl Ergon*. 2001;32:53–60. doi:10.1016/S0003-6870(00)00038-7.
48. Franche RL, Cullen K, Clarke J, Irvin E, Sinclair S, Frank J, et al. Workplace-based return-to-work interventions: a systematic review of the quantitative literature. *J Occup Rehabil*. 2005;15:607–31.
49. Heneweer H, Aufdemkampe G, van Tulder MW, Kiers H, Stappaerts KH, Vanhees L. Psychosocial variables in patients with (sub)acute low back pain: an inception cohort in primary care physical therapy in The Netherlands. *Spine*. 2007;32(5):586–92. doi:10.1097/01.brs.0000256447.72623.56.
50. Hashemi L, Webster BS, Clancy EA, Volinn E. Length of disability and cost of workers' compensation low back pain claims. *J*

- Occup Environ Med. 1997;39:937–45. doi:[10.1097/00043764-199710000-00005](https://doi.org/10.1097/00043764-199710000-00005).
51. Pransky G, Gatchel RJ, Linton SJ, Loisel P. Improving return to work research. *J Occup Rehabil*. 2005;15:453–57. doi:[10.1007/s10926-005-8027-y](https://doi.org/10.1007/s10926-005-8027-y).
 52. Baril R, Clarke J, Friesen M, Stock S, Cole D. Work-ready group. Management of return-to-work programs for workers with musculoskeletal disorders: a qualitative study in three Canadian provinces. *Soc Sci Med*. 2003;57:2101–14. doi:[10.1016/S0277-9536\(03\)00131-X](https://doi.org/10.1016/S0277-9536(03)00131-X).
 53. Nicholas MK. Reducing disability in injured workers: the importance of collaborative management. In: Linton SJ, editor. *New avenues for the prevention of chronic musculoskeletal pain and disability*. Amsterdam: Elsevier; 2002. p. 33–46.
 54. Shaw WS, Robertson MM, Pransky G, McLellan RK. Training to optimize the response of supervisors to work injuries: needs assessment, design, and evaluation. *AAOHN J*. 2006;54:226–35.
 55. Shaw WS, Robertson MM, McLellan RK, Verma SK, Pransky G. A controlled case study of supervisor training to optimize response to injury in the food processing industry. *Work* (Reading, Mass.). 2006;26:107–14.
 56. Derebery VJ, Giang GM, Saracino G, Fogarty WT. Evaluation of the impact of a low back pain educational intervention on physicians' practice patterns and patients' outcomes. *J Occup Environ Med*. 2002;44:977–84. doi:[10.1097/00043764-20021000-00018](https://doi.org/10.1097/00043764-20021000-00018).
 57. Gatchel RJ, Polatin PB, Noe C, Gardea M, Pulliam C, Thompson J. Treatment and cost-effectiveness of early intervention for acute low-back pain patients: a one-year prospective study. *J Occup Rehabil*. 2003;13:1–9. doi:[10.1023/A:1021823505774](https://doi.org/10.1023/A:1021823505774).
 58. Linton SJ, Nordin E. A 5-year follow-up evaluation of the health and economic consequences of an early cognitive behavioral intervention for back pain: a randomized, controlled trial. *Spine*. 2006;31:853–8. doi:[10.1097/01.brs.0000209258.42037.02](https://doi.org/10.1097/01.brs.0000209258.42037.02).
 59. Pransky G, Shaw W, Fitzgerald TE. Prognosis in acute occupational low back pain: methodologic and practical considerations. *Hum Ecol Risk Assess*. 2001;7:1811–25. doi:[10.1080/20018091095410](https://doi.org/10.1080/20018091095410).
 60. Rainville J, Pransky G, Indahl A, Mayer EK. The physician as disability advisor for patients with musculoskeletal complaints. *Spine*. 2005;30:2579–84. doi:[10.1097/01.brs.0000186589.69382.1d](https://doi.org/10.1097/01.brs.0000186589.69382.1d).
 61. Shaw WS, Hong QN, Pransky G, Loisel P. A literature review describing the role of return-to-work coordinators in trial programs and interventions designed to prevent workplace disability. *J Occup Rehabil*. 2008;18:2–15. doi:[10.1007/s10926-007-9115-y](https://doi.org/10.1007/s10926-007-9115-y).