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Management of upper limb disorders and the biopsychosocial model

Prepared by the **University of Huddersfield, Health Services Consultancy, Humane Technology Ltd, Rolls-Royce plc** and **Pulvertaft Hand Centre** for the Health and Safety Executive 2008

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Research Report

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Management of upper limb disorders and the biopsychosocial model

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This review, using a best evidence synthesis, examined the evidence on management strategies for work-relevant upper limb disorders and established the extent to which the biopsychosocial model can be applied. Articles were found through systematic searching of electronic databases together with citation tracking. Information from included articles was extracted into evidence tables. Themes were identified and the information synthesised into high level evidence statements, which were distilled into key messages. The main results are presented in thematic sections covering classification/diagnosis, epidemiology, associations/risks, and management/treatment, focusing on return to work and taking account of distinctions between non-specific complaints and specific diagnoses.

Neither medical treatment nor ergonomic workplace interventions alone offer an optimal solution; rather, multimodal interventions show considerable promise, particularly for vocational outcomes. Early return to work, or work retention, is an important goal for most cases and may be facilitated, where necessary, by transitional work arrangements. The emergent evidence indicates that successful management strategies require all the players to be onside and acting in a coordinated fashion; this requires engaging employers and workers to participate.

The biopsychosocial model applies: biological considerations should not be ignored, but it is psychosocial factors that are important for vocational and disability outcomes. Implementation of interventions that address the full range of psychosocial issues will require a cultural shift in the way the relationship between upper limb complaints and work is conceived and handled. A number of evidence-based messages emerged, which can contribute to the needed cultural shift.

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EXECUTIVE SUMMARY

BACKGROUND

The study started from the recognition that upper limb disorders are experienced by most people, predominantly during working age: in that sense they can be considered to be common health problems. Although there is evidence that common health problems in general are characterised by a strong association with psychosocial factors, it is uncertain to what extent that holds true for upper limb disorders in particular.

The Health & Safety Executive acknowledges that not all work-relevant upper limb disorders can be prevented, and therefore has an interest in determining whether there are effective methods for managing cases, with particular focus on the suitability of a biopsychosocial approach, to help reduce the working days lost to musculoskeletal problems. This review aimed to provide an evidence-base for that question.

METHODS

The methodology was a 'best evidence synthesis': summarising the available literature and drawing conclusions about the balance of evidence, based on its quality, quantity and consistency. A systematic search of major electronic databases was undertaken using appropriate keywords to retrieve articles pertaining to the development and management of upper limb disorders. In addition citation tracking was undertaken, together with searches of personal databases and the Internet. Each article for inclusion (n ~ 200) was read and summarised; the original authors' main findings were extracted, checked, and entered into evidence tables. Themes were identified from the evidence tables and the information was synthesised into high level evidence statements and linked to the supporting evidence, which was graded to reflect the level of support. Finally, the retrieved material was then distilled into a number of key messages related to the aim of the project.

FINDINGS

The main results are presented in thematic sections covering classification/diagnosis, epidemiology, associations/risks, and management/treatment, focusing on return to work and taking account of distinctions between non-specific complaints and specific diagnoses. As well as high level evidence statements, the main evidence themes are discussed in narrative format to further develop the ideas and put them into context, with particular reference to a biopsychosocial framework.

There is considerable uncertainty over classification and diagnosis for upper limb disorders; the inconsistent terminology impacts on studies of their epidemiology, treatment, and management. Upper limb disorders are commonly experienced irrespective of work and can lead to difficulty undertaking everyday tasks; this applies to specific diagnoses as well as non-specific complaints. Work has a limited overall role in the primary causation of ULDs, yet the symptoms are frequently work-relevant (some work tasks will be difficult for people experiencing upper limb symptoms, and may sometimes provoke symptoms that may otherwise not materialize). Management of cases shows more promise than attempts at primary prevention.

Neither medical treatment nor ergonomic workplace interventions alone offer an optimal solution; rather, multimodal interventions show considerable promise, particularly for vocational outcomes. Some specific diagnoses may require specific biomedical treatments, but the components of supplementary interventions directed at securing sustained return to work seem to be shared with regional pain disorders. Early return to work, or work retention, is an important goal for most cases and may be facilitated, where necessary, by transitional work arrangements. The emergent

evidence indicates that successful management strategies require all the players to be onside and acting in a coordinated fashion, in order to overcome obstacles to recovery and return to work.

INTERPRETATION

The biopsychosocial model is certainly appropriate to understand the phenomenon of work-relevant upper limb disorders, and has important implications for their management. Biological considerations should not be ignored, particularly for initial treatment of cases with specific diagnoses, but it is psychosocial factors that are important when developing and implementing work retention and return to work interventions. Work is beneficial and people need to be helped and encouraged to remain in, or return to, work. This is true both for non-specific upper limb complaints and specific diagnoses. Interventions and management strategies need to be capable of addressing psychosocial issues, when required. This requires a cultural shift in the way the relationship between upper limb complaints and work is conceived and handled. Educational strategies aimed at employers, workers, and the public are likely to be the most useful method to achieve this.

KEY MESSAGES

A number of evidence-based messages have been distilled, which should contribute to the needed cultural shift. Whilst these points apply to the whole range of players involved (population/workers; employers; health professionals; unions; lawyers; media; policy makers; enforcers), transforming them into suitable material for various purposes and media requires assimilating the detail contained in the text and evidence tables.

CONCEPT MESSAGES

Upper limb symptoms are a common experience - although symptoms are often triggered by physical stress (minor injury), recovery and return to full activities can be expected: activity is usually helpful: prolonged rest is not.

Work is not the predominant cause - although some work will be difficult or impossible for a while, that does not mean the work is unsafe: most people can stay at work (sometimes using temporary adjustments), but absence is appropriate when job demands cannot be tolerated.

Early return to work is important - it contributes to the recovery process and will usually do no harm; facilitating work retention and return to work requires support from workplace and healthcare

All players onside is fundamental - sharing goals, beliefs and a commitment to coordinated action.

PROCESS MESSAGES

Promote self-management – give evidence-based information and advice - adopt a can-do approach, focusing on recovery rather than what's happened.

Intervene using stepped care approach - treatment only if required (beware detrimental labels and over-medicalisation); encourage and support early activity; avoid prolonged rest; focus on participation, including work.

Encourage early return to work - stay in touch with absent worker; use case management principles; focus on what worker can do rather than what they can't; provide transitional work arrangements (only if required, and time-limited).

Endeavour to make work comfortable and accommodating - assess and control significant risks; ensure physical demands are within normal capabilities, but don't rely on ergonomics alone; accommodating cases shows more promise than prevention.

Overcome obstacles - principles of rehabilitation should be applied early: focus on tackling biopsychosocial obstacles to participation - all players communicating openly and acting together, avoiding blame and conflict.

INDEX

1. INTRODUCTION

1.1 PREAMBLE

Musculoskeletal disorders are known to be responsible for a considerable proportion of work incapacity due to ill health. The Health and Safety Commission has included musculoskeletal disorders within its Ill Health Reduction Programme as a key contributor to its current Public Sector Agreement Targets. The Health and Safety Executive (HSE) judges that it requires the musculoskeletal disorders (MSD) programme to contribute an 8% reduction in the incidence of work-related MSDs by 2007-8. The targets also require HSE to achieve a 9% reduction in working days lost due to injuries and ill health by the same time, and the MSD programme will contribute to this. Upper limb disorders (ULDs) represent a significant part of the total number of MSDs, and need to be considered in the development of guidance on MSDs.

The HSE, in it's guidance *Upper limb disorders in the workplace* (HSE 2002), acknowledges that not all ULDs can be prevented, and provides a section entitled "Manage any episodes of ULDs" that includes reference to diagnosis and return to work. However, the HSE recognises that there may be improved methods for managing cases of ULDs which, in principle and if implemented, could help address the working days lost target for ULDs.

As a consequence, HSE issued a tender specification for a piece of research to collate the scientific evidence on the management of ULDs, with particular focus on the suitability of a biopsychosocial approach. An additional specific requirement was the development of accurate (evidence-based) "simple headline message(s) about how people with ULDs should behave".

The commissioned research was to be principally a review of the available published literature (primarily existing reviews) in order to determine the extent that the evidence supports management of ULDs according to biopsychosocial principles. It was noted that use should be made of the papers and data on this subject that have been reviewed already by Waddell and Burton (Waddell & Burton 2004).

1.2 BACKGROUND

The study starts from the recognition that upper limb disorders (ULDs) afflict many people at some time, predominantly during working age. ULDs are characterised by symptoms (usually pain) which have inconsistent associations with workloss and disability. Whilst there is evidence that musculoskeletal disorders in general, like other common health problems, have a strong association with psychosocial factors (Waddell & Burton 2004), it is uncertain to what extent that holds true specifically for ULDs.

The biopsychosocial model has been shown to be highly applicable to the understanding and management of pain, and has successfully been applied in the management of problems such as low back pain. It may be that a biopsychosocial approach is equally applicable to other musculoskeletal disorders such as ULDs, but before reaching this conclusion it is necessary to consider whether there are differences between the two groups of conditions that might render application of the biopsychosocial model less relevant and useful. The field of ULDs is complicated because, in addition to the accepted existence of non-specific regional pain, there is a

plethora of commonly used diagnoses and classifications, many of which are predicated on specific pathophysiological features. Furthermore, so far as work-relevance is concerned, some of these specific conditions are prescribed industrial diseases and eligible (in the UK) for Industrial Injuries Disablement Benefit. Although certain specific diagnoses will relate to recognisable underlying pathology, there is considerable variation in diagnostic labelling. Plausible theoretical reasons for assuming that the underpinnings for non-specific musculoskeletal pain should vary by region of the body are not immediately apparent.

The field of low back pain is known to have a more extensive literature than that for other MSDs, and it is possible that knowledge from the back pain field can transfer across. Indeed it is conceivable, and even likely, that there will be some common factors that influence all MSDs, and these may be a mix of physical, physiological, psychological, or social/cultural (HSL (Lee & Higgins) 2006; HSL (Lunt et al) 2007). This review focuses on ULDs (including non-specific complaints and specific diagnoses), but draws inferences where appropriate from studies of back pain and other regional pain disorders, and pain of musculoskeletal origin.

1.3 RESEARCH PROPOSAL

The present research project was commissioned by HSE with a commencement date of 01 April 2007, with a draft report to be presented within three months.

1.3.1 Aim

The aim of the review was to establish the extent to which the scientific evidence supports management of upper limb disorders according to the biopsychosocial model. (This should be distinguished from guideline development, which was not the purpose of this project).

1.3.2 Objectives

- Identify all the relevant literature, including recent publications and 'grey' literature, on the management of ULDs. Emphasis will be placed on effective management that achieves faster recovery and reduced times for return to work. The effectiveness of single-modality treatments (eg cortisone injections) will be summarised to provide context for the purposes of comparison.
- Provide an expert review of the available scientific information on the management of ULDs.
- Draw conclusions on the question of whether there is evidence that the biopsychosocial model can be successfully applied to the management of ULDs.
- Provide evidence-based, simple headline messages about what should be done to help people with ULDs recover quickly and achieve sustained return to work.

1.3.3 Terminology

Terminology is undoubtedly an issue in the field of upper limb disorders (whilst this term is used for convenience in this report, as noted below, there are alternatives that may more accurately reflect various aspects of the phenomenon). A multiplicity of terms is available to describe the same or similar things, and there is often a multiplicity of meanings that can be attributed to the same term. In addition to the regional-specific differentiation is the issue of the relationship with work.

A great variation in terminology is apparent across the literature, reflecting ongoing debates. For example, the words 'upper limb' emphasise the limb only, whereas 'upper

extremity' takes into account (a) the shoulders; and (b) that some symptoms perceived in the limb are due to neck or shoulder problems; whilst neither specifically includes neck symptoms, both are typically taken to include neck pain. There is also a distinction between terms that use the word 'disorder' (implying a known lesion) and 'complaints' (which reflect the self-reported nature of symptoms, and their inherent subjectivity). There is also a need to consider the meaning of the word 'work' in these terms, and the distinction between work-related and work-relevant (see below). Resolving these, and other related issues, is beyond the scope of this report but it means that some provisos and qualifications are necessary, and they will be discussed at pertinent points in the report. Meanwhile, some essential definitions are given briefly here, and discussed in more detail in the Appendix.

***Biopsychosocial*:** refers to the concept that biological, psychological, and social factors combine to play a significant role in human functioning; and, these need to be treated or managed as interlinked systems.

***Non-specific regional pain/symptoms*:** refers to self-reported complaints (predominantly pain) occurring in a regional anatomical distribution, and for which there is no agreed or demonstrable cogent underlying pathological explanation.

***Pain*:** is an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage.

***Psychosocial*:** refers to the interaction between the person (beliefs, emotions, behaviour, etc) and their social environment (significant others, healthcare providers, people at the workplace, funders, etc), and how this influences their behaviour (what they do).

***Prevention*:** the term can refer to preventing an injury/complaint from happening, or it can refer to an approach/intervention to reduce the consequences of an injury/complaint. It is not currently understood how to prevent people from developing musculoskeletal pain and discomfort. However, preventing deleterious consequences is potentially feasible.

***Upper limb disorder*:** generally used as a generic term to cover specific diagnoses and non-specific complaints of the upper limb/extremity (hand, wrist, forearm, arm, shoulder), and may also include symptoms in the neck. *Disorder* is a term encompassing both illness and disease (*illness* being an absence of well-being perceived by the individual in the form of symptoms, or by others as an abnormality of function or behaviour for which the individual cannot be held responsible; *disease* being a combination of pathological abnormalities that are thought to be interrelated (Coggon et al. 2005)).

***Work-relevant*:** refers to health complaints/disorders that, irrespective of cause, are experienced at the workplace to a greater or lesser extent, and which in turn impact on the performance of a worker. Most available evidence pertains to paid work and employment; however the idea likely applies equally to all forms of productive activity.

[Note: the terminology used in the cells of the evidence tables (Tables A1 to A4) follows that used by the original authors].

2. METHODOLOGY

2.1 LITERATURE SEARCHING

Two key search methods were employed: a search of electronic databases and identification of relevant literature from existing bibliographies held by the authors of this report or listed in other key references. In addition, general Internet searches were performed to attempt to identify any 'grey literature', for example reports published by government departments or other organisations.

A systematic literature search of Medline, Medline Daily Update, Medline Pending, Embase, CINAHL, AMED (Allied and Complementary Medicine Database), PsycInfo, Cochrane DSR (Database of Systematic Reviews), ACP (American College of Physicians) Journal Club, and DARE (Database of Abstracts of Reviews of Effects) was conducted in June 2007, limited to citations published from 1996 onwards.

In broad terms this included search strings with all relevant keywords that might identify musculoskeletal disorders of the upper extremities. Over 10,000 potential citations were identified, and all relevant citations were then selected using Boolean search terms to satisfy the selection process.

Citations retrieved from the systematic search were selected according to a priori criteria for relevance. Guidance received from the HSE about the topic was to focus the literature search on the following: tenosynovitis (hand/forearm), tendonitis (fingers/hand/forearm), rotator cuff tendonitis (including supraspinatus) and bicipital tendonitis, De Quervain's, carpal tunnel syndrome, shoulder capsulitis, tennis elbow, golfer's elbow, cervical spondylosis, diffuse/non-specific ULD, and 'tension neck'. These labels were not used exclusively; rather they formed the basis for determining operational boundaries for the topic and attempts were made to include a wide range of terms used to describe upper limb conditions in working-age adults.

To maintain the above focus, numerous conditions and topics were excluded: eg whiplash associated disorder, rheumatic and systemic diseases, brachial plexus avulsion, and fractures. In addition, disorders of peripheral circulation and phantom limb pain were excluded since they are conceptually different. The extensive (clinical) literature reporting on neck pain alone was excluded, but relevant aspects of the topic were included in the literature retrieved by the above search terms.

2.1.1 Article selection

It was neither possible nor practical to review all studies and articles retrieved. Systematic reviews and extensive narrative reviews were the primary focus, but individual studies were selected where they added additional or more detailed information. In addition, we identified literature relevant to specific aspects such as application of the biopsychosocial model and return to work.

Once a potential pool of articles and studies had been identified, tables consisting of titles and abstracts (when available) were circulated to three reviewers (KB; NK; BP), and each indicated which should be obtained for possible inclusion in the review.

Where there was disagreement, and that was only rare, it was remedied by consensus. However, the general approach was to view the full article or document if there was any likelihood that it may be relevant and appropriate to include. Copies of some 200 relevant articles were obtained, circulated, and archived.

2.2 DATA EXTRACTION AND SYNTHESIS

Each article for inclusion was read and summarised by one of the authors. The original authors' main findings were extracted and the data entered into evidence tables, which were organised to cover reviews in three main categories (epidemiology/risk factors; intervention/classification; concepts/guidance) supplemented by a separate table for original studies (see Tables A1 to A4). Where appropriate, the data table entries were amplified by explanatory or cautionary comments by the present reviewers (and displayed in italics). The data extractions were checked by the other two reviewers, with any revisions to the final wording achieved by consensus; they were then reviewed by the two clinical reviewers (LB; CB) who had not been involved in the original extraction, and any final amendments made.

2.2.1 Evidence statements

In order to summarise the data in the evidence tables, themes were identified by the reviewers and the information was synthesised into evidence statements, each linked to the supporting evidence. To reflect the nature of the subject matter and to aid interpretation, the emphasis was placed on high level evidence statements reflecting overarching principles rather than dealing with, say, specific treatments.

The text of the evidence statements is used to expand on the nature or limitations of the underlying evidence where necessary, and to offer caveats and cautions. In addition, the main evidence themes are discussed in narrative format to further develop the ideas and put them into context, with particular reference to a biopsychosocial framework.

The final wording of the evidence statements and accompanying text was developed through an iterative process involving all five authors of the review, and any disagreements were resolved by majority consensus guided by the reviewer with most clinical/scientific expertise in the area concerned.

2.2.2 Evidence grading

The strength of the scientific evidence supporting the statements was graded using an adaptation of a previously used system – see Box 1. Importantly, the strength of the evidence should be distinguished from the size of the effect: there may be strong evidence about an association between, say, work and a particular health outcome, yet the effect may be small. Conversely, weak evidence statements do not necessarily mean that it is untrue or unimportant, and may simply reflect limited scientific study.

Box 1: Evidence grading system used to rate the strength of the scientific evidence underlying the evidence statements

	Evidence grade	***Definition***
***	**Strong**	generally consistent findings provided by (systematic review(s) of) multiple scientific studies.
**	**Moderate**	generally consistent findings provided by (review(s) of) fewer and/or lower quality scientific studies.
*	**Weak**	based on a single scientific study, general consensus and guidance, or inconsistent findings provided by (review(s) of) multiple scientific studies.

[Adapted from (Waddell & Burton 2006)]

2.2.3 Synthesis

Finally the themes contained within the evidence statements were appraised; the retrieved material was distilled and synthesised into a number of key messages to reflect the evidence primarily, but not exclusively, on the relevance of the biopsychosocial model and a biopsychosocial approach to the management of work-relevant upper limb disorders.

The overall methodology follows that used in previous evidence reviews that attempted to bring together a diverse literature on a complex subject (Waddell & Burton 2004; Franche et al. 2005). It should be viewed as a 'best evidence synthesis', summarising the available literature and drawing conclusions about the balance of evidence, based on its quality, quantity and consistency (Slavin 1995). This approach offered the flexibility needed to handle complex topics, but at the same time took a rigorous approach when it came to assessing the strength of the scientific evidence.

It should be stressed that the evidence has been synthesised here in high level terms and the findings should not in any way be construed as a clinical guideline.

2.2.4 Quality assurance

The draft report was peer reviewed by seven independent reviewers representing a number of disciplines with an interest in the topic, and also submitted to HSE for comment. The reviewers' comments were taken into account when preparing the final report for publication.

3. FINDINGS

3.1 STRUCTURE

The findings of the review are presented here in the form of 'evidence-statements' as a convenient way of summarising knowledge across complex themes; each statement is linked to the main supportive sources of evidence in Tables A1 to A5.

The presentation is in a logical sequence, starting from the need to define the disorders of concern, and to present the evidence on classification and diagnosis of upper limb disorders. Then the fundamental matter of epidemiology and risk factors follows, leading into the evidence on treatment, management approaches, and return to work. Within each section the implications of the evidence are discussed and additional evidence is introduced where this is helpful in amplifying the themes.

The intention is to reflect the aim of the review by providing high level evidence statements that inform on the more generic, overarching aspects of the topic, as opposed to specific circumstances.

3.2 CLASSIFICATION AND DIAGNOSIS

The intention here is to present the evidence on the extent to which upper limb disorders can be classified and recognised; exploration of detailed diagnostic criteria is beyond the scope of the review.

** There is a wide spectrum of classification systems for ULDs in current clinical use, ranging from specific disorders to descriptive syndromes.

Table A2: (Nørregaard et al. 1999; Piligian et al. 2000)

*** Classification and diagnosis of ULDs is particularly problematic; there is a lack of agreement on diagnostic criteria, even for the more common specific diagnoses (eg tenosynovitis, epicondylitis, rotator cuff syndrome). Inconsistent application, both in the clinic and workplace, leads to misdiagnosis, incorrect labelling, and difficulties in interpretation of research findings.

Table A1: (Huisstede et al. 2006)
Table A2: (Helliwell 1996; Nørregaard et al. 1999; Piligian et al. 2000; Van Eerd et al. 2003; Walker-Bone et al. 2003a)
Table A4: (Beaton et al. 2007)

** The scientific basis for descriptive classification terms implying a uniform aetiology, such as RSI (repetitive strain injuries) and CTD (cumulative trauma disorders), is weak or absent and they are inconsistently applied/understood; there is an argument that such terms should be avoided.

Table 1: (Szabo 2006)
Table A2 (Hagberg 2005)
Table 3 (Szabo & King 2000; Lucire 2003)
Table 4: (European Agency for Safety and Health at Work 2000)
Table A4: (Macfarlane et al. 2000; Bonde et al. 2003)

These nosological inconsistencies have led to debate and uncertainty over issues from pathology to causation (Beaton et al. 2007). It is likely that misdiagnoses will be common both in the clinic and in the workplace (Nørregaard et al. 1999), frequently manifested as patients receiving multiple and conflicting explanations and diagnostic labels from the various clinicians they encounter. This, in turn, will compromise the results of clinical trials due to heterogeneous participants. Similarly it will compromise epidemiological studies, where it is difficult to know whether 'cases' represent a homogenous population (Coggon et al. 2005). Furthermore, over-diagnosis of specific diseases may raise patient expectations, and promote false beliefs about work-relatedness (Helliwell 1996).

There is a conceptual argument that adopting the approach currently used in back pain and whiplash associated disorder, where a specific pathology-based diagnosis is eschewed in favour of simple description of the presenting symptoms and their correlates, is suitable for ULDs (HSL (Lee & Higgins) 2006; Beaton et al. 2007). Conversely, there is evidence that a carefully structured examination system can distinguish between specific and non-specific upper limb pain, yet that needs to be conducted by a health professional and the prognostic ability is not established (Walker-Bone et al. 2006). Alternatively, it is possible to achieve expert consensus on criteria for case definitions suitable for occupational surveillance systems, although the clinical validity of the classifications is uncertain (Harrington et al. 1998; Huisstede et al. 2007), and it is unknown if they will lead to improved clinical management.

These diagnostic uncertainties have encouraged some reviewers to discuss ULDs simply as regional musculoskeletal disorders, reflecting the subjective experience and difficulty in determining a specific cause or pathology in the vast majority of cases (Hadler 2005). Indeed, a considerable number of the articles retrieved for the present review take a 'lumping' approach whereby studies will include a variety of different disorders under labels such as 'work-related upper limb disorder' or simply 'musculoskeletal disorders'. Seemingly, then, a proportion of researchers and commentators believe there is sufficient commonality between disorders/complaints afflicting different anatomical regions (including even the low back in some studies) to justify lumping. However, that is not a universal view, and some researchers point to the possibility of specific neuropathic pathologies underlying what is often termed non-specific arm pain or RSI (Greening et al. 2003), whilst others point to the possibility, albeit rarely, of serious residual conditions such as dystonia (van Rijn et al. 2007). There are sometimes non-clinical needs for trying to split the disorders: eg the entitlement to Industrial Injuries Disablement Benefit (in the UK) is based on specific medical diagnoses implying a particular pathology (related to specific work).

There is the potential for this conceptual issue to have practical consequences when it comes to management strategies. On the one hand it may be argued that a specific diagnosis provides insight into pathogenesis, and therefore to effective treatment. On the other hand, it may be felt that many of the specific diagnoses offered to patients are in reality uncertain, and in any case tell us little about what treatment may be effective. Alternatively, there may be powerful generic approaches to management that can be combined with specific healthcare interventions. A utilitarian approach is that the optimal definition for a disorder may vary according to the circumstances in which it is applied (Coggon et al. 2005). Whilst an extensive conceptual review supported generic rehabilitation concepts for common health problems (Waddell & Burton 2004), it did not specifically address management of ULDs. Thus, there is a need to explore whether optimal management of ULDs is likely to be best served by a lumping or splitting approach, or by some combination of the two.

3.3 EPIDEMIOLOGY

The epidemiology of ULDs is essential to understanding how they arise, in whom, and to inform on their natural history. There are numerous epidemiological study designs that offer different perspectives on the subject, and it is important to realise their relative limitations when interpreting the data. (Punnett & Wegman 2004; Szabo 2006). Many studies of the epidemiology of ULDs have relied on cross-sectional observational designs (including surveillance data), which may illustrate an association between a given characteristic (eg job) and the existence of symptoms, but does not confirm a causative link. If study design is not carefully considered, along with the criteria for causation - strength, temporality, consistency, specificity, and dose-response of the association, plus biological plausibility (Szabo 2006) - there is a risk of misinterpreting the epidemiological evidence. Cross-sectional studies often report on the strength of *association* between a given outcome and a particular work characteristic and refer to it as a *risk* factor - although statistical terminology uses statistics such as relative risk, the indiscriminate use of the term risk factor can be misleading unless a direct link has been established through robust scientific studies. By and large, longitudinal studies (which can be either prospective or retrospective) will provide considerably more robust evidence for determining causation.

A further consideration when interpreting epidemiological studies on ULDs is the nature of the disorders themselves, and the way they affect people. There is a cascade in the way they are experienced, which is similar to that noted for other musculoskeletal problems such as back pain: a clear distinction should be made between the presence of symptoms, the reporting of symptoms, attributing symptoms to work, seeking health care, loss of time from work and long term damage, which may all have rather different determinants (Waddell & Burton 2001).

For example, a cross-sectional study might show a strong association between working above shoulder height and self-reported shoulder pain. That may simply reflect the fact that people with shoulder pain will find that job more difficult or painful because of their shoulder pain – the study shows a link between a work activity and symptoms, but does not provide evidence of a primary injury. Longitudinal studies can help, but even then the outcome of concern needs to be clearly defined: some factors may have a cogent relationship with duration of sick leave but without any plausible relationship with the onset of symptoms or development of a disorder (Walker-Bone et al. 2004b).

*** There is a very high background prevalence of upper limb pain and neck symptoms in the general population: 1-week prevalence in general population can be >50%. Estimates of the prevalence rates of specific diagnoses are less precise, but are considerably lower than for non-specific complaints. Rates vary depending on region, population, country, case definition, and on the question asked.

Table A1: (Walker-Bone et al. 2003b; Kuijpers et al. 2004; Walker-Bone & Cooper 2005; Huisstede et al. 2006; Palmer & Smedley 2007)
Table A4: (Walker-Bone et al. 2004a; Walker-Bone et al. 2004b; Silverstein et al. 2006; Roquelaure et al. 2006; Eltayeb et al. 2007)

** Upper limb pain is frequently experienced in more than one region at the same time (both bilaterally and at anatomically adjacent sites).

Table A4: (Macfarlane et al. 2000; Walker-Bone et al. 2004a; Walker-Bone et al. 2004b)

*** ULDs often lead to difficulty with normal activities and to sickness absence, yet most workers with ULDs can and do remain at work.

Table A4: (Walker-Bone et al. 2004b; HSL (Lee & Higgins) 2006; Baldwin & Butler 2006; Silverstein et al. 2006)

* Upper limb symptoms, and related disability, tend to be transient, yet they are frequently recurrent, and many ULDs can be considered common health problems.

Table A3: (Waddell & Burton 2004; HSL (Lee & Higgins) 2006)
Table A4: (Silverstein et al. 2006)

3.4 ASSOCIATIONS AND RISKS

The issue of risk factors for ULDs is clearly highly relevant to the concept of preventing onset of symptoms or injury, but the subject is poorly understood and inconsistently documented. A whole host of factors, both occupational and personal, are purported to be 'risk factors', but the nature of those risks and their potential outcome(s) are readily misunderstood.

The UK legislative framework for health and safety requires employers to undertake risk assessments, with the intention of identifying hazards and controlling risks: here a hazard is something with the potential to cause harm (this can include substances or machines, methods of work and other aspects of work organisation), whilst risk expresses the likelihood that the harm from a particular hazard is realised (the extent of risk covers the number of people exposed and the consequences for them) – risk therefore reflects both the likelihood that harm will occur and its severity.

Implicit in this approach is the idea that controlling risk at the workplace will result in (some measure of) prevention of injury and ill health. Whilst that approach has had considerable success for safety outcomes (eg reducing major injuries and occupational diseases), it has not had the same effect on health outcomes (eg pain and disability due to musculoskeletal symptoms, which are sometimes characterised as injuries) (Hadler 2005; Szabo 2006). This is evident from the high levels of growth in disability and work loss associated with musculoskeletal pain over the very period when industrialised countries have implemented occupational safety and health legislation, and developed inspectorates for compliance and enforcement (Burton 1997; Coggon et al. 2007). When considering prescription, the Industrial Injuries Advisory Council (IIAC) recognises that for diseases which commonly occur in the general population there may be no difference in the pathology or clinical features to distinguish an occupational from a non-occupational cause, and in these circumstances IIAC looks for consistent evidence that the risk of developing the disease is more than doubled in a given occupation (IIAC 2006). Only if a substantial proportion of cases of a health condition are caused by work is the hazard/risk control strategy likely to have a meaningful impact. For instance, if the odds ratios for physical risk factors are low, then preventive strategies (even if highly successful) will have small effect sizes and avert only a small proportion of overall cases.

The issue of prevention was fully explored during development of the European Commission sponsored *European guidelines for prevention in low back pain* (Burton et al. 2006a) (www.backpaineurope.org). The guideline development team considered that 'the general nature and course of commonly experienced low back pain means that there is limited scope for preventing its incidence (first-time onset); if primary causative mechanisms remain largely undetermined, risk factor modification is unlikely to achieve prevention. However, there is considerable scope, in principle, for

prevention of the *consequences* of low back pain – e.g. episodes (recurrence), care seeking, disability, and workloss. Whilst the basic epidemiology suggests these concepts may be applicable to ULDs, further consideration of the evidence on 'risk factors' is needed to permit robust conclusions. It should be noted, however, that the available literature does not always clearly distinguish the outcome being studied (eg it is not always apparent whether a factor is being explored for its relationship with the onset of new symptoms, the reporting of pre-existing symptoms, the need for time off work, or for transition to long-term disability); furthermore some reviews of purported risk factors have included cross-sectional as well as longitudinal studies.

3.4.1 Occupational factors

** Large-scale influential reviews published around the turn of the millennium (which included much cross-sectional data) concluded that there were strong associations between biomechanical occupational stressors (eg repetition, force) and ULDs: backed by plausible mechanisms from the biomechanics literature, the association was generally considered to be causative, particularly for prolonged or multiple exposures (though a dose-response relationship generally was not evident).

Table A1: (NIOSH 1997; National Research Council 1999; National Research Council 2001)

*** More recent epidemiological studies involving longitudinal designs also suggest an association between physical exposures and development of ULDs, but they report the effect size to be rather modest and largely confined to intense exposures. The predominant outcome investigated (primary causation, symptom expression, or symptom modification) is inconsistent across studies and remains a subject of debate. This is true for regional complaints and (with few exceptions, eg (IIAC 2006)) most of the specific diagnoses.

Table A1: (Punnett & Wegman 2004; Walker-Bone & Cooper 2005; IIAC 2006; Bongers et al. 2006; Ijmker et al. 2007; Palmer & Smedley 2007; Palmer et al. 2007c)
Table A3: (Coggon et al. 2007)
Table A4: (van den Heuvel et al. 2006; Thomsen et al. 2007)

* The evidence that cumulative exposure to typical (modern) work is the cause of most reported upper limb injury is limited and inconsistent.

Table A3: (Dembe 1996; NIOSH 1997; Hadler 2005)
Table A4: (Macfarlane et al. 2000)

*** Workplace psychosocial factors (beliefs, perceptions, and work organisation) have consistently been found to be associated with various aspects of ULDs, including symptom expression, care seeking, sickness absence, and disability.

Table A1: (NIOSH 1997; National Research Council 2001; Bongers et al. 2002; Woods & Buckle 2002; Walker-Bone & Cooper 2005; Woods 2005; Bongers et al. 2006)
Table A4: (Macfarlane et al. 2000; Devereux et al. 2004; van den Heuvel et al. 2005; Burton et al. 2005)

3.4.2 Personal factors

*** Individual psychological factors (such as anxiety, distress, and depression) have consistently been found to be associated with various aspects of ULDs, including symptom expression, care seeking, sickness absence, and disability.

Table 1A: (National Research Council 2001; Mallen et al. 2007)
Table A3: (Hadler 2005)
Table A4: (Henderson et al. 2005; Coutu et al. 2007; Alizadehkhaiyat et al. 2007)

*** Older age is associated with more, and more troublesome, upper limb complaints; older people have a somewhat less favourable prognosis.

Table A1: (Walker-Bone et al. 2003b; Kuijpers et al. 2004)
Table A4: (Dziedzic et al. 2007)

** Upper limb complaints and (most) specific diagnoses are more common among females; this likely reflects a reporting phenomenon rather than a physiological issue in all but a few specific diagnoses.

Table A1: (Walker-Bone et al. 2003b; Hooftman et al. 2004)
Table A4: (Walker-Bone et al. 2004a; Eltayeb et al. 2007)

There is no doubt that certain jobs can legitimately be considered to entail hazards that are, on the balance of probabilities, risk factors for the development of certain specific diseases (IIAC 2006), yet these diseases account for a relatively small proportion of all ULDs.

There can be little doubt, also, that many upper limb symptoms result from some physical stress across joints and in soft tissues, but work is not the exclusive (or necessarily most important) source of such stress. Indeed, it is clear from the epidemiology that many people will experience upper limb symptoms without any exposure to the sort of physical stress that conceivably could result in meaningful injury. There is emerging evidence that a combination of exposure to physical and psychosocial factors at work has a stronger association than either type of factor alone (Warren et al. 2000; Devereux et al. 2004). By and large, the duration of exposure has been inconsistently reported across the epidemiological literature, so attributing upper limb complaints to cumulative exposure is by no means fully justified; in view of the potential deleterious consequences of perpetuating unhelpful myths about the relationships between work and health, the concept might best be put aside unless and until further evidence becomes available. Of interest in this respect is that one of the strongest predictors of incident upper limb symptoms among workers can be a prior history of symptoms, as opposed to work exposures such as repetitiveness, work pace, or forceful awkward postures (Descatha et al. 2007).

In view of the widespread experience of upper limb symptoms in the community, the patchy nature of associations between work characteristics and ULDs (both non-specific and specific), and the difficulty of establishing cogent occupational causation (Hadler 2003), the often used collective term ‘work-related’ seems not altogether accurate and potentially misleading. Instead, it seems more reasonable to refer to ULDs among workers as **work-relevant**, which avoids undue concentration on occupational causation yet allows recognition that work can be troublesome for people experiencing upper limb symptoms, irrespective of their cause (see Definitions in

Appendix for further discussion). Making this distinction is likely to be fundamental to advances in the management of upper limb complaints.

Regardless of the causation debate, the consistent association between upper limb complaints and the physical demands of work shows that ULDs are frequently work-relevant: remaining at work may be difficult or impossible in the face of symptoms. Recognition of this issue is likely to be an important aspect for successful interventions.

Overall, the evidence in Tables A1 and A2 suggests that permanent impairment is the exception, but a proportion of people do experience long-term difficulties. The fact that deleterious consequences of ULDs, such as disability, sick leave, depend more on psychosocial influences than on what has happened physically, will need to be taken into account and addressed if people are to be helped fully to participate.

3.5 MANAGEMENT APPROACHES AND TREATMENT

The fact that most people experience upper limb symptoms, and that many do not seek healthcare, supports the view that it can be considered 'normal' to have one or even several complaints (Eriksen & Ihlebaek 2002). Indeed, musculoskeletal pain may be perceived as no more than inconvenient discomfort until some other (usually psychosocial) life event changes the situation from a person with a predicament into someone who seeks care (Hadler 2005; ARMA 2007). However, some people will experience altogether more severe symptoms, possibly resulting from a specific injury or pathology, and they will expect healthcare to provide pain relief and to address the pathology. Other individuals will be more concerned with participation - obtaining help with work retention/return. All may need to recognise that ULD pain and discomfort may be decreased but not eliminated in the majority of cases (Hagberg 2005).

3.5.1 Summary of biomedical treatments for specific diagnoses

There was no intention to perform an exhaustive review of the effectiveness of the biomedical interventions that are currently provided for people with ULDs, but a short 'review of reviews' here provides a broad overview. This information is summarised in Table A5. It is included to provide a context against which to compare and contrast the biopsychosocial and other interventions that are the main subject of the project.

*** There is strong evidence for the effectiveness of the following treatments: exercise for rotator cuff tendonitis; oral steroids for shoulder pain such as impingement syndrome or capsulitis; and, corticosteroid injections for tenosynovitis. There is strong evidence that oral diuretics for carpal tunnel syndrome (CTS); and, extracorporeal shock wave therapy for epicondylitis are ineffective. In general, the effect sizes tend to be modest and limited to clinical outcomes.

Table A5: (multiple citations)

** There is moderate evidence for the effectiveness of surgery to treat CTS. There is moderate evidence that pyridoxine vitamin B6 for CTS, and massage for tendonitis are ineffective.

Table A5: (multiple citations)

* There is weak evidence for the effectiveness of the following treatments: manipulation, corticosteroid injections, and oral steroids for CTS; ergonomics, exercise, and massage for diffuse non-specific upper extremity pain; acupuncture, ultrasound,

exercise, manipulation, corticosteroid injections, and topical nonsteroidal anti-inflammatory drugs (NSAID) for epicondylitis; manipulation, corticosteroid injections, and oral NSAIDs for rotator cuff tendonitis; laser, electromagnetic fields and ionization (in short term only), ultrasound (in short term only), ergonomics, exercise, corticosteroid injections, and oral NSAIDs for shoulder pain such as impingement syndrome or capsulitis; and, ergonomics for tension neck syndrome. There is weak evidence that laser, oral NSAIDs, and yoga for CTS; and, laser, and electromagnetic fields and ionization for epicondylitis are ineffective.

Table A5: (multiple citations)

3.5.2 Interventions in respect of general musculoskeletal disorders

The search retrieved additional relevant information about interventions for musculoskeletal problems in general, which reflects the view that there is a commonality to MSDs that justifies considering their management in a generic sense.

* General management principles are to provide advice that promotes self-management, such as staying active and engaging in productive activity (with appropriate modifications). Pain modulation and control should be directed toward allowing appropriate levels of activity.

Table A2: (ARMA 2007; Breen et al. 2007)

*** Programmes using cognitive-behavioural approaches are effective and cost-effective at reducing pain and increasing productive activity in both the earlier and later phases.

Table A2: (Meijer et al. 2005; Hanson et al. 2006)
Table A4: (Marhold et al. 2001)

* Multimodal integrated interventions that address both biomechanical and psychosocial aspects at the same time should be useful for managing musculoskeletal problems in the workplace.

Table A2: (National Research Council 2001; Selander et al. 2002; Waddell & Burton 2004; Cole et al. 2006)
Table A4: (Feuerstein et al. 2003a)

* Worksite physical activity programmes can have a positive effect in respect of MSDs (leading to reduced subjective complaints, notably low back pain).

Table A2: (Proper et al. 2003)

3.5.3 Interventions specifically in respect of upper limb disorders

In addition to the information concerning MSDs in general, the search retrieved numerous studies concerning interventions more specifically on people with ULDs; specific diagnoses were generally included along with non-specific complaints.

* There is limited evidence for the effectiveness of multidisciplinary biopsychosocial rehabilitation for neck pain and shoulder pain, or for ‘RSI’.

Table A2: (Karjalainen et al. 2003a; Karjalainen et al. 2003b)
Table A3: (Lucire 2003)

** However, pain management programmes, using cognitive-behavioural principles, and multidisciplinary occupational rehabilitation for people with ULDs can improve occupational outcomes in the short term, and significantly reduce sickness absence in the longer term. Earlier intervention appears to yield better results.

Table A2: (Feuerstein et al. 1999; Crawford & Laiou 2007)

* There is a conceptual case that rehabilitation should be started early, and that long periods of rest or sick leave are generally counterproductive.

Table A2: (NHMRC 2004; Helliwell & Taylor 2004; Hagberg 2005)
Table A3: (Franche & Krause 2002; Waddell & Burton 2004)

** Ergonomic work (re)design, directed at equipment or organisation, has not been shown to have a significant effect on incidence and prevalence rates of ULDs. Ergonomics interventions can improve worker comfort (which is valuable): in principle, that can contribute positively to multimodal interventions.

Table A1 (Szabo 2006)
Table A2: (Pransky et al. 2002; Boocock et al. 2007)
Table A3: (Szabo & King 2000; Karsh et al. 2001; Hadler 2005)
Table A4: (Christmansson et al. 1999)

* There is limited evidence that ergonomic adjustments (mouse/keyboard design) can reduce upper limb pain in display screen workers, but insufficient evidence for equipment interventions among manufacturing workers.

Table A2: (Williams et al. 2004; Verhagen et al. 2006; Boocock et al. 2007)

* In general, resting injured upper limbs delays recovery; early activity improves pain and stiffness, and can speed return to work yet does not increase complications or residual symptoms, and may lead to less treatment consumption.

Table A2: (Buckwalter 1995; Nash et al. 2004)
Table A3: (Melhorn 2005)
Table A4: (Haahr & Andersen 2003; Cheng & Hung 2007)

It is notable that the evidence supporting some biomedical interventions, which focuses on clinical outcomes, is considerably stronger than that for rehabilitation and ergonomic interventions focused on vocational outcomes. This is partly a reflection of the difficulty in conducting high quality scientific studies (eg randomised controlled trials) in the workplace environment, but also reflects the heterogeneous nature of the interventions and their implementation. It is not always clear just what was included in the interventions and whether the studies actually managed to implement the interventions they intended to test – for instance, demonstrating the effectiveness of workplace 'rehabilitation' readily can be compromised by difficulties in overcoming obstacles to implementation (McCluskey et al. 2006). Furthermore, it may be that workplace interventions are not necessarily transferable to different settings – a recent systematic review identified no single-dimensional or multidimensional strategy for intervention that was considered effective across occupational settings (Boocock et al. 2007). It may be that some interventions introduce mixed messages, thus undermining the effect – an intervention may have a beneficial impact on one outcome whilst having a detrimental effect on another (eg provision of a modified keyboard may relieve symptoms for the individual, but at the same time might create the erroneous belief (by

other workers as well as the individual) that the original equipment was incorrect and the cause of the trouble).

Overall, for the non-biomedical interventions, it would seem that those directed at helping the individual with a ULD complaint towards early activation are likely to be more effective than strategies directed at reducing exposure to physical stressors. This apparent lack of primary preventive effect from ergonomics interventions might be expected from the underlying epidemiology: if only a small number of cases are directly attributable to a given exposure, it becomes very difficult to detect any meaningful reduction in the number of cases on removal of the exposure. Nevertheless, looking at other outcomes such as work retention and return to work may offer a substantial role for workplace interventions to accommodate workers who are hurting.

3.5.4 Return to work

Since work is (generally) good for heath and well being, and can have a therapeutic role for people with common health problems (Waddell & Burton 2006), getting back to work can be seen as an important outcome for the absent worker faced with an upper limb disorder. Achieving return to work (RTW) is more a matter of management than treatment; that is not to eschew healthcare, but rather recognition that a coordinated effort may be required.

* There is wide consensus that early RTW is an important goal, which should be facilitated by multimodal interventions, including provision of accurate information, pain relief, and encouragement of activity. An integrative approach by all the players (notably employer, worker, and health professional) is conceptually a fundamental requirement.

Table A2: (Kupper et al. 2004; Helliwell & Taylor 2004; Hagberg 2005; Meijer et al. 2005; Franche et al. 2005; Breen et al. 2007)
Table A3: (Waddell & Burton 2004; Melhorn 2005; HSL (Lee & Higgins) 2006; Cheng & Hung 2007)

** Although the components of RTW interventions vary, there is emerging evidence that integrative approaches can be effective for MSDs in general and, probably also for ULDs. Case management shows promise for getting all the players onside. Facilitation of RTW through temporary transitional work arrangements (modified work) seems to be an important component.

Table A2: (Franche et al. 2005; Breen et al. 2007)
Table A3: (Selander et al. 2002; Shaw et al. 2002; Hanson et al. 2006)
Table A4: (Feuerstein et al. 2003a; Shaw & Feuerstein 2004; Abásolo et al. 2005; Cole et al. 2006; McCluskey et al. 2006)

Return to work is not always a straightforward outcome (Kendall & Thompson 1998), and many studies have considered it simply in terms of the first return to work. The majority of workers with ULDs find the symptoms resolve quickly and they return to work, yet a small but significant proportion experience recurrent work absence, or unusually lengthy spells of absence with low probabilities of returning to work. Hence, It can be misleading to focus on the first return to work since a first return does not necessarily mark the end of work disability (Baldwin & Butler 2006). This all brings up the question of whether people should return to work whilst symptomatic. For back pain it has become established that there is no need to await total resolution of symptoms before reactivation and return to work – in fact that is seen as detrimental (Carter & Birrell 2000). Whilst the evidence is less extensive for ULDs, it is reasonable to think

that the same principles will apply. In which case, early return to work should be encouraged even when symptoms remain, and that integrative approaches to support the returnee (including transitional work arrangements if necessary) should be made available and should, in principle, contribute to a sustained return (Franche et al. 2005) – it follows that if the employer fails to provide this facility, further workloss is more likely and the situation may be perpetuated, hence the need for all players to be onside.

3.5.5 Non-specific complaints and specific diagnoses

Overall, when considering management of ULDs, the bulk of the literature has either concentrated on regional symptoms (termed disorders by some investigators) or has taken an even wider perspective and combined regional symptoms (including the upper limb) under generic labels such as work-related musculoskeletal disorder.

* There is insufficient robust evidence to identify reliable prognostic indicators that are applicable across the ULD spectrum (specific diagnoses and regional complaints).

Table A1 (NIOSH 1997; Kuijpers et al. 2004)
Table A2: (Nørregaard et al. 1999; Hagberg 2005)
Table A4: (Ryall et al. 2007)

* There is inconsistent and conflicting evidence on whether and to what extent certain specific diagnoses and regional complaints should be conceived differently in terms of overall management targeted at vocational outcomes.

Table A3: (Melhorn 2005; Hadler 2005; Derebery et al. 2006; Staal et al. 2007)

Whilst there are numerous treatments offered to people with specific upper limb diagnoses, their RTW management (after healthcare has achieved improvement in clinical outcomes) is less well documented. Whilst there seems to be good reason to separate (some) specific diagnoses when making clinical decisions about treatment, there is little evidence that the distinction is helpful when considering vocational outcomes and rehabilitation. It can be argued that returning a hurting worker to their job relies on achieving an acceptable balance between ‘capacity’ and ‘tolerance’, and this concept is largely independent of whether the individual has a specific diagnosis or regional complaint (Melhorn 2005; Derebery et al. 2006). Furthermore, the substantial general pain literature supports the importance of psychological and psychosocial factors (eg the so-called yellow flags and blue flags) in the development of persistent symptoms and disability, irrespective of diagnosis or underlying pathology (Main & Spanswick 2000).

Viewed overall, there is good reason to expect effective interventions for ULDs to have a combined approach: specific treatment (when needed, using a stepped approach) coupled with workplace accommodation (when needed, on a temporary basis). Whilst lumping and splitting approaches may be helpful under differing circumstances (Coggon et al. 2005), achieving a balance in terminology is likely to be particularly important: if wrongly applied, diagnostic labels can alarm and harm, whereas unemotive complaint-based labels can help ‘normalize’ the experience and ease the path to participation in productive activity.

4. BIOPSYCHOSOCIAL MODEL

The determinants of symptom onset, the decision to seek help or healthcare, and the development of long-term problems appear to be different (Macfarlane et al. 2000; Schultz et al. 2000), albeit with some overlap. The reason an individual who is experiencing symptoms of pain or discomfort decides to seek help is not always entirely clear, but the decision appears to often involve an appraisal that one can no longer cope, or fear that something serious has happened (Hadler 2005).

A basic biomedical model seeks to identify disease and its manifestations, understand its mechanisms, and intervene to effect prevention or cure. The healthcare provider conducts a clinical assessment, and attempts to arrive at a diagnosis, or a working hypothesis in cases where diagnostic tests are to be used. These may confirm or refute the working hypothesis, in which case an alternative or differential diagnosis is considered.

However, this biomedical model has some limitations and one area that it meets significant difficulty is explaining various phenomena of pain. The combined biomedical/psychosomatic model began to be seriously challenged by the study of pain in the middle of the 20th century, leading to Melzack and Wall's key revolutionary Gate Control Theory, published by in 1965. This suggested that subjectively experienced pain is not merely the result of activation of pain receptor neurons, but rather the interaction between ascending information to the central nervous system and descending control systems that can inhibit and modulate pain information. These concepts facilitated a whole new understanding of pain perception and pain management, which has flourished into a large area of scientific and clinical endeavour.

The predominant musculoskeletal symptom is pain, and for this reason there has been something of a convergence between the fields of musculoskeletal medicine and pain management. When a patient presents with a musculoskeletal health problem, such as a ULD, the first clinical treatment response is to attempt to abolish or minimise the symptom of pain. It is anticipated that this will be achieved through reduction of important biological mechanisms such as spasm, inflammation, or restrictions in motion. The most common interventions are extremely familiar to nearly the whole population, since either they have experienced them themselves, or have observed someone use them. This is a consequence of the commonness of musculoskeletal pain and discomfort. The most common treatments involve use of oral medications, biomechanical methods such as manipulation or massage, or injections. The principal goal is symptomatic relief from pain. It is assumed, according to the biomedical model, that relief from pain will result in restoration of normal function. That is, the patient will return to their usual life, and full activities including work.

Individual response to treatments and interventions is highly variable. Some people get better, and return to normal life as expected; others get much better, but do not return to normal life; some others do not get better, but still return to normal life; and, others do not get better and do not return to normal life.

One explanation could be that the wrong type of treatment was selected, and this is frequently an initial assumption made by healthcare providers. Patient expectation seems to be geared toward this idea also. The consequence is that more treatment is given, perhaps of several types. A competing explanation might be that the clinician is attempting to treat pain and discomfort that represents a 'normal experience' for a proportion of the population.

There is a major concern that repeated treatment failures, from the provision of serial ineffective therapy, convey potentially harmful messages to the patient, including the following:

- There is a problem that needs medical/physical treatment
- The treatments will cure the problem
- Pain reduction is necessary first (before rehabilitation, or return to activity)
- The clinician is responsible for getting you better (patient has passive role)

These may be harmful or deleterious in the sense that they facilitate beliefs and behaviours that are unhelpful and contribute to reduced levels of activity, higher levels of distress, and a tendency to consume more healthcare and extended absence. The same sort of harmful messages are, of course, likely to arise from ineffective or inappropriate workplace (ergonomic) interventions.

The biopsychosocial model assumes that biological, psychological and social factors can all play a significant role in pain problems. The major implication of this is that it may be necessary to treat biological, psychological and social issues as interlinked systems (see Appendix).

The model draws a distinction between the actual pathological processes that cause disease, and the patient's perception of their health and the effects on it (illness). Illness and disease are not necessarily directly related. A patient may be well (no disease or injury), but if they feel unwell that's an illness. Similarly, patients who are diseased or injured may say they feel completely all right, and hence do not exhibit illness. The biopsychosocial model acknowledges the illness, as much as the injury or disease. Table 1 uses the scenario of a clinical visit to illustrate the differing perspectives between a biomedical and biopsychosocial approach; the same ideas apply to non-clinical perspectives.

Table 1. Contrasting the biomedical and biopsychosocial models for ULDs

	Biomedical Model	Biopsychosocial Model
Presentation	Focus is on physical causes of disease. Clinician asks questions about onset and cause, pain history, and other symptoms. However, empirical signs and symptoms of pain and tenderness are considered paramount.	Clinician aims to ascertain psychosocial and physical processes that may contribute to the arm pain. Clinician may ask for a history of recent life stressors and behaviours, in addition to conducting a clinical examination.
Diagnosis	Clinician examines the arm, and may consider x-ray and/or other lab tests (depending on signs and symptoms) and forms diagnosis.	Based on a combination of clinical examination of the arm, psychosocial factors, (probably without X-ray or other lab tests) the clinician forms an explanation for the symptoms.
Treatment	Medical plan prescribed for the patient based on biological aetiology and pathogenesis.	Clinician discusses available interventions with special attention to behaviours and lifestyles that could influence pain and adherence to the treatment plan. The patient is involved in formulating and implementing the plan.

The biopsychosocial model is on the face of it more time-consuming, and therefore more resource-intensive. However, the basic application of biopsychosocial principles can be applied without requiring exhaustive input. For example, in the low back pain field, it is advocated that individuals should be provided with explanations designed to

prevent development of unhelpful beliefs, and to adopt self-management coping strategies and behaviours (eg *The Back Book* (London, TSO)); this approach can be effective ((Burton et al. 1999; Buchbinder et al. 2001), and has been suggested for ULDs (HSL (Lee & Higgins) 2006).

The biopsychosocial model offers a variety of possible clinical pathways *including those proposed by the biomedical model*. Additional approaches include a shift away from focusing on symptom elimination, and toward changes in function and activity. This is usually achieved through providing cognitive-behavioural intervention, including pain management programmes. Similarly, biopsychosocial principles can be applied to non-clinical interventions, such as those delivered at the workplace.

When considering outcomes, the biopsychosocial model acknowledges the illness (what the person does, the behaviour they engage in), as much as the injury or disease itself. This means that the targets and goals for clinical outcomes go beyond 'cure' and abolition of symptoms. For example, even if the symptom of upper extremity pain cannot be reduced, the goal of returning the individual to productive activity is considered to be of value, in and of itself. This is because the individual's quality of life is always multidimensional in nature. Some aspects of the person's life might be significantly improved, even if symptoms cannot be modified.

This approach is sometimes parodied as 'learning to live' with pain, or as carrying on 'in spite of' pain. Neither is strictly true, from a biopsychosocial perspective, since the inter-relatedness of all these factors means that typically if improvement can be made in some areas there is a 'knock-on' effect into others, at least with respect to perception (eg the individual who has successfully returned to work but the pain is still there, yet it is no longer so important or so 'bothersome').

Finally, an important consideration is the belief that certain types of MSDs, including specific diagnoses, are different to the regional complaints and need to be managed differently. For example, some researchers have advanced the hypothesis that problems such as complex regional pain syndrome may include cases that have a neuropathic pain disorder, or that tenosynovitis is an inflammatory disorder that must be rested. But, overall, is there any theoretical reason to consider musculoskeletal disorders in various regions of the human body to be fundamentally different, when they share the same type of tissue and physiological processes? A considerable body of knowledge about common musculoskeletal health problems has resulted in consistent messages about biopsychosocial management of the disorders and their symptoms, stressing the importance of facilitating return to work, which run across anatomical regions (Waddell & Burton 2004; Talmage & Melhorn 2005; Hadler 2005). The debate will continue beyond this report, but it is important to stress that a biopsychosocial approach is about helping people return to normal productive activity: treatment to reduce pathology and symptoms may be necessary but it is not sufficient; the workplace also has a contributory role.

If a biopsychosocial perspective for the management of upper limb complaints is to be adopted, this evidence review is but one step in the process. It is important to acknowledge that there may well be resistance to adopting such an approach along with hurdles to its practical application. While lessons can perhaps be learnt from how a biopsychosocial perspective for the management of low back pain developed and was successfully introduced, it cannot be assumed that the stakeholders involved in upper limb disorders will necessarily respond in the same way. Changing the way in which upper limb disorders are managed will require careful consideration of the way in which the change is managed.

5. SYNTHESIS

5.1 INTERPRETATION

The epidemiological evidence is quite clear: musculoskeletal symptoms affecting the upper limb and neck are a common experience among the general population, tending to be a recurrent complaint. This high prevalence suggests that the symptoms arise from normal physiological processes and everyday events, such as fatigue or soft tissue strain, rather than some sinister pathology. Indeed, a specific diagnosis cannot reliably be established for the majority of people with ULDs: they might best be viewed as having a regional complaint. Much less common are the specific diagnoses implicating pathology or injury. There is considerable debate over their classification and, whilst some consensus seems possible, diagnostic criteria remain unreliable – many cases will be mislabelled (whether colloquially or by a healthcare professional).

For many people, their symptoms will be work-relevant: their work may be painful or difficult irrespective of the origin of the symptoms. However, even when work is related to the expression of symptoms, that does not mean work was necessarily the underlying cause: it is apparent that work is not the predominant cause of most ULDs.

Many people with ULDs cope without recourse to healthcare or need for sick leave. Many of those who do seek healthcare will be doing so simply because they are not able to cope with this particular episode of neck/arm pain (Hadler 2003), though a small proportion will have a more significant disorder. Irrespective of severity, a small number of people with ULDs will progress to persistent pain and/or long-term disability.

This pattern is typical of a wide range of common health problems, sometimes termed subjective health complaints (Eriksen & Ihlebaek 2002), in which personal and cultural factors are a predominant feature, notably the psychological and social variables that influence beliefs and behaviours (Waddell & Burton 2004). Although the evidence is limited for ULDs, knowledge from the literature on other musculoskeletal problems strongly implicates psychosocial factors as drivers for symptom reporting, workloss, and disability (Fordyce 1995; Burton et al. 2006b). These factors have been characterised as yellow, blue and black flags representing psychological, workplace and systems influences (Main & Burton 2000), which act as obstacles to recovery and obstacles to return to work (Waddell & Burton 2004). Since there is no particular reason to expect that complaints and disorders related to the musculoskeletal apparatus of the upper limb and neck is fundamentally different from the musculoskeletal apparatus of the lower back, it is logical and reasonable to surmise that there will be shared influences, and what evidence there is supports psychosocial factors as being important in understanding and managing ULDs.

Clinical management of ULDs is seemingly less effective than might be expected, perhaps reflecting the difficulties around classification and diagnosis, together with uncertainties over the optimal timing of treatment delivery (longer duration of symptoms having a negative impact on outcomes (Mallen et al. 2007). However, in principle, there is likely to be benefit from biomedical interventions aimed at controlling symptoms (and/or targeting any identifiable pathology) whilst offering support and encouragement for early return to normal activities (including work).

To impact on vocational outcomes (work retention and return to work), interventions require more than biomedical treatment. There is a need to address the range of psychosocial factors (obstacles to recovery/return to work) at both the individual and

workplace level, and those efforts need to be coordinated and integrated among the relevant players, including the individual worker.

Despite the difficulties surrounding recognition of the specific diagnoses, the 'bio' component must be acknowledged. Some patients will have recognised pathology requiring medical or surgical intervention (which may involve short-term rest). However, once that treatment has been delivered (or even while it is being completed), there is no robust evidence suggesting that multimodal approaches to facilitating normal activity return to work are precluded for specific diagnoses (though their implementation may require something of a cultural shift in how specific diagnoses should be conceived and managed). There is some concern that applying the principles of an active approach together with early return to work will be inappropriate for some conditions such as 'tenosynovitis', where anecdotally rest is the preferred option (HSL (Lee & Higgins) 2006). However, these fears may be (at least in part) unfounded: although limited, the evidence on ULDs (both specific and regional) is consistent with the principle of an active approach that is promoted and implemented for MSDs in general (Buckwalter 1995) and, importantly, there is no robust contradictory evidence. The notion of 'rest' as a sole treatment, (implying withdrawal from participation) is likely to be unhelpful: even if specific aggravating activities need to be avoided short-term, that does not preclude other activities and exercises being undertaken as part of therapy (Jebson & Steyers 1997). So far as post-surgical management is concerned, there has been an increasing recognition of the benefits of early activation following most surgical procedures, and restrictions may be more a matter of the surgeon's idiosyncratic advice than any absolute need (Ratzon et al. 2006).

Although early work-return is seen as advantageous, simply sending someone directly back to a job they find painful is counter-intuitive and inappropriate. There is a strong case for using transitional work arrangements as the facilitator, which takes account of both biological and psychosocial obstacles to RTW. There is considerable evidence for the use of temporary modification of activities to support people with regional pain states on their return to normal activity, and there is no clear evidence that the principle cannot or should not be applied to the specific diagnoses.

Just because the epidemiological pattern of most ULDs does not favour ergonomic interventions as a significant primary preventive measure, this does not mean there is no merit in making work ergonomically acceptable. Jobs, naturally, should be within the reasonable capabilities of the workers; if job tasks are close to, or exceed, physiological limits, a proportion of workers are going to succumb to injury. However, portions of the ergonomics literature and official guidance give the erroneous impression that work is intrinsically the predominant cause of ULDs, and that by applying an 'ergonomics approach' they will be eliminated. The evidence reviewed here indicates they will not. Furthermore, a possible problem with ergonomic interventions is that they can reinforce workers' beliefs that they are exposed to a serious hazard, and thereby encourage undue reporting of symptoms, inappropriate workloss, and development of disability (Coggon et al. 2007). Nevertheless, an ergonomics approach, correctly applied, should improve comfort and efficiency, and assist in accommodating those with work-relevant complaints or disorders. The adage '*work should be comfortable when we are well and accommodating when we are ill*' (Hadler 1997) is certainly apposite – good ergonomics will not stop all workers' arms hurting, yet it is a necessary, albeit not sufficient, tool for managing the ULD phenomenon.

Viewed overall, the evidence on the management of ULDs favours neither biomedical nor workplace interventions alone, either for regional complaints or specific diagnoses. Rather, the evidence indicates what is needed is a biopsychosocial approach, which necessitates multimodal interventions with all the players onside and acting in unison.

Whilst the evidence-base supporting this principle of integrating the beliefs and behaviours of all the relevant players is as yet limited, the concept is central to overcoming biopsychosocial obstacles (Waddell & Burton 2004). Achieving all that will require a cultural shift in the way the relationship between upper limb complaints and work is conceived and handled. Educational strategies are likely to be a useful tool in that respect, but will need to be carefully developed and tailored to the relevant target audience (Shaw et al. 2007).

The biopsychosocial model remains ill-understood in some circles, thus compromising its adoption. Importantly the biopsychosocial approach does not seek to 'blame' the individual or suggest it is 'all in the mind', and does not aim to devalue the contributions of ergonomics and biomedical interventions. However, acknowledging the crucial role of personal and occupational psychological factors (impacting on all the players) does not deny the reality of the symptoms or the legitimacy of the concerns. The biopsychosocial model assumes that biological, psychological, and social factors all play a significant role in determining the full range of outcomes, and that these factors need to be addressed in a positive and constructive climate.

5.2 FUTURE DIRECTIONS

The findings of this review complement, and should feed into, the UK Government's Health, Work and Well-being strategy www.health-and-work.gov.uk/. There is an accepted need to shift the culture surrounding the relationship between work and health (Waddell & Burton 2006) and growing acceptance that modern rehabilitation approaches may be more effective than primary prevention strategies in the overall management of work-relevant health problems.

The available evidence reviewed here strongly supports the adoption of a biopsychosocial perspective for the management of ULDs. Although the supporting evidence is less well developed than that for back pain, it points in the same direction and, importantly, there is no robust conflicting evidence.

If the need for cultural change is accepted then there is also a need for policy makers to rethink the priorities of certain underlying concepts (eg primary prevention *v* management: work-caused *v* work-relevant) and develop means to disseminate evidence-based information to the various players (employers, workers, healthcare, unions, lawyers, legislators). Media campaigns are increasingly seen as a suitable vehicle to contribute to public health and cultural change in respect of health behaviours, supplemented by complementary guidance material (eg the TSO publications such as *The Back Book* and *Work & Health*); there seems to be good reason to suppose the issue of ULDs should be similarly targeted (as recommended by an HSL consensus workshop (HSL (Lee & Higgins) 2006)).

Whilst the overall message may be clear – biopsychosocial factors are influential in the phenomenon of upper limb complaints and need to be addressed – there are gaps in the evidence. Observational studies will help to better understand the natural history of non-specific complaints and the specific diagnoses, and controlled trials are needed to determine the most appropriate means for implementing both clinical and workplace care. Innovative multimodal interventions seem promising, yet the optimal content, timing and method of delivery is yet to be determined. Nevertheless, the detailed evidence assembled during this review is extensive, so perhaps the most immediate task is to look at the detail (which was not the purpose of this review) in order to blend the findings with what has been learned in other fields, in order to guide the development of those multimodal approaches.

6. KEY MESSAGES

The brief for this review sought accurate (evidence-based) simple headline messages about ULDs. The findings are unequivocal: targeting messages just at the individual with an upper limb complaint will be suboptimal. A number of messages do emerge from the evidence, and may well contribute to the needed cultural shift. However, they apply to the whole range of players involved (population/workers; employers; health professionals; unions; lawyers; media; policy makers; enforcers), so they will need to be carefully constructed for each target group, tailored to their needs, and comprehensively disseminated if positive change is to be achieved.

The evidence gathered and analysed in this review was extensive, and whilst not all of it was specific to ULDs, its overall interpretation reveals a considerable quantity of evidence-based information and advice that is applicable to the management of ULDs. It is convenient to summarise this information in bullet form; transforming these points into suitable material for various purposes and media requires assimilating the detail contained in the text and evidence tables.

The messages are presented in two groups, reflecting the need to provide (1) facts and ideas to improve understanding and inform attitudes and beliefs (concept messages), and (2) advice on the necessary actions, and what should and should not be done (process messages).

CONCEPT MESSAGES

- ***Upper limb symptoms are a common experience -***
    - they are generally transitory but recurrent;
    - they are often triggered by physical stress (minor injury):
        - due to everyday activities as well as work,
        - but, rarely do they reflect irreparable damage;
    - some cases need treatment, but many settle with self-management:
        - activity is usually helpful: prolonged rest is not;
    - recovery and return to full activities can be expected:
        - lasting impairment is rare.
- ***Work is not the predominant cause -***
    - some work will be difficult or impossible for a short while:
        - yet that does not mean the work is unsafe,
            - indeed, over-attribution to work is detrimental;
    - most people can stay at work (sometimes with temporary adjustments):
        - but, absence is appropriate if job demands cannot be tolerated.
- ***Early return to work is important -***
    - it contributes to the recovery process and will usually do no harm;
    - facilitating early return requires support from workplace and healthcare.
- ***All players onside is fundamental -***
    - sharing goals, beliefs and a commitment to coordinated action.

PROCESS MESSAGES

- ***Promote self-management -***
    - Give evidence-based information and advice:
        - adopt a can-do approach,
        - dispel myths,
        - focus on recovery rather than what's happened.
- ***Intervene using stepped care approach -***
    - provide only what's needed when it's needed:
        - treatment only if required,
        - beware detrimental labels and over-medicalisation;
    - encourage and support early activity:
        - avoid prolonged rest;
    - focus on participation - including work.
- ***Encourage early return to work -***
    - stay in touch with absent worker;
    - use case management principles;
    - focus on what worker can do rather than what they can't:
        - a fit note may be more helpful than a sick note;
    - provide transitional work arrangements:
        - but only if required, and time-limited.
- ***Endeavour to make work comfortable and accommodating -***
    - assess and control significant risks:
        - ensure physical demands are within normal capabilities,
        - but, don't rely on ergonomics alone;
    - accommodating cases shows more promise than prevention.
- ***Overcome obstacles -***
    - principles of rehabilitation should be applied early:
        - focus on tackling biopsychosocial obstacles to participation;
    - all players communicating openly and acting together:
        - avoiding blame and conflict.

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APPENDIX

DEFINITIONS

Allodynia

Allodynia is pain due to a stimulus that does not normally provoke pain (International Association for the Study of Pain 1994).

Hyperalgesia

Hyperalgesia is an increased response to a stimulus that is normally painful (International Association for the Study of Pain 1994).

Biopsychosocial

Most people understand that “health is good” and “disease is bad”, and this dichotomy separating health and disease became firmly embedded in the doctrine of specific aetiology from the 19th century onwards. Health and disease became to be considered as separate entities, defined by the presence or absence of a specific biological factor. This conceptual approach is frequently referred to as the “biomedical model”, and the “psychosomatic model” complements it. This broadly proposes that somatic symptoms, which cannot be readily explained by biological factors, are due primarily to psychological factors. The problem for the biomedical/psychosomatic model is that the mere presence of a biological factor does not guarantee the development of disease, nor does the inability to detect biological causes automatically implicate psychogenic causation. For this reason the World Health Organization (WHO) proposed in 1948 that health is a complete state of “physical, mental and social well-being, and not merely the absence of disease and infirmity”. Ongoing dissatisfaction with the constraints and limitations of the biomedical model led to the development of other models. Among these was the “biopsychosocial model”.

It is believed that the term biopsychosocial was first used in 1977 by George Engel in an article discussing the need for a new medical model (Engel 1977). In broad terms the biopsychosocial model posits that biological, psychological, and social factors combine to play a significant role in human functioning. The concept has been adopted into academic fields including medicine, psychology, and sociology. However, to date, a single irreducible biopsychosocial model has yet to be published.

The important implication of the biopsychosocial model for healthcare is that biological, psychological and social issues should be treated as interlinked systems. In the musculoskeletal arena, perhaps the greatest contribution to development of the biopsychosocial model has arisen within the study of pain. Based on the earlier work of Merskey and Spear (Merskey & Spear 1967), the International Association for the Study of Pain adopted a biopsychosocial definition of pain as “an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage” (International Association for the Study of Pain 1994).

The description of pain as a biopsychosocial phenomenon has undergone development. Initially John Loeser (Loeser 1982) identified four dimensions of pain: nociception, pain, suffering, and pain behaviour. He defined these as follows: Nociception = potentially tissue-damaging thermal or mechanical energy impinging

upon specialized nerve endings that in turn activate A-delta and C fibres. Pain = nociceptive input to the nervous system. Suffering = negative affective response generated in higher nervous centres by pain and other situations such as loss of loved objects, stress, anxiety, etc. Pain behaviour = all forms of behaviour generated by the individual commonly understood to reflect the presence of nociception, including speech, facial expression, posture, seeking health care attention, taking medications, refusing to work. Only pain behaviour is considered directly observable. The most important subsequent refinement to the biopsychosocial model of pain has been the explicit recognition that the social and environmental context in which pain occurs can play an important role (Fig 1).

Fig.1 Biopsychosocial model of pain

It is important to note that while the biopsychosocial model proposes biological, psychological, and social issues should be treated as interlinked systems, it does not require that all of these must necessarily be addressed in each and every case. Rather, it suggests that relevant and important factors should be managed. Proponents of the biomedical model often overlook this.

Within the occupational 'rehabilitation' framework a further refinement has been the development of the concept of identifying obstacles to return to work.

A major strength of the biopsychosocial model is that it provides a wider spectrum for potential interventions, and this can yield great benefits to some individuals who had previously been consigned to an untreatable category. The most obvious example within the musculoskeletal arena has been the development and delivery of pain management and rehabilitation approaches based on cognitive-behavioural principles. However, considerable care needs to be exercised to identify suitable candidates for these interventions, since they are not required or appropriate for all.

For the purposes of this report the term 'biopsychosocial' refers to the concept that biological, psychological, and social factors combine to play a significant role in human functioning; and, these need to be treated or managed as interlinked systems.

[Note, sometimes the term 'multidisciplinary' treatment is used as if it were a synonym for 'biopsychosocial' intervention. In regular musculoskeletal clinical practice it is common to have multidisciplinary treatments entirely within a biomedical framework. Likewise, it is possible for a single clinician to deliver a biopsychosocial intervention].

Pain

Pain is an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage (International Association for the Study of Pain 1994).

Prevention

The meaning of the term ‘prevention’ appears straightforward and obvious. However, in the musculoskeletal arena it can refer to several different things, and is often used ubiquitously without careful explanation.

There are two important domains to consider. The first is temporal. There has been an expanding evidence base that demonstrates the factors relevant to musculoskeletal disorders vary across different time “phases”. There are different factors implicated in the onset of symptoms, the reporting of musculoskeletal problems, and the development of long-term problems (e.g. work disability). Prevention may be successful at certain phases, but not at others. Sometimes the terminology ‘primary prevention’ is used to denote interventions designed to prevent onset of injury or disease; ‘secondary prevention’ to describe approaches to prevent acute problems becoming chronic or persistent; and, ‘tertiary prevention’ to refer to attempts to recover function and quality of life among the long-term disabled.

The second important domain is the possible targets, or goals, for prevention. In practice, these are usually the same as outcomes (although the relevance or importance of each outcome depends on the perspective of the stakeholder – e.g. patient, clinician, spouse and family, employer and workplace, funder, etc.). Musculoskeletal disorders often involve pain problems, which are multidimensional in nature. That is, there are several important components such as symptom severity, functional limitations, associated psychological distress, and important behavioural implications that include productive activity.

This means that the overall prevention field is complex, and unlikely to be responsive to uni-dimensional interventions. For example, in the prevention of onset of injury or disease, the most common principle is one of hazard identification using some form of risk assessment based on an agreed rule or “standard”. This approach rests on a sequence of assumptions. First, is that risks and hazards are known and understood. Second, is that they can be accurately identified in practice. Third, is that once they have been identified they can be eliminated, or at least reduced, and this will yield a subsequent reduction in cases of injury or illness. However, this does not always hold true. Nor does it necessarily take account of multifactorial and complex causation.

While what might constitute effective primary prevention approaches for musculoskeletal problems remains unclear, there is strong evidence for benefit from both the secondary and tertiary approaches. However, tertiary approaches are expensive and labour-intensive; and, secondary prevention approaches tend to be underutilized. This may be due to their application of the biopsychosocial model, and the perceived conflict of this with the prevailing biomedical model.

The term ‘prevention’ can refer to preventing an injury/complaint from happening, or it can refer to an approach/intervention to reduce the consequences of an injury/complaint. It is not currently understood how to prevent people from developing musculoskeletal pain and discomfort. However, preventing deleterious consequences is potentially feasible: it needs much greater emphasis, and should be targeted at a specific phase of a musculoskeletal disorder, with clearly defined targets or goals.

Productive activity

This term refers to any activity that is productive, whether it is remunerated or not. That is, it includes paid work whether part-time or full-time, voluntary work, studying, domestic work, etc. It is therefore a more inclusive term than ‘work’, which tends to only describe those in paid employment and fails to recognise that people participate in a

wide variety of productive activities that may require equal or greater personal effort than paid work, and may place similar biomechanical demands on the individual.

Complex Regional Pain Syndrome (CRPS)

CRPS is a term promoted by the International Association for the Study of Pain to replace 'reflex sympathetic dystrophy' and 'causalgia'. In their 1994 published taxonomy IASP established diagnostic criteria for CRPS as follows:

1. The presence of an initiating event
2. A cause of immobilization
3. Continuous pain, allodynia and/or hyperalgesia
4. Skin temperature changes more than 1.1^{o} C difference from the homologous body part
5. Evidence at some time of oedema, skin colour changes and abnormal pseudomotor activity in the area of pain
6. No existence of other condition that would otherwise account for the degree of pain and dysfunction

This taxonomy also defined two types of CRPS. Type I (reflex sympathetic dystrophy) where minor injuries or fracture of a limb precede the onset of symptoms; and, Type II (causalgia), which develops after injury to a major peripheral nerve.

Psychosocial

The psychologist Erik Erikson brought the term 'psychosocial' into common use in his most influential work, Childhood and Society (Erikson 1950), in which he divided the human life cycle into eight psychosocial stages of development with a specific focus on personality development. In this context the term referred to psychological development in, and interaction with, a social environment. The individual may not be fully aware of this interactive relationship with their environment. Erikson proposed that human personality, in principle, develops according to steps predetermined in the growing person's readiness to be driven toward, to be aware of, and to interact with a widening social radius.

The clinical and healthcare arena gradually adopted the term, without formal definition, and its popularity has steadily increased. Current uses can be found in the following areas (Martikainen et al. 2002): causes and risk factors ('psychosocial causation', 'psychosocial influences', 'psychosocial risk factors'), mediating factors and contexts ('psychosocial mechanisms', 'psychosocial environment', 'psychosocial context', 'psychosocial resources', 'psychosocial support'), and outcomes ('psychosocial (di)stress', 'psychosocial well-being' and 'psychosocial health'). Unspecified use of the term ultimately degrades its usefulness, so that it ends up referring to everything and nothing in particular.

Dictionary entries provide definitions such as "pertaining to the influence of social factors on an individual's mind or behaviour, and to the interrelation of behavioural and social factors" (Oxford English Dictionary, 2007), or "combination of psychological and social factors" (National Institutes of Health, 2007). Within the musculoskeletal arena, and the conceptual development of 'psychosocial yellow flags', the term refers to "the interaction between the person and their social environment, and the influences on their behaviour" (Kendall et al. 1997).

The important feature here is that 'psychosocial' factors refer to the interaction between influences at the social and the individual level, but are neither solely one nor the other. Furthermore, it fully encompasses the influence of the social environment on individual's beliefs, attitudes, emotions and behaviours. It is important to note that the social environment includes not only family and friends, but also extends to a number

of groups including: employers, line managers and co-workers; healthcare providers and those that provide advice; governmental agencies, insurers and other funders. For those with injuries or diseases, the interactions with these multiple influences form the relevant psychosocial factors. A major strength of this conceptual approach is that it allows identification of causal and contributory relationships that are both multidimensional and bi-directional. However, great care needs to be exercised to prevent confusion between cause and effect.

For the purposes of this report the term 'psychosocial' refers to the interaction between the person (beliefs, emotions, behaviour, etc) and their social environment (significant others, healthcare providers, people at the workplace, funders, etc), and the influences on their behaviour (what they do).

Note, the term 'psychosocial' is different from 'psychological', which refers more narrowly to the cognitive and behavioural aspects of individuals. These are shaped by, and based on, matters that range from hereditary factors through to interactions with others.

Work-relevant

The idea of work being a contributor to morbidity, documented by Ramazzini at the beginning of the 18th century (Ramazzini 1700) has, quite rightly, had a powerful influence on occupational health and ergonomics, although it needs to be accepted that science has moved on in more recent years. For any disease or injury, the attribution of causality is most salient when it may lead to an effective preventive strategy. To this end, surveillance and sentinel systems have been established to identify potential and actual causal links, and to overcome the problem of identifying these despite long latency periods (Kendall, 2005). A good example that is widely acknowledged as successful was the identification of asbestos exposure as a cause of lung cancer and mesothelioma. Sometimes, exposure to potentially harmful things happens during the course of working, or while a person is present in their workplace. This observation historically led to the development of two cornerstones of modern working life: prevention strategies through occupational safety and health initiatives, and relevant insurance and compensation systems.

Prevention programmes are delivered nowadays under the rubric of 'occupational safety and health'. The most common principle used is one of hazard identification using some form of risk assessment based on an agreed rule or 'standard'. This approach rests on a sequence of assumptions. First, is that risks and hazards are known and understood. Second, is that they can be accurately identified in practice. Third, is that once they have been identified they can be eliminated, or at least reduced, and this will yield a subsequent reduction in cases of injury or illness (Kendall, in press). Unfortunately this sequence of assumptions does not always hold true in its entirety. For this reason, there is a lack of agreement over what constitutes a truly effective occupational safety and health system.

The notion that a worker might be made ill or injured during the course of their employment runs counter to the principle that he or she has the right to undertake work without it impacting adversely on their health. This is now formally expressed in documents such as "The Declaration of Fundamental Principles and Rights at Work" adopted by the ILO (International Labour Organisation, 1988). This conclusion led to the development of the concepts of compensation for a worker. In practice this occurs through recourse to placing claims before the courts, or through making insurance or compensation claims. The basis for all these claims is an assumed causal connection between an exposure at work and the appearance of a disease or injury. Unequivocal evidence of such connection is not always forthcoming, and in reality the inquiry into

cause is apt to produce perplexing legal and philosophical problems that the courts frequently have difficulty in resolving.

These historical developments led to the growth of occupational health, and importantly to the emergence of a lexicon of terminology that include a host of words and phrases to describe the relationship between work and health. These are too prolific in number to list or discuss here.

However, two areas of terminology are worthy of brief discussion. First is the term 'work-related', and its variants. Second, are terms describing clinical presentations that incorporate an assumption about causation, and the involvement of the workplace. In the upper extremity arena these include "repetitive strain injury" (RSI), "cumulative trauma disorder" (CTD), "occupational overuse syndrome" (OOS), "work-related upper extremity/limb disorder" (WRUED/WRULD), etc. It is clear from current scientific knowledge that direct causation for musculoskeletal health problems by a singular and unique factor is rare indeed. It is also clear, that in some circumstances, work and workplace factors can contribute to the development or exacerbation of signs and symptoms in an individual. However, these may also interact with multiple factors to produce and maintain the relevant health problem. That is, any causal relationships may be complex and indirect.

For this reason, it is argued that terminology which assumes or implies a causal relationship between work and health is best avoided. The term 'work-relevant' achieves this goal (Faber et al. 2006). It acknowledges there is a relationship to work and the workplace, but recognises this may be complex and indirect - the relationship may be causal, contributory, or coincidental. Furthermore, it acknowledges that health problems may themselves impact on the workplace.

For the purposes of this report the term 'work-relevant' refers to health complaints/disorders that, irrespective of cause, are experienced at the workplace to a greater or lesser extent, and which in turn impact on the performance of a worker.

EVIDENCE TABLES

Table A1. Reviews on epidemiology and risk factors

Table A1. Reviews on epidemiology and risk factors	
Authors	Key features *(Reviewers' comments in italic)*
(Bongers et al. 2002) Systematic review	Are psychosocial factors, risk factors for symptoms and signs of the shoulder, elbow, or hand/wrist?: a review of the epidemiological literature Moderate quality systematic review of studies published between 1980 and 1999, using a priori selection criteria and levels of evidence. Identified 200 studies, and included 28. Of these, only one was a prospective study (of medium quality), one was retrospective, and one was a case-control study. The remainder were cross-sectional. A broad range of psychosocial factors were considered including: qualitative and quantitative job demands, stimulus from work, job control, social support, job satisfaction, perceived job stress, rest break opportunities in a job and two non-work psychosocial factors, i.e., support by family and friends and worry, distress and non-work stress reactions. The large majority of cross-sectional studies reported at least one association between psychosocial factors and upper extremity symptoms or signs. However, the single prospective study found increased perceived monotony" to be a risk factor for hand/wrist discomfort. The retrospective study found limited rest breaks and relatively high time pressure to be risk factors. The case control study found an association with a specific work organisation factor (no job rotation between different work stations), but found no association with either autonomy or rest break opportunities. Overall, this review found only weak evidence for psychosocial factors to be contributors to upper limb disorders. *(There appears to be an error in this systematic review. The appendix with data extraction material states that Bergqvist (1995) used 341 VDU workers as subjects. However, the numbers of subjects were 260 and 353 in the two citations listed for Bergqvist (1995) in the bibliography).*
(Bongers et al. 2006) Narrative review	Epidemiology of work-related neck and upper limb problems: (1) psychosocial and personal risk factors Work related neck and upper limb symptoms have a multifactorial origin. Physical, psychosocial, or personal factors can reinforce each other and their influence can also be mediated by cultural or societal factors. An overview is presented of the results of recent epidemiological studies on work related psychosocial and personal risk factors for neck and upper limb symptoms. In addition, the interplay between these factors and the possible intermediate role of individual work style in this process is explored. It is now possible to base conclusions on numerous longitudinal studies. High work demands or little control at work are often related to ULD symptoms. However, this relationship is neither very strong nor very specific. Perceived stress, general distress, and other pain (comorbidity), though less extensively studied, are quite consistently related to neck and upper limb symptoms. Job dissatisfaction does not contribute to neck and upper limb symptoms. Too little research on personal characteristics is available to draw any conclusions. It is plausible that behavioural aspects, such as work style, are of importance in the aetiology of work related upper limb symptoms but the (promising) evidence is too scarce to draw conclusions. *(See companion entry in Table A2).*
(Gerr et al. 2006) Quasi-systematic review	Keyboard use and musculoskeletal outcomes among computer users Reviews the epidemiological evidence examining associations between upper extremity musculoskeletal symptoms and disorders, the intensity of keyboard use and users' postures. A search of the peer-reviewed medical literature between 1966 and November 2005 identified a total of 558 citations. Only thirty-nine epidemiological studies examining associations between computer use and MSD outcomes were identified in which: the sample size was >20; posture was ascertained by a study investigator (as opposed to self-report); or computer use was ascertained, by self-report or other methods, in units of hours-per-day, hours-per-week, or as a percentage of work-time. Despite concluding that "several methodological limitations including non-representative samples, imprecise or biased measures of exposure and health outcome, incomplete control of confounding variables, and reversal of cause and effect" may have contributed to "the heterogeneity of observed results" the authors felt able to identify a number of "trends" in the findings: associations between various aspects of computer use are associated with neck/upper limb symptoms/disorders. (*This review seems to underplay the severe methodological limitations of*

Table A1. Reviews on epidemiology and risk factors	
Authors	Key features *(Reviewers' comments in italic)*
	most of the studies identified: because most of the studies were cross-sectional and there was little difference in the number of 'positive' and 'negative' studies, an alternative explanation might be that there is limited and inconsistent evidence for a close association between computer use and neck/upper limb symptoms/disorders).
(Hooftman et al. 2004) Systematic review	Gender differences in the relations between work-related physical and psychosocial risk factors and musculoskeletal complaints The authors conducted a systematic review of the literature to establish whether the reported gender differences in prevalence rates for musculoskeletal complaints might be due to differences in the effect of exposure to work-related physical and psychosocial risk factors. 31 studies were included, and scored for methodological quality (range 29% to 81%). Risk factors considered for back pain were lifting, awkward postures, heavy physical work, whole-body vibration, job demands, job control, job satisfaction, and social support. Evidence was found for male > female only for lifting. For neck-shoulder complaints the risk factors considered were repetition, hand-arm vibration, arm posture, arm force, job demands, job control, and social support. Evidence was found for male > female for hand-arm vibration, and for female > male for arm posture.
(Huisstede et al. 2006) Systematic review	Incidence and prevalence of upper-extremity musculoskeletal disorders. a systematic appraisal of the literature A systematic appraisal of the worldwide incidence and prevalence rates of upper extremity disorders (UED) available in scientific literature. Studies that recruited at least 500 people, collected data by using questionnaires, interviews and/or physical examinations, and reported incidence or prevalence rates of the whole upper-extremity including neck, were included. No studies were found with regard to the incidence of UEDs and 13 studies that reported prevalence rates of UEDs were included. The point prevalence ranged from 1.6–53%; the 12-months prevalence ranged from 2.3–41%. One study reported on the lifetime prevalence (29%). We did not find evidence of a clear increasing or decreasing pattern over time. In general, higher prevalence rates of UEDs were found in women then in men and the estimates of self-reported complaints were higher than those acquired by using (in addition) physical examinations. The case definitions for UEDs used in the studies, differed enormously, which impacted on the prevalence rates. *(This study, pleading for unambiguous terminology, was a precursor to Huisstede et al 2007 Table A4)*.
(IIAC 2006) ‡ UK Legislation	Prescribed diseases (Industrial Injuries Advisory Council) The UK law provides for payment of benefits to people who are suffering from certain diseases contracted in the course of certain types of employment. These diseases are referred to as prescribed diseases and are listed in Regulations. There is no entitlement to benefit in respect of a disease if it is not listed in the Regulations, or if the person's job is not listed against the particular disease. This is especially important for diseases common in the population at large, where it is known that some workers would have got the disease whatever job they did. A disease can only be prescribed if the risk to workers in a certain occupation is substantially greater than the risk to the general population, and the link between the disease and the occupation can be established in each individual case or presumed with reasonable certainty. In diseases which occur in the general population (e.g. chronic bronchitis and emphysema) there may be no difference in the pathology or clinical features to distinguish an occupational from a non-occupational cause. In these circumstances, in order to recommend prescription, IIAC looks for consistent evidence that the risk of developing the disease is more than doubled in a given occupation. There are a number of common musculoskeletal disorders that are considered prescribed diseases: cramp of the hand or forearm due to repetitive movements; subcutaneous cellulitis of the hand due to manual labour causing severe friction or pressure; bursitis or subcutaneous cellulitis at the knee due to severe prolonged external friction or pressure; bursitis or cellulitis at the elbow due to severe or prolonged external friction or pressure; traumatic inflammation of the tendons (tenosynovitis) affecting the hand due to manual labour or frequent or repeated movements of the hand or wrist; vibration white finger and carpal tunnel syndrome related to use of hand-held vibrating tools; osteoarthritis of the hip in agriculture as a farmer or farm worker for a period 10 years. (*Whilst it is recognised that exposures in certain jobs are related to certain musculoskeletal diseases, it is not implied as inevitable that exposure to the job will result in the disease*).

Table A1. Reviews on epidemiology and risk factors	
Authors	Key features *(Reviewers' comments in italic)*
(Ijmker et al. 2007) Systematic review	Should office workers spend fewer hours at their computer? Based on 9 articles (6 were high quality) there is moderate evidence for a positive association between duration of mouse use and hand-arm symptoms, with indications for a dose-response relationship. Risk estimates were stronger for hand-arm region than neck-shoulder region, and stronger for mouse use than for total computer use or keyboard use. A pathophysiological model focusing on overuse of muscles during computer use supports these differences. Further studies are required to determine the safe level of computer use – usage needs to be measured more objectively, and distinguishing between different aspects of usage, eg mouse v keyboard. *(A strong point of this review is inclusion of only longitudinal studies, but 'outcomes' were restricted largely to self-reported symptoms – varying regions and over varying periods (recent days to months) – thus it is not possible to distinguish between work-caused disorder and work-relevant symptoms).*
(Keyserling 2000) Narrative review	Workplace risk factors and occupational musculoskeletal disorders, part 2: a review of biomechanical and psychophysical research on risk factors associated with upper extremity disorders Narrative review of laboratory biomechanical and psychophysical studies, with reference to models for work-related ULD's based on these. The authors pointed out the results of these studies complement, but do not replace, epidemiological data. They concluded there is a wide range of potential risk factors including: forceful prehensile exertions; exertions involving a flexed or extending wrist; exertions involving radial or ulnar deviation; exertions involving pinch grip posture or pressing with the finger tips; repetitive hand exertions (task frequency); task duration/shift length; distance moved (displacement of object during hand-intense work); dynamic effects of hand motions (wrist acceleration); work with pneumatic fastening tools (nut runners, screwdrivers, etc); keyboard work; and, work with gloves. *(Information about the strength of these observed associations was not provided, nor is there any indication of the relative importance of these potential risk factors relative to each other, or to other factors).* Job and task factors that are significantly related to Biomechanical Strain are: Magnitude of grip/pinch/trigger force; Exertion with finger tip (pinch or pressing action); Posture: wrist flexion or extension; Posture: wrist ulnar deviation; Posture: work with elevated shoulder; Dynamics of wrist motion (acceleration); Duration of work activity; Torque output of pneumatic hand tool; Torque impulse of pneumatic hand tool; Keyboard ''make force'' ; Arm support during keyboard work; Working with gloves; and, Population variability. Job and task factors that are significantly related to Psychophysical Strain are: Magnitude of grip/pinch/trigger force; Posture: wrist flexion or extension; Posture: wrist ulnar deviation; Posture: work with elevated shoulder; Frequency of repeated hand motions; Displacement distance during transfer Tasks; Duration of work activity; Torque output of pneumatic hand tool; Torque impulse of pneumatic hand tool; Handle configuration of pneumatic hand tool; Vertical and horizontal reach with hand tool; Weight of pneumatic hand tool; and, Population variability. The authors also pointed out that further research is required to understand the quantitative relationship between exposure to these factors and the incidence and severity of a work-related ULD. However, they advise that these task attributes should be incorporated into job evaluation and job design procedures in order to reduce exposures to factors that are known to increase biomechanical and/or psychophysical strain.
(Kuijpers et al. 2004) Systematic review	Systematic review of prognostic cohort studies on shoulder disorders The reviewers noted that shoulder complaints are common and have an unfavourable outcome in many patients, yet there is little consensus about prognostic indicators that can identify patients at high and low risk of chronicity. Identified 16 articles focusing on the prognosis of shoulder disorders, and assessed the methodological quality of these 16 studies. Six were deemed to be high quality. It was noted that there is wide variation among the studies with respect to length of follow-up, the study population used, the evaluated prognostic factors, types of outcome measures used, and the methods of analysis employed. Because of this heterogeneity statistical pooling of data was not conducted, and instead a qualitative 'best-evidence synthesis' was completed. The reviewers concluded (based on factors with RR or OR > 2.0) that: (1) there is strong evidence that high pain intensity predicts a poorer outcome in primary care populations; (2) there is strong evidence that middle age (45-54) is associated with poor outcome in occupational populations; and, (3) there is moderate evidence that a long duration of complaints, and high disability score at baseline predict a poorer outcome in primary care. Factors with RR or OR between 0.5 and 2.0 or a not statistically significant association included years of education, repetitive work, precipitating trauma and instability of the glenohumeral joint. The authors advised caution in interpreting these findings since they are based on a small number of highly heterogeneous studies.

Table A1. Reviews on epidemiology and risk factors	
Authors	Key features *(Reviewers' comments in italic)*
(Lederman 2003) Narrative review	Neuromuscular and musculoskeletal problems in instrumental musicians Reviews the major playing-related disorders seen in 1353 instrumental musicians, who are described as tending to be introspective, self-analytical, and exceptionally single-minded and determined about their art. They often set high standards for themselves, which are sometimes unrealistic. Their expectation of others, including their health-care providers, may be similarly high. Many are almost pathologically fearful of medical, to say nothing of surgical, interventions. The major diagnoses included musculoskeletal disorders in 64%, peripheral nerve problems in 20%, and focal dystonia in 8%. Of these instrumentalists, 60% were women, although men were the majority in the group with focal dystonia. Among musculoskeletal disorders, regional muscle pain syndromes, particularly of the upper limb, upper trunk, and neck, were most common. Specific entities such as tendinitis and ligament sprain were less common. Frequent peripheral nerve disorders included thoracic outlet syndrome, ulnar neuropathy at the elbow, and carpal tunnel syndrome. Each instrument group showed a characteristic distribution of symptoms and signs that appeared to be directly related to the static and dynamic stresses inherent in the playing of the instrument. With carefully designed treatment, the majority of instrumental musicians can return to full and pain-free playing. Nerve entrapment syndromes have the highest treatment success rate, followed by musculoskeletal pain syndromes. Despite some recent innovative approaches, focal dystonia remains largely resistant to therapy. *(This review is of interest here mainly because it suggests instrumentalists are highly motivated to 'return to work' and most apparently do; focal dystonia seems a separate issue needing special consideration*).
(Mallen et al. 2007) Systematic review	Prognostic factors for musculoskeletal pain: a systematic review Forty-five observational cohort studies in primary care were included. Eleven factors, assessed at baseline, were found to be associated with poor outcome at follow up for at least two different regional pain complaints: higher pain severity at baseline, longer pain duration, multiple-site pain, previous pain episodes, anxiety and/or depression, higher somatic perceptions and/or distress, adverse coping strategies, low social support, older age, higher baseline disability, and greater movement restriction. Despite substantial heterogeneity in the design and analysis of original studies, this review has identified potential generic prognostic indicators that may be useful when assessing any regional musculoskeletal pain complaint. However, It is unclear whether these indicators, used alone, or in combination, can correctly estimate the likely course of individual patients' problems. Further research is needed, particularly in peripheral joint pain and using assessment methods feasible for routine practice.
(Marinus & van Hilten 2006) Systematic review	Clinical expression profiles of complex regional pain syndrome, fibromyalgia and a-specific repetitive strain injury: more common denominators than pain? The aim of this review was to evaluate and compare the clinical manifestations, disease course, risk factors and demographic characteristics of Complex Regional Pain Syndrome type 1 (CRPS), fibromyalgia (FM) and a-specific Repetitive Strain Injury (RSI). Studies were included only if they had 20 or more subjects (n= 59 on CRPS; n= 73 on FM; n=7 on RSI). Comparisons were made for the characteristics of CRPS, FM, and RSI across a large number of variables that included epidemiology, disease course and the role of trauma, distribution of symptoms, pain and sensory signs and symptoms, autonomic signs and symptoms, motor signs and symptoms, trophic signs and symptoms, systemic signs and symptoms, psychological characteristics, and factors associated with onset or progression. The reviewers noted that all thee disease types show similarities in age distribution, male-female ratio, pain characteristics and sensory signs and symptoms. Motor, autonomic and trophic changes are frequently reported in CRPS, but only occasionally in FM and RSI. Systemic symptoms are found in patients with CRPS and FM, and in a subgroup of patients with RSI. In all three disorders, symptoms usually start locally, but may spread to other body regions later, which, in the case of FM, is a prerequisite for diagnosis. Disease onset is always, usually, or occasionally of traumatic origin in RSI, CRPS and FM, respectively. Anxiety and depression are more frequent in patients compared to controls, but probably not very different from patients with other pain conditions or chronic diseases. The authors concluded that, aside from some obvious differences, there are many common features to CRPS, FM and RSI. They suggested this indicates a common pathway may be involved.
(Melrose et al. 2007)	Better display screen equipment (DSE) work-related ill health data The project sought information about the extent of such ill health in DSE workers through a survey of employees. It compared the data with those in the scientific literature. An extensive literature review sought to identify consistent evidence on any possible causal role of workplace factors. The survey found

Table A1. Reviews on epidemiology and risk factors	
Authors	Key features *(Reviewers' comments in italic)*
Narrative review + survey	high prevalences in DSE users of self-reported symptoms, eg. headaches (52%), eye discomfort (58%), and neck pain (47%); other symptoms such as back (37%) and shoulder (39%) pain were also frequently reported. Most of those reporting symptoms did not take any time off work. These findings are broadly consistent with other studies in the literature. The results showed a significant influence of DSE work in that the prevalences of symptoms were higher among those who spent more time at their computer at work and among those who worked for longer without a break. All symptoms were more common among respondents who had indications of stress, anxiety and/or depression. These findings are again consistent with the published literature. Although many studies have examined possible causal factors, methodological differences make it hard to draw any firm conclusions about causation of symptoms. Comparing these results with those of earlier research provides no positive evidence that the introduction of legislation on DSE work in 1993 has reduced ill-health in DSE workers. However there are substantial uncertainties, not least over the extent to which the provisions of the legislation have been fully implemented, and it cannot be safely concluded that the legislation has had no effect.
(National Research Council 1999) ‡ Workshop report	Work-related musculoskeletal disorders There is a strong association between biomechanical stressors at work and reported musculoskeletal pain, injury, loss of work and disability. There is a strong biological plausibility to the relationship between the incidence of musculoskeletal disorders and high-exposure occupations, but methodological weaknesses make it difficult to draw strong causal inferences or to establish the relative importance of task and other factors. Evidence that lower levels of biomechanical stress are associated with musculoskeletal disorders remains less definite. Research clearly demonstrates that reducing the amount of biomechanical stress and interventions which tailor corrective action to individual, organisational and job characteristics can reduce the reported rate of musculoskeletal disorders for workers who perform high-risk tasks.
(National Research Council 2001) ‡ Panel review	Musculoskeletal disorders and the workplace This US panel concluded: musculoskeletal disorders should be approached in the context of the whole person rather than focusing on body regions in isolation. There is a clear relationship between disorders of the upper extremities and repetition, force and vibration. (*That relationship is not claimed to necessarily be causative*). Work-related psychosocial factors associated with upper extremity disorders include high job demands and high job stress. Some individual characteristics (e.g. age, psychosocial factors) affect vulnerability to work-related musculoskeletal disorders. The basic biomechanics literatures provide evidence of plausible mechanisms for the association between musculoskeletal disorders and workplace physical exposures. Modification of various physical factors and psychosocial factors could reduce the risk of symptoms for low back and upper extremity disorders. *(Essentially a 'panel consensus' document, albeit comprehensively reviewing the literature. Focused on evidence for work-relatedness of musculoskeletal disorders and the potential value of ergonomics interventions). (Also in Table A2).*
(NIOSH 1997)‡ Systematic review	Musculoskeletal disorders and workplace factors: a critical review of epidemiologic evidence for work-related musculoskeletal disorders of the neck, upper extremity, and low back (National Institute for Occupational Safety and Health) (*Large, systematic review of the epidemiological evidence on risk factors for a wide variety of work-related musculoskeletal disorders*). Concluded that the consistently positive findings from a large number of cross-sectional studies *(which do not establish causation)*, strengthened by the limited number of prospective studies, provides strong evidence for increased risk of work-related musculoskeletal disorders for some body parts. For some body parts and risk factors there is some epidemiological evidence for a causal relationship. For other body parts and risk factors, there are insufficient studies from which to draw conclusions or the overall conclusion from the studies is equivocal. In general there is limited detailed quantitative information about exposure-response relationships between risk factors and musculoskeletal disorders. The reviewers considered that the epidemiological literature identified a number of specific physical exposures strongly associated with specific musculoskeletal disorders when exposures are intense, prolonged, and particularly when workers are exposed to several risk factors simultaneously. There is evidence that psychosocial factors related to the job and work environment play a role in the development of work-related musculoskeletal disorders of the upper extremity and back. Musculoskeletal disorders can also be caused by non-work exposures. There are insufficient studies to determine whether continued exposure to physical factors alters the prognosis of musculoskeletal disorders. (*This*

Table A1. Reviews on epidemiology and risk factors	
Authors	Key features *(Reviewers' comments in italic)*
	review does not clearly distinguish between incidence, prevalence, injury, chronicity, and work loss, and simply assumes that statistical associations represent a causal relationship. Because of the focus on risk factors as opposed to outcomes, it provides little information on work retention or return-to-work).
(Palmer et al. 2007b) Systematic review	Carpal tunnel syndrome and its relation to occupation Data extracted from 38 primary reports on comparison of job titles (22), physical activities in the job (13), or both (3). Reasonable evidence that regular and prolonged use of hand-held vibratory tools increases the risk of CTS >2-fold and found substantial evidence for similar or even higher risks from prolonged and highly repetitious flexion and extension of the wrist, especially when allied with a forceful grip. The balance of evidence on keyboard and computer work did not indicate an important association with CTS. The source papers recognised to have various limitations: eg retrospective exposure data, biased case recruitment, heterogeneous case definition, small sample size, but the evidence was considered consistent. *(It should be emphasized that the implicated exposures variously are prolonged, forceful, highly repetitive, or involving substantial wrist excursions: less extreme exposures in outwardly similar work cannot be considered to carry the same risk).*
(Palmer et al. 2007c) Systematic review	Compensating occupationally related tenosynovitis and epicondylitis. Data extracted on populations, exposure contrasts, and estimates of effect from 18 papers. Most based analyses on job tiles rather than on directly assessed physical activities. Few jobs studied more than once. Little consistent evidence of jobs or work activities that carried a more than doubling of risk for either disorder. Highlights difficulty of compensating disorders that are not specific to work and for which there are no distinctive clinical features in occupationally related cases. There is a relative lack of data to support work attribution for tenosynovitis and epicondylitis. *(Review commissioned by IIAC with natural focus on their criteria for occupational diseases – see IIAC (2006) – Table A1).*
(Palmer & Smedley 2007) Systematic review	Work relatedness of chronic neck pain with physical findings – a systematic review Systematic review of the work-relatedness of neck-shoulder disorders with associated physical findings – focus on studies incorporating a physical examination. 21 relevant reports (four prospective) were found. Most considered the outcome tension neck syndrome. Exposures included repetitive work, static loading, neck flexion, force, and occupational psychosocial factors (computer users excluded). The evidence base rests on 2 high quality investigations in the same population, plus sundry observations of mainly retrospective or cross-sectional studies. Moderate evidence was found for a causal relation for repetition at the shoulder and for neck flexion allied with repetition. Limited evidence was found for hand-wrist repetition, neck flexion with respect to static loading and force in the absence of repetition, and high job demands, low control, low job support and job strain. Evidence is lacking on the validity, clinical course, and functional importance of this diagnostic entity – case definition is problematic.
(Punnett & Wegman 2004)‡ Narrative review	Work-related musculoskeletal disorders: the epidemiologic evidence and the debate The debate about the work-relatedness of musculoskeletal disorders reflects both confusion about epidemiological principles and gaps in the scientific literature. Some dispute remains over the relative importance of physical ergonomic risk factors. This paper is said to address the controversy with reference to the report from the National Research Council (2001). The authors consider the available epidemiological evidence to be substantial, but accept more research is needed concerning the latency effect, natural history, prognosis, and potential for selection bias in the form of the healthy worker effect. Examination techniques still do not exist that can serve as a gold standard for many of the symptoms commonly reported in workplace studies. Exposure assessment has too often been limited to crude indicators such as job title, and lack of standardized exposure measures limits ability to compare studies. Despite these challenges, the epidemiological literature on work-related musculoskeletal disorders in combination with extensive laboratory evidence of pathomechanisms related to work stressors is convincing to most (*sic*). (*As important as the underlying data is the way it is interpreted – that part of the debate remains unresolved*).

Table A1. Reviews on epidemiology and risk factors	
Authors	Key features *(Reviewers' comments in italic)*
(Szabo 2006) Narrative review	Determining causation of work-related upper extremity disorders This paper discusses nature of epidemiological evidence and study design: surveillance (monitor population for departures in the typical number of cases over time; cross-sectional or prevalence study (cannot establish temporal association between exposure and outcome); case-control (compares exposures in groups with and without the disease); prospective cohort study (temporal association between exposure and outcome can be established); randomised study (overcomes selection bias but potential ethical conflicts). Paper also discusses the criteria for causality (ie strength, temporality, consistency, specificity, and dose-response of the association, plus biological plausibility). If these factors are not taken into account, there is a risk of misinterpreting epidemiological evidence. The vague definition of 'repetitive stress/strain injury' indicates that scientific studies have failed to show that low-force repetitive movements cause injury, Whilst ergonomics proponents argue that elimination of certain risk factors related to force, repetition, posture and duration can prevent or cure RSI, scientific support is scant. Ergonomics interventions doubtless improve worker comfort (which is of benefit to the worker) but that does not equate with prevention or cure: improved ergonomics generally has not lowered the incidence or prevalence of work-related musculoskeletal disorders. Author points out that much of the uncertainty and confusion surrounding RSI-type conditions is due to misunderstanding of the relevant terms. An occupational disease is one where there is a direct cause and effect between a hazard and the disease (eg silicosis). A disease is considered work related when the work environment and the performance of work contribute significantly, but as one of several factors, to causation of the disease. Epidemiologists refer to risk factors as being associated with rather than causes of a disease, because the cause-effect link often cannot be established. A worker's decision to report a symptom is influenced by personal, psychosocial, and economic factors, as is the progression from symptoms to disability. When a worker reports an upper extremity symptom while at work, the 'workplace paradigm' labels the symptom as work-related (provoking a search for a physical factor to blame). The idea of early reporting of symptoms may be seen attractive to reduce the progression to disease or injury status. But, the symptoms are common yet progression is the exception – thus, there may be limited benefit from early reporting. Most patients will not understand the concepts of causation, so a short discussion to explain these concepts is warranted (and may spare them the dehumanizing medico-legal experience, and time/money can be saved on useless physical interventions). *(Another related confusion comes when the association between symptoms and work is simply misinterpreted: a particular job may be more difficult or painful for people with a disorder, but that says nothing about cause-effect. Where a causal relationship is not established, a better term may be 'work-relevant', which does not stimulate assumptions about causal relationships)*.
(Walker-Bone et al. 2003b) Narrative review	Soft-tissue rheumatic disorders of the neck and upper limb: prevalence and risk factors Review of authoritative reviews and relevant text books for data about epidemiology of regional pain or specific soft-tissue entities. Numerous epidemiologic studies among different populations suggest a high point prevalence of pain in the shoulder (18% to 26%), elbow (8% to 12%), and wrist/hand (9% to 17%). Less clear is the proportion of pain caused by specific upper-limb disorders as compared with nonspecific pain; however, as many as 6% of adults may have carpal tunnel syndrome. Significant risk factors for these disorders include age, female gender, obesity, and association with mechanical exposures (eg, posture, force, repetition, vibration) in the workplace. Also implicated are psychological well-being and psychosocial workplace factors such as high levels of demand, poor control, and poor support. Pain and soft-tissue rheumatic disorders of the neck and upper limb are common. It appears that individual, mechanical, and psychosocial factors all contribute to upper-limb disorders, suggesting that future strategies for prevention will need to address each of these factors.
(Walker-Bone & Cooper 2005) ‡ Narrative review	Hard work never hurt anyone: or did it? A review of occupational associations of soft tissue musculoskeletal disorders of the neck and upper limb Focus was occupational associations with neck and upper limb musculoskeletal disorders. Considered separately neck disorders, shoulder disorders, epicondylitis, non-specific forearm pain, and carpal tunnel syndrome. • Neck disorders: High background prevalence of neck pain among adults in developed countries (point prevalence up to 34%); contributes to sickness absence and demands on medical services. Neck pain and neck disorders are associated with mechanical and psychosocial workplace factors (with complex interactions) – preventive strategies are not convincing. • Shoulder disorders: High background prevalence of shoulder pain (point prevalence up to 26%). Symptoms/disorders are associated with overhead work

Table A1. Reviews on epidemiology and risk factors	
Authors	Key features *(Reviewers' comments in italic)*
	and possibly repetitive work: occupational psychosocial factors are also implicated (this holds true even when the outcome studied is a specific diagnosis). • Epicondylitis: Strenuous manual tasks seem to be associated with epicondylitis, but unclear if mechanical factors initiate the disorder or aggravate a tendency among predisposed people: emerging evidence suggesting association with psychosocial factors. • Non-specific forearm pain: Rare among working age adults (point prevalence 0.5%). Significantly associated with psychological distress but not with any mechanical exposures. • Carpal tunnel syndrome: Aetiology controversial due to problem of case definition. Overall, workplace factors may be contributory (force, repetition, and vibration). Neck and upper limb pain is a common problem among working age adults and contributes to sick leave. Workplace factors such as prolonged abnormal posture and repetition contribute to these conditions. Psychosocial influences show the aetiology is complex, and both types of factor may be important, though there is insufficient evidence to determine the relative contribution. (*The odds ratios quoted from the original studies tended to be <2 for physical factors and >3 for psychosocial factors – see Coggon et al 2007 – Table A3).*
(Woods 2005)‡ Narrative review	Work-related musculoskeletal health and social support Concerns the relationship between the level of social support at work (e.g. poor communication channels, unsatisfactory work relationships, unsupportive organisational culture) and work-related musculoskeletal ill-health (reported symptoms, sick leave, medical consultation, disability retirement). Indicates a lack of social support (from co-workers, supervisors, or managers) is a risk factor for musculoskeletal ill-health (*though not necessarily causative*). In addition, there is limited evidence that poor social support is associated with musculoskeletal sickness absence, restricted activity, and not returning to work after a musculoskeletal problem. (*As elsewhere, ULDs are considered generically with MSDs).* Prevention programmes should involve psychosocial as well as ergonomic elements. A small number of studies have shown the effects of good social support and its importance in protecting against musculoskeletal ill-health and helping workers cope with problems. *(The findings are based on cross-sectional, case-control studies and prospective research*).
(Woods & Buckle 2002) ‡ Narrative review	Work, inequality and musculoskeletal health A review of the relationship between aspects of work, inequality, and musculoskeletal health *(as elsewhere, ULDs considered generically with 'musculoskeletal')*. Concerned the following workplace and individual factors and their association with musculoskeletal ill health: social support, access to health information/education at work, job insecurity, low status work, income, education level, age, gender, and ethnicity. Numerous associations were found, but gaps in knowledge, complex interrelationships, and lack of independence of the variables meant that attributing causal relationships was not possible. Notes that some studies have broadened the scope to consider psychosocial factors (eg temporary or insecure work, social support at work) but there remains a paucity of knowledge for socio-economic factors such as poor housing, access to health care services and unemployment *(these are encompassed within the biopsychosocial model).* Notes that access to health information/education at work may have a role in prevention/reduction of musculoskeletal ill health problems.

[CTS = carpal tunnel syndrome; DSE = display screen equipment; IIAC = Industrial Injuries Advisory Council; MSD = musculoskeletal disorder; OR = odds ratio; RSI = repetitive strain injury; RR = risk ratio; UED = upper extremity disorder; ULD = upper limb disorder]

[∫ = data extraction (adapted) from Waddell & Burton 2004. ‡ = data extraction (adapted) from Waddell & Burton 2006]

Table A2. Reviews on interventions and classification

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Authors	Key features *(Reviewers' comments in italic)*
(ARMA 2007) Consensus statement	Standards of care for people with regional musculoskeletal pain (UK Arthritis and Musculoskeletal Alliance) (*Developed by expert working group, which access to the evidence. The Standards are intended to inform health care policy makers in respect of regional musculoskeletal pain*). Notes high prevalence of self-reported ULDs: eg 10-30% of population have had shoulder pain lasting >1 week in previous month; 5-10% experience elbow pain and 5-15% experience hand pain; ~10% have forearm pain at any one time. States both physical and psychosocial factors appear to be risk factors, the most important being psychosocial distress, repetitive movements of limb, undue forceful movements, monotonous work, and lack of autonomy at work. These may be interrelated: musculoskeletal pain may be no more than an inconvenience until some other life incident changes the situation from a person with a predicament into someone who seeks care. Recreational activity is considered an important contributor to the physical factors involved in onset, perhaps leading to advice-conflicts (*it is not made clear if this applies to both upper and lower limb regional pain*). The Standards take a biopsychosocial perspective and are given for: Promoting musculoskeletal health; Information on self-management and prevention; Information on services, treatments, and providers; Access to diagnosis; Assessment of needs; Individualised care plans; Pain relief; Support to remain in, or return to, work, education, or the home environment; Involvement of people with regional musculoskeletal pain in; Multidisciplinary teams, Self-management. Most regional musculoskeletal pain can and should be managed in the community. Notes role of psychosocial factors (identified by the 'flags' system) as obstacles to recovery: management requires adequate information (to remain active, to continue at work or in education wherever possible and maintain other normal activities), pain control (adequate to allow reactivation), biopsychosocial assessment and intervention in or near the workplace (for improved early management).
(Andrew et al. 2005) Systematic review	Carpal tunnel syndrome – splinting or surgery? a systematic review Literature review based on database search. Only 2 studies met inclusion criteria. Both were non-blinded RCTs with patients (n=22 females, single-centre, UK; n=176, multicentre, Netherlands) allocated to either surgery or splinting arms. In both studies clinical outcomes (symptoms, nerve conduction studies) were statistically better in the surgical groups than the splinting groups, but this difference disappeared when the results of both studies were pooled (using Review Manager, RevMan, software from the Cochrane Collaboration). The authors concluded that surgery seems to be more efficacious, but that the evidence is currently inconclusive until more RCT's are conducted.
(Bisset et al. 2005) Systematic review	A systematic review and meta-analysis of clinical trials on physical interventions for lateral epicondylalgia High quality systematic review that identified 76 RCTs on lateral epicondylalgia (tennis elbow), and selected 28 as suitable for meta-analysis. These were scored using the modified PEDro rating scale (15 items) to assess methodological quality. Only 28 studies met the a priori criteria of a minimum 50% quality score (8 out 15 criteria). Only 8 studies performed a long-term follow-up (>6-months). The range of interventions used in the studies were (1) Non-electrotherapeutic: exercise (n=1), manipulation (n=3), orthotics and taping (n=9), acupuncture (n=4); and (2) Electrotherapeutic: laser (n=6), extracorporeal shock wave therapy (ESW) (n=2), electromagnetic field and ionisation (n=4), ultrasound and phonophoresis (ultrasound with a hydrocortisone coupling gel, n=5). The results found indications that exercise and manipulation may be beneficial, but this requires further research to confirm. Conclusions regarding the effectiveness of orthotics and taping, and acupuncture could not be drawn. The evidence for laser was equivocal, but tended to suggest no benefit over placebo. The two high-quality RCT's for extracorporeal shock wave therapy (ESWT) found it was ineffective. The evidence for electromagnetic field and ionisation, and ultrasound and phonophoresis, was equivocal, and conclusions could not be drawn. A weak effect for combined therapy (deep friction massage, ultrasound, and exercise) compared to corticosteroid injection, but not when compared to manipulation. In summary, the reviewers found a lack of evidence for physical interventions for tennis elbow, with positive evidence that ESWT is ineffective.

Table A2. Reviews on interventions and classification	
Authors	Key features *(Reviewers' comments in italic)*
(Bongers et al. 2006) Narrative review	Epidemiology of work-related neck and upper limb problems: (2) effective interventions from a bio-behavioural perspective There are few controlled trials of individual or organisational interventions for work-related neck and upper limb symptoms. This precludes any conclusions on effectiveness of bio-behavioural interventions for reduction of neck and upper limb problems and return to work after symptoms. From the low back pain intervention research there is evidence that interventions should be targeted at both the worker and the organisation and that interventions will only be successful when all the players are involved. *(See companion entry in Table A1).*
(Boocock et al. 2007) Systematic review	Interventions for prevention and management of neck/upper extremity musculoskeletal conditions Review of non-clinical intervention programmes for neck/upper extremity musculoskeletal conditions: 31 studies included, covering mechanical exposure interventions; production systems/organisational culture; modifier interventions - directed variously at people without pain, with pain, or with chronic pain. Heterogeneity of subjects and outcome measures, and limited information on the interventions (*predominantly ergonomics, quasi-ergonomics, and exercise*). No one single-dimensional or multidimensional strategy for intervention was considered effective across occupational settings. Limited evidence that work environment/workstation adjustments (mouse/keyboard design) can improve neck/upper extremity musculoskeletal conditions in display screen workers, but insufficient evidence for equipment interventions among manufacturing workers. Evidence to support the benefits of production systems/organisational culture interventions is lacking. Until better evidence is available, interventions for the prevention and management of neck/upper extremity musculoskeletal conditions should continue to use multifactorial approaches. *(See also Williams et al 2004, Verhagen et al 2006).*
(Borkholder et al. 2004) Systematic review	The efficacy of splinting for lateral epicondylitis: a systematic review Systematic literature review that selected 11 articles, and graded them according to strength of evidence. One was accorded level 1b, and ten were level 2b (Sackett's levels of evidence). The reviewers suggested they had identified good quality evidence offering "early positive, but not conclusive, support for the effectiveness of splinting lateral epicondylitis". *(The level 1b study, Labelle et al 1997, in fact was an RCT to test the effectiveness of an oral NSAID, diclofenac, against placebo. Both groups were given cast immobilisation for 14 days. Outcome measures were Jamar dynamometer, pain and function. However, follow-up was only for 4 weeks. The authors of the systematic review have interpreted the finding that both groups exhibited significant improvement to mean that the cast immobilisation was an effective treatment, whereas these short-term changes may equally have been due to a positive natural history, placebo, or other non-specific factors. Other studies categorised as level 2b have also been interpreted in a similar manner. Careful reading of the source data suggests there is a lack of evidence for splinting). (See also Struijs 2001)*
(Breen et al. 2007) Narrative review	Early pain management for musculoskeletal disorders *(Although focused on proposing care pathways, the search strategy retrieved articles with a biopsychosocial perspective; evidence reviewed has wider implications).* The pathways are for employees, employers and health professionals and start within the first week of onset. The evidence was variable in quality across MSDs, with ULDs in need of greatest development. Latest evidence and current thinking supports the use of biopsychosocial assessment and intervention in close proximity to work for improved early management of MSDs. The employee and employer have the main roles, with musculoskeletal practitioners being the preferred healthcare providers. Psychosocial influences are significant predictors of outcome for non-specific MSDs, together with high level of initial pain. Combinations of physical load factors potentially implicated in tenosynovitis or peritenonitis of wrist or forearm, but imprecise measurement of exposure makes the association undependable. Neck pain: Current thinking (albeit in a climate of largely inconclusive evidence) supports a very similar approach to that for back pain (information and reassurance; stay active, adequate pain control; manual therapy if not improving; temporary modified work if needed). Shoulder pain: Some support for combined interventions including active exercises, stretching, and hot and cold. Tentative evidence for ultrasound for calcific tendonitis. Upper limb disorders: Current thinking focuses more on work modifications and physical and mental reconditioning than on treatment. But, treatment may be of value for resistant problems: rotator cuff tendonitis (local steroid injection); epicondylitis (topical NSAID); carpal tunnel syndrome (individual exercise/keyboard adaptations).

Table A2. Reviews on interventions and classification	
Authors	Key features *(Reviewers' comments in italic)*
	Generic care pathway:- Stage 1 – within 1 week: Discussion, assessment and action planning with employer → activity modification considered → involvement of health professional (if concerned). Stage 2 – if not recovered in 2 weeks: Reassessment and revised action plan → monitor and amend staged recovery plan, together with employer with focus on activity and function (as distinct from pain alone). Employee pathway: Stage 1 – within 1 week: Advice – MSDs common, self-limiting and may have nothing to do with work or injury; control thew pain, stay at work (even if some pain); stay active, perhaps with modified activities → tell employer about problem and discuss effect of work activities → if worried, consider seeing health professional (active physical treatment) + keep in touch with work → Stage 2 – if not recovered in 2 weeks: Do not be discouraged; use pain control and (if necessary) + modified activities at work and/or seek other treatment; plans with employer for workplace accommodation; if the plan not helping recovery, need to identify with employer and healthcare professional what needs to be done. *(Especially in early stages, psychosocial factors, and interventions, are promoted; need for all players onside)*.
(Brosseau et al. 2002) Cochrane	Deep transverse friction massage for treating tendinitis When combined with other physiotherapy modalities, deep transverse friction massage did not show consistent benefit over the control of pain, or improvement of grip strength and functional status for patients with lateral forearm tendonitis.
(Buchbinder et al. 2002) Cochrane	Surgery for lateral elbow pain Various operations have been described based upon the surgeon's concept of the pathological entity. The most described surgical procedures involve release of the extensor carpi radialis brevis (ECRB) from the lateral epicondyle region based upon the premise that there is pathology in the attachment of ECRB to the lateral epicondyle. The reviewers were not able to identify any published controlled trials, and noted that without a control group it was not possible to draw any conclusions on the effectiveness of this treatment
(Buchbinder et al. 2003) Cochrane	Corticosteroid injections for shoulder pain The reviewers found that for rotator cuff disease, subacromial steroid injection was demonstrated to have a small benefit over placebo in some trials however no benefit of subacromial steroid injection over NSAID was demonstrated based upon the pooled results of three trials. For adhesive capsulitis, two trials suggested a possible early benefit of intra-articular steroid injection over placebo but there was insufficient data for pooling of any of the trials. One trial suggested short-term benefit of intra-articular corticosteroid injection over physiotherapy in the short-term (RR 1.7 at seven weeks). However, the reviewers urged caution when interpreting these findings due to small sample sizes, variable methodological quality and heterogeneity, meaning that currently there is little overall evidence to guide treatment
(Buchbinder et al. 2005) Cochrane	Shock wave therapy for lateral elbow pain The review included 9 trials that randomised 1006 subjects with lateral elbow pain to extracorporeal shock wave therapy (ESWT) or placebo, and 1 trial that randomised 93 subjects to ESWT or steroid injection. Eleven of the 13 pooled analyses found no significant benefit of ESWT over placebo. The reviewers concluded there is strong evidence that shock wave therapy provides little or no benefit in terms of pain and function in lateral elbow pain, and there is good evidence (from a singe trial) that steroid injection may be more effective than ESWT
(Buchbinder et al. 2006) Cochrane	Oral steroids for adhesive capsulitis Five RCTs using subjects with adhesive capsulitis, frozen shoulder, stiff painful shoulder or periarthritis and interventions of oral steroids compared to placebo, no treatment, or any other treatment were included. The reviewers concluded there is good evidence that oral steroids provide significant short-term benefits in pain, range of movement of the shoulder and function in adhesive capsulitis but the effect may not be maintained beyond six weeks.
(Buckwalter 1995)	Activity vs. rest in the treatment of bone, soft tissue and joint injuries One of the most important advances in the treatment of musculoskeletal injuries has come from understanding that controlled early resumption of activity can promote restoration of function, and that treatment of injuries with prolonged rest may delay recovery and adversely affect normal tissues. In the last

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Authors	Key features *(Reviewers' comments in italic)*
Narrative review	decade of the nineteenth century two widely respected orthopaedists with extensive clinical experience strongly advocated opposing treatments of musculoskeletal injuries. Hugh Owen Thomas in Liverpool believed that enforced, uninterrupted prolonged rest produced the best results. He noted that movement of injured tissues increased inflammation, and that, "It would indeed be as reasonable to attempt to cure a fever patient by kicking him out of bed, as to benefit joint disease by a wriggling at the articulation." Just Lucas-Championnier in Paris took the opposite position. He argued that early controlled active motion accelerated restoration of function, although he noted that mobility had to be given in limited doses. In general, Thomas' views met with greater acceptance in the early part of this century, but experimental studies of the last several decades generally support Lucas-Championneir. They confirm and help explain the deleterious effects of prolonged rest and the beneficial effects of activity on the musculoskeletal tissues. They have shown that maintenance of normal bone, tendon and ligament, articular cartilage and muscle structure and composition require repetitive use, and that changes in the patterns of tissue loading can strengthen or weaken normal tissues. Although all the musculoskeletal tissues can respond to repetitive loading, they vary in the magnitude and type of response to specific patterns of activity. Furthermore, their responsiveness may decline with increasing age. Skeletal muscle and bone demonstrate the most apparent response to changes in activity in individuals of any age. Cartilage and dense fibrous tissues also can respond to loading, but the responses are more difficult to measure. The effects of loading on injured tissues have been less extensively studied, but the available evidence indicates that repair tissues respond to loading and, like immature normal tissues, may be more sensitive to cyclic loading and motion than mature normal tissues. However, early motion and loading of injured tissues is not without risks. Premature or excessive loading and motion of repair tissue can inhibit or stop repair. *(Though perhaps somewhat idiosyncratic, this 'early' article is included since there is a paucity of reviews that consider activity v rest for MSDs).(See also Nash et al 2004).*
(Cleland & Durall 2002) Systematic review	Physical therapy for adhesive capsulitis: systematic review Reviewers searched for "Non-operative experimental or descriptive research-based outcomes studies of physical therapy", and selected 12 that had quality scores on a 16-point scale ranging from 38% to 69%, with a mean of 54%. 7 of these were prospective case series, 2 were prospective non-randomised comparison studies (one compared physical therapy with manipulation finding no significant differences, and the other compared physical therapy with calcitonin injections also finding no significant differences), 1 was a retrospective case series, and 2 were RCT's. One RCT compared 6 weeks of treatment by a physiotherapist or 6 weeks of corticosteroid injections administered by GP's. Outcomes (pain, and shoulder disability) were significantly better for the injection group at 7 weeks, although the gap narrowed to little difference by 26 and 52-week follow-up. The other RCT divided patients, on the basis of physical examination, into two diagnostic groups: a shoulder girdle group (n = 58) and a synovial group (n = 114). Patients in the shoulder girdle group were randomised to manipulation or physiotherapy, and patients in the synovial group were randomised to corticosteroid injection, manipulation, or physiotherapy. In the shoulder girdle group duration of complaints was significantly shorter after manipulation compared with physiotherapy. Also the number of patients reporting treatment failure was less with manipulation. In the synovial group duration of complaints was shortest after corticosteroid injection compared with manipulation and physiotherapy. These results indicate that to treat shoulder girdle disorders manipulation may be the preferred treatment, whereas for the synovial disorders, corticosteroid injection seems the best treatment. *(The case series, either prospective or retrospective, is a descriptive study that by its very nature does <u>not</u> test the hypothesis of treatment efficacy. The main value of case series is to explore new areas, and to find support for conducting controlled clinical trials.*
(Cole et al. 2006) Narrative review	Integrative interventions for MSDs: nature, evidence, challenges & directions Review focused on neck and upper extremity, with the aim of exemplifying "integrative" interventions, rather than being an exhaustive review. They describe "integrative" workplace interventions to include both biomechanical and psychosocial aspects, aiming at achieving both primary and secondary prevention, and/or consisting of multiple components versus only a single component. Authors noted that currently there are mixed messages on workplace intervention effectiveness due to a variety of reasons, including a lack of participation in research by workplaces. They argued that there are many opportunities to expand the range of 'integrative interventions'. They find an integrated approach to both biological and psychosocial to be appealing, since it allows the targeting of two main categories of risks, to better prevent and manage musculoskeletal disorders in the workplace. They pointed out that given there are multiple causes for workplace injury, illness and disability, then preventing these problems requires multiple solutions, operating in synergy. Also, that effort

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	to reduce workplace injury, illness and disability should build on combined strategies for primary and secondary prevention. They highlighted the use of multiple component interventions such as combining proactive case management from insurers with workplace ergonomic interventions to facilitate faster return to work. *(Somewhat more conceptual than definitive review).*
(Crawford & Laiou 2007) Quasi-systematic review	Conservative treatment of work-related upper limb disorders Summarises the evidence base for conservative clinical management of ULDs including specific and non-specific conditions (articles published 1993-2004; variable quality). Much of the evidence for the efficacy of various conservative treatments for the management of ULDs is generally limited and of low quality – positive statements given with caution: Carpal tunnel syndrome: +ve for local steroid injection, exercise, stretching: no evidence for NSAIDs and workplace intervention strategies. Epicondylitis: +ve for short term symptomatic relief from local steroid injections, acupuncture, topical NSAIDs; longer-term relief from 'physiotherapy'. Rotator cuff syndrome and bicipital tendonitis: +ve for local steroid injection, NSAIDs, although evidence unclear. *(Straps/braces not included in review)*. Shoulder capsulitis: +ve for local steroid injection: no evidence for other conservative approaches. Impingement syndrome: +ve for exercise and NSAIDs, but evidence low quality. Tension neck syndrome: +ve for ergonomic interventions to reduce discomfort: physical training does not have an impact. Tenosynovitis, tendonitis, de Quervain's disease, or diffuse non-specific ULDs: no evidence to support or refute conservative treatment. General management of work-related MSDs: few papers found – considered not surprising as each disorder has its own diagnosis and aetiology and it would be unlikely that a generalized approach would help clinical management. *(However, that does not mean generalized approaches are precluded, and lack of evidence is not evidence against)*. Pain management programmes: +ve for cognitive behavioural programmes (especially early) for occupational outcomes: +ve for hypnosis with biofeedback for RSI pain, but low quality. Authors note that it may be more appropriate to use the term 'tendinopathy' to describe common painful overuse tendon conditions (as opposed to 'tendonitis') since a degenerative disorder rather than an inflammatory one is revealed in the tendon.
(Desmeules et al. 2003) Systematic review	Therapeutic exercise and orthopedic manual therapy for impingement syndrome: a systematic review. Review of seven RCT's up to 2002 using therapeutic exercise and orthopaedic manual therapy for the treatment of impingement syndrome (included rotator cuff tendinitis, or bursitis). Used a methodological score to evaluate quality of the studies, and noted most were 'low' to 'very low' quality with average score of 58%. This review confirmed the lack of uniformity in defining impingement syndrome. Results were equivocal. The three trials with the best methodological score (67%) found: supervised exercise with manual therapy was superior to supervised exercise alone on measures of strength, pain, and function at 2-months; arthroscopic surgery and supervised exercise were better than placebo (detuned laser) for pain and function at 30-months; and, a treatment package of exercises, hot packs, soft tissue mobilisation and education was improved by the addition of joint mobilisations on measures of pain, but not for ROM or function at 3 to 4 weeks. One study found improvements in pain-free abduction, flexion ROM, and function at 1-month due to therapeutic exercise compared to 'no treatment'. Two trials found no differences between study groups: arthroscopic subacromial decompression with physiotherapy-supervised exercises versus self-training exercises; and, 'classic physiotherapy' (exercise, massage, physical applications) versus manipulation versus corticosteroid injections. The lowest quality trial (38%) found open anterior acromioplasty to be superior to exercise and education. The authors concluded there was limited evidence to support the effectiveness of therapeutic exercise and manual therapy to treat impingement syndrome. (*Note, no attempt was made to consider the relative effectiveness of these two interventions independent of each other. Furthermore, the authors conclusion needs to be placed in the context of negative findings, and weak methodological quality including very short follow-up periods).*
(Ejnisman et al. 2004)	Interventions for tears of the rotator cuff in adults Tears of the rotator cuff tendons, which surround the joints of the shoulder, are one of the most common causes of pain and disability in the upper extremity. 8 randomised or quasi-randomised clinical trials involving tears of the rotator cuff, involving conservative interventions or surgery were included

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Cochrane	(nonsteroidal anti-inflammatory drugs, intra-articular or subacromial glucocorticosteroid injection, oral glucocorticosteroid treatment, physiotherapy, and open or arthroscopic surgery). The reviewers concluded there is a lack of evidence to support or refute the efficacy of common interventions.
(Feuerstein et al. 1999) Narrative review	Clinical management of carpal tunnel syndrome: a 12-year review of outcomes Searched for prospective, multiple-group (ie both randomised and non-randomised, with control group) treatment studies for carpal tunnel syndrome. These were classified into six intervention categories as follows (with the number of studies in each category): surgery (n=14; 6 randomised, and 8 non-randomised), pharmacological/vitamins/steroids (n=6), physical therapy/splinting (n=6), chiropractic/manipulation (n=1), biobehavioral therapies (n=5), and occupational/work rehabilitation (n=2). The methodological quality of the various studies was not assessed. The strength, or level, of evidence was not included. The methodological limitations of the studies were discussed. The reviewers noted that the majority of studies assessed the effects of surgical interventions, and offered to following conclusions: (a) Endoscopic release was associated with higher levels of physical functioning and fewer days to return to work when compared to open release; (b) Limited evidence indicated: 1) steroid injections and oral use of B6 were associated with pain reduction; 2) in comparison to splinting, range of motion exercises appeared to be associated with less pain and fewer days to return to work; 3) cognitive behaviour therapy yielded reductions in pain, anxiety, and depression; and, 4) multidisciplinary occupational rehabilitation was associated with a higher percentage of chronic cases returning to work than usual care; and, (c) Workers' compensation status was associated with increased time to return to work following surgery.
(Fleisch et al. 2007) Systematic review	Corticosteroid injections in the treatment of trigger finger: a level I and II systematic review Reviewers identified four English-language prospective randomized controlled trials using injectable corticosteroids to treat trigger finger (defined by the authors as a tendonitis, and stenosing tenosynovitis). All four RCTs use adult subjects and had greater than 85% follow-up. The authors noted that the incidence of trigger finger is greatest in women (75%), with an average patient age range of 52 to 62 years. Using a combined analysis of the four studies the reviewers concluded that corticosteroid injections are effective in 57% of patients.
(Franche et al. 2005) ‡ Systematic	Workplace-based return-to-work interventions: a systematic review of the quantitative literature Reviews return-to-work interventions provided at the workplace to workers disabled with musculoskeletal or other pain-related conditions. There was strong evidence that work disability duration is significantly reduced by work accommodation offers and contact between healthcare provider and workplace; and moderate evidence that it is reduced by interventions which include early contact with worker by workplace, ergonomic work site visits, and presence of a return-to-work coordinator. For these five intervention components, there was moderate evidence that they reduce costs associated with work disability duration. There was limited evidence on the sustainability of these effects. There was mixed evidence regarding direct impact on quality-of-life outcomes. *(Importantly, however, this review found no evidence that return to work had adverse impact on quality of life)*. Overall, the evidence base shows workplace-based interventions can reduce work disability duration and associated costs. *(In common with others, this review considered musculoskeletal and other pain problems generically in respect of RTW interventions).*
(Gerritsen et al. 2002) Systematic review	Conservative treatment options for carpal tunnel syndrome: a systematic review of randomised controlled trials Reviewers identified 14 RCT's and graded these for methodological quality, and strength of evidence. Treatment types (and numbers of studies) were: Steroid injections (n=3); Ultrasound treatment (n=2); Pyridoxine (n=2); Oral diuretics (n=2); Oral steroid (n=1); and one study each (n=4) of chiropractic manipulation, yoga, soft-laser (Helium-Neon) light on acupuncture points, and plaster-of-paris splinting of hand/wrist/arm for 1-month. The reviewers originally intended to conduct a meat-analysis and pool data. However, they refrained from this, due largely to the small number of trials and numbers of subjects involved. They offered the following conclusions. Steroid injections: there is limited (level 3) evidence that steroid injection proximal to the carpal tunnel is more effective than placebo in improving CTS symptoms in the short-term (1 month). The same applies to a steroid injection into the carpal tunnel, compared with an intramuscular steroid injection. Ultrasound: there is conflicting (level 3) evidence that ultrasound is more effective than placebo in relieving CTS symptoms in the short-term, and limited evidence (level 3) for its long-term effectiveness. Pyridoxine (vitamin B6): there is moderate (level 2) evidence that pyridoxine and placebo are equally effective. Oral diuretics: there is strong (level 1) evidence that oral diuretics are not more effective than placebo. Oral steroid: there is limited (level 3) evidence that NSAID's are not more effective than placebo, but there is conflicting limited (level 3) evidence

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	that short-term relief may be obtained. Chiropractic manipulation: no conclusions could be drawn due to lack of symptom outcome measure. Yoga: there is limited (level 3) evidence that yoga is not more effective than 'current treatment'. Soft-laser light on acupuncture points: there is limited (level 3) evidence that soft-laser acupuncture is not more effective in relieving symptoms than placebo. Plaster splinting for one-month: there is limited (level 3) evidence that at 1-year follow-up splinting was significantly less effective than surgery in providing symptom relief. The authors concluded that there is still little known about the efficacy of most conservative treatment options for CTS.
(Goodyear-Smith & Arroll 2004) Systematic review	What can family physicians offer patients with carpal tunnel syndrome other than surgery? A systematic review of nonsurgical management Reviewers assessed two systematic reviews (Cochrane review by Marshall et al (2000 – now dated 2007), and the narrative review by Feuerstein et al (1999)). 16 RCT's, and one non-randomised study for methodological quality (using PEDro scale). The authors noted that CTS has a positive natural history with a "considerable percentage…resolving] spontaneously". *(Despite using similar methodology to the earlier review by Gerritsen et al (2001), these reviewers included only 10 of the 14 studies included in that meticulous systematic review. It is noteworthy that they did not cite the Gerritsen et al (2001) review).* The authors concluded there is strong evidence that local corticosteroid injections *(in contrast to Gerritsen et al's finding of only limited evidence)*, and to a lesser extent oral corticosteroids *(consistent with Gerristen et al)*, give short-term relief for CTS sufferers. They found limited evidence to indicate that splinting, laser-acupuncture, yoga, and therapeutic ultrasound may be effective in the short to medium term (up to 6 months). *(This is in contrast to Gerritsen et al 2001 who found limited evidence that splinting is less effective than surgery; laser-acupuncture and yoga are not effective; and, that ultrasound may be effective in the long-term but short-term findings are equivocal)*. The authors also concluded the evidence for nerve and tendon gliding exercises is "tentative", and that the evidence does not support the use of NSAID's, diuretics, pyridoxine (vitamin B6), chiropractic treatment, or magnet treatment.
(Green et al. 1998) Systematic review	Systematic review of randomised controlled trials of interventions for painful shoulder: selection criteria, outcome assessment, and efficacy Randomised controlled trials of non-steroidal anti-inflammatory drugs, intra-articular and subacromial glucocorticosteroid injection, oral glucocorticosteroid treatment, physiotherapy, manipulation under anaesthesia, hydrodilatation, and surgery for shoulder pain were included. This review has confirmed the lack of uniformity in the way shoulder disorders are labelled and defined. It has also highlighted the wide variation in assessment of outcome in clinical trials investigating the efficacy of interventions for painful shoulder, which limits data pooling and comparison of trials. There is little evidence to support or refute the efficacy of common interventions for shoulder pain. The only conclusions that may be drawn about efficacy are that non-steroidal anti-inflammatory drugs and subacromial glucocorti-costeroid injection may be superior to placebo in improving range of abduction in rotator cuff tendinitis and that the addition of corticosteroid injection to non-steroidal anti-inflammatory drugs does not seem to confer further benefit. No conclusions can be drawn about the efficacy of the interventions studied for adhesive capsulitis.
(Green et al. 2002) Cochrane	Acupuncture for lateral elbow pain 4 small RCTs were identified, all with design flaws, which precluded meta-analysis. The authors concluded there is insufficient evidence to either support or refute the use of acupuncture (either needle or laser) in the treatment of lateral elbow pain. *(See also Trinh et al 2004)*
(Green et al. 2001) Cochrane	Non-steroidal anti-inflammatory drugs (NSAIDs) for treating lateral elbow pain in adults Included 14 randomised and quasi-randomised trials using NSAIDs (oral or topical) compared to placebo or another intervention, or comparing two NSAIDs (oral or topical) to each other, in adults with lateral elbow pain (tennis elbow). There is some support for the use of topical NSAIDs to relieve lateral elbow pain at least in the short term. There remains insufficient evidence to recommend or discourage the use of oral NSAID, although it appears injection may be more effective than oral NSAID in the short term. A direct comparison between topical and oral NSAID has not been made and so no conclusions can be drawn regarding the best method of administration.

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(Green et al. 2003) Cochrane	Physiotherapy interventions for shoulder pain Twenty six trials met the inclusion criteria. Methodological quality was variable and trial populations were generally small (median sample size = 48, range 14 to 180). Exercise was demonstrated to be effective in terms of short term recovery in rotator cuff disease (RR 7.74), and longer term benefit with respect to function (RR 2.45). Combining mobilisation with exercise resulted in additional benefit when compared to exercise alone for rotator cuff disease. Laser therapy was demonstrated to be more effective than placebo (RR 3.71 (1.89, 7.28) for adhesive capsulitis but not for rotator cuff tendinitis. Both ultrasound and pulsed electromagnetic field therapy resulted in improvement compared to placebo in pain in calcific tendinitis (RR 1.81 and 1.9 respectively). There is no evidence of the effect of ultrasound in shoulder pain (mixed diagnosis), adhesive capsulitis or rotator cuff tendinitis. When compared to exercises, ultrasound is of no additional benefit over and above exercise alone. There is some evidence that for rotator cuff disease, corticosteroid injections are superior to physiotherapy and no evidence that physiotherapy alone is of benefit for adhesive capsulitis.
(Green et al. 2005) Cochrane	Acupuncture for shoulder pain Nine trials of varying methodological quality met the inclusion criteria, using various placebos. All trials had poor descriptions of interventions. The reviewers concluded that there is little evidence to support or refute the use of acupuncture for shoulder pain although there may be short-term benefit with respect to pain and function.
(Hagberg 2005) Narrative review	Clinical assessment, prognosis and return to work with reference to work related neck and upper limb disorders 65 relevant articles were identified (published between 1980 and 2002) that addressed assessment, prognosis and RTW for neck and upper limb problems. Many of these were found to be review articles and the author noted a paucity of randomised studies of prognosis and return to work with reference to neck and upper limb disorders. It was concluded that clinical assessment should include (in addition to history, exposures, and diagnostic tests) testing range of motion; testing muscle contraction pain and muscle strength; palpation of muscle tendons and insertions; and specific tests (such as Spurling's neck compression test, Arm-Lasègue test, Phalen test, Roos test, and bursa test). The author pointed out that the scientific basis for terms such as RSI (repetitive strain injuries) and CTD (cumulative trauma disorders) is weak or absent, and should therefore be avoided. Treatment that focuses on keeping the patient active and maintains contact with the workplace is recommended. Non-specific neck and upper arm pain and discomfort may be decreased but not eliminated in the majority of cases. Rehabilitation is best started early and should provide workplace accommodation, and if this is not available RTW may not be indicated. The prognosis for most work related disorders is variable and it seems that ergonomic and psychosocial stress, pain severity, and pain coping style predict short-term clinical outcomes whereas number of past treatments/providers, recommendation for surgery and pain coping style predict longer-term outcomes.
(Hanson et al. 2006) Narrative review + cross-sectional survey	The costs and benefits of active case management and rehabilitation for musculoskeletal disorders Project aimed to review evidence on the costs and benefits of active case management and rehabilitation programmes for musculoskeletal disorder; to identify potential incentives, and obstacles to, the adoption of these programmes; and, to describe a model programme based on the evidence and assess its acceptability to stakeholders. This project involved a literature review, and a cross-sectional survey of current providers in the UK (through focus groups and questionnaires). The authors concluded there is moderate evidence that case management approaches are effective and can yield a variety of benefits that are cost effective. The benefits observed include reduced healthcare costs, reduced treatment duration, reduced sick-leave and time off work, improved worker productivity, reduced compensation claims and litigation, reduced claim duration and more rapid claim closure. An outline of the key components of successful and cost-effective case management was provided. There is strong evidence that rehabilitation programmes using a cognitive-behavioural orientation and an activity focus are effective, and cost-effective at reducing pain and increasing productive activity in both the sub-acute and the chronic groups. There is also strong evidence that the use of these interventions at the sub-acute stage can prevent the development of long-term problems and reduce time off work. Furthermore, there is good evidence that this is highly cost-effective, especially when the intervention is selectively delivered to individuals screened as having a high risk for a poor outcome. The key components of good quality rehabilitation service delivery were outlined. An evidence-based delivery model was outlined (with high acceptability to UK providers, although there was acknowledgement that applicability to small

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	employers was uncertain) using the following key features: create the right culture; manage workers with musculoskeletal disorder; manage the return to work process; and, monitor and review the programme effectiveness. *(Review was concerned with MSDs in general, not focused on upper limb disorders. See also Williams et al 2004).*
(Harris & Susman 2002) Summary of clinical guideline	Managing musculoskeletal complaints with rehabilitation therapy: summary of the Philadelphia Panel evidence-based clinical practice guidelines on musculoskeletal rehabilitation interventions The Philadelphia Panel has published evidence-based guidelines for selected rehabilitation interventions in the management of low back, knee, neck, and shoulder pain. This article provides a summary and overview. The only guideline recommendation relevant to upper limb disorders is that Panel recommends "the use of therapeutic ultrasound in the treatment of calcific tendonitis of the shoulder". The Panel stated in the source material for shoulder pain (Philadelphia Panel 2001) that "Only 1 positive recommendation of clinical benefit was developed. Ultrasound provided clinically important pain relief relative to a control for patients with calcific tendonitis in the short term (less than 2 months)".
(Helliwell 1996) Narrative review	Diagnostic criteria for work-related upper limb disorders *(Literature review and discussion with health professionals, conducted for HSE).* Distinguishes between specific conditions (eg epicondylitis, tenosynovitis, carpal tunnel syndrome) and non-specific soft tissue syndrome (sensory – primarily pain). Clinical diagnostic criteria use symptoms and physical signs, but different physicians may not elicit these physical signs in same patient. Where sensitivity and specificity of criteria are available (eg for carpal tunnel syndrome) the results are poor. Different diagnostic criteria suit different purposes: primary care requires high sensitivity in order not to miss cases; secondary care requires high specificity in order not to over-diagnose. High sensitivity criteria may raise problems such as increasing patient expectations, promoting belief of work-relatedness. Makes the comment that psychosocial factors are probably important in the presentation and continuation of work-related upper limb disorders (*though little evidence quoted*).
(Helliwell & Taylor 2004) ‡ Narrative review	Repetitive strain injury Pain in the forearm is common in the community. In the workplace reporting of symptoms is associated with frequent high repetition, high forces, prolonged abnormal postures, and psychosocial issues. Early intervention and active management is important: the principles of the well-developed back pain guidelines apply – reassurance (addressing psychosocial factors), maintain work if possible, temporary activity modification. Ergonomic interventions may make the workplace more comfortable, and may reduce sickness absence. *(Focus was mostly on clinical issues).*
(Karjalainen et al. 2003a) ∫ Cochrane	Biopsychosocial rehabilitation for upper limb repetitive strain injuries (RSI) in working age adults (Cochrane review) Only two relevant studies found, both low quality and clinical relevance unsatisfactory. Little scientific evidence for effectiveness of biopsychosocial rehabilitation for RSI. One small trial suggested hypnosis supplementary to comprehensive treatment can decrease pain intensity for acute RSI at 6-weeks. Need for high quality trials. *(Clearly little 'scientific' work done in this field –no information on vocational outcomes)*
(Karjalainen et al. 2003b) ∫ Cochrane	Multidisciplinary biopsychosocial rehabilitation for neck and shoulder pain among working age adults (Cochrane review) Only two relevant studies found: 1 low quality randomised trial and 1 low quality controlled trial. Limited scientific evidence for effectiveness of multidisciplinary biopsychosocial rehabilitation for neck and shoulder pain, compared with other commonly used intervention. Urgent need for high quality trials. *(Clearly little 'scientific' work done in this field, but work outcomes were a feature of the included studies).*
(Karsh et al. 2001) ∫ Narrative review	Workplace ergonomic interventions to control musculoskeletal disorders Ergonomic interventions to control musculoskeletal disorders are, in many instances, effective in reducing musculoskeletal pain, discomfort, and injury. Although weight of evidence from rigorous controlled trials in not substantial, authors argue that weight of evidence from other designs shows definite positive benefit *(yet previous reviews have less definitive findings)*. Interventions were: back belts, ergonomic/lifting training, exercise, job redesign, multiple intervention components. 84% of studies found positive results, although majority had mixed results – only 32% had experimental or quasi-experimental designs. *(Focus was reduction of musculoskeletal disorders or their risk factors - importantly, medical and return to work interventions were excluded, but*

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	does indicates that workplace (ergonomic) changes may be a helpful component for facilitating work).
(Konijnenberg et al. 2001)∫ Systematic review	Conservative treatment for repetitive strain injuries The goal of the review was to evaluate the effectiveness of conservative treatment options for repetitive strain injury (RSI). The trials had to include a conservative, i.e. non-surgical, therapy arm. All types of conservative intervention that were prescribed or performed in the treatment of RSI were included: occupational therapy, physiotherapy, exercises, behavioural therapy, chiropractic, multidisciplinary treatment or medication. Ergonomic measures were also included. RSI was defined as any work disorder of the upper extremity, neck or thoracic region in adults of a working age (18 to 65 years), due to repetitive work or continuous strain at work. Patients with such complaints that were non-work-related were excluded. All occupational groups were included. Fifteen studies were included (12 RCT's and 3 non-randomised controlled clinical trials). The methodological quality of the included studies was found to be low, with problems of concealment of allocation, blinding and lack of intention to treat analyses. Using 'best-evidence synthesis', no strong evidence was found for the effectiveness of any treatment options. Limited evidence that multidisciplinary rehabilitation, ergonomic intervention measures, exercises, and spinal manipulation combined with soft tissue therapy are effective in providing symptom relief or improving activities of daily living. There is conflicting evidence for effectiveness of behavioural therapy. Concludes that little is known about the effectiveness of conservative treatment for RSI *(Focus on clinical outcomes rather than RTW). (See also Verhagen et al 2007).*
(Kupper et al. 2004) HSE Research Report	The challenge of managing upper limb disorders – how can health professionals become more effective? Combination of literature review and interview/questionnaire survey. Authors found that there was not enough quality research (e.g. randomised controlled trials and systematic reviews) that studied the effectiveness of treatments and management approaches to enable them to determine what best practice should comprise. Generally physiotherapists and OH nurses were aware of psychosocial issues and favoured keeping the ULD sufferer active and in employment rather than taking sick leave. There was a limited amount of evidence to suggest that this overall approach is favourable. Numerous recommendations were made, with a strong theme of inter-professional communication and communication between healthcare and the workplace: written information and advice for all the players was advocated.
(Marshall et al. 2007) Cochrane	Local corticosteroid injection for carpal tunnel syndrome Five RCTs used in the review. Local corticosteroid injection for carpal tunnel syndrome provides greater clinical improvement in symptoms one month after injection compared to placebo. Symptom relief beyond one month compared to placebo has not been demonstrated. Local corticosteroid injection provides significantly greater clinical improvement compared to oral steroid up to three months after treatment. Local corticosteroid injection does not provide improved clinical outcome compared to either anti-inflammatory treatment and splinting after eight weeks or Helium –Neon laser treatment after six months.
(Mason et al. 2004) Systematic review	Topical NSAIDs for chronic musculoskeletal pain: systematic review and meta-analysis The reviewers, adding to an earlier systematic review, identified double-blind RCT's comparing topical NSAID with either placebo or another active treatment, in adults with chronic pain. A total of 25 studies were included in this review. A hierarchy of outcomes was used to extract efficacy information in the following order of preference: (1) number of patients with a 50% or more reduction in pain; (2) patient reported global assessment of treatment; (3) pain on movement; (4) pain on rest or spontaneous pain; and, (5) physician or investigator global assessment of treatment. Fourteen trials (1,502 patients) provided data on efficacy. Topical NSAIDs were significantly better than placebo. The mean placebo response rate was 26% ranging from 7% to 78%. The mean treatment response rate was 48% ranging from 2% to 90%. The number needed to treat (NNT) was 4.6 (95% CI 3.8 to 5.9) for one patient to experience improvement in chronic musculoskeletal pain at two weeks with topical NSAIDs, compared with placebo. These findings were not altered by trial quality, validity and size, outcome reported, or condition treated. It was noted that local adverse events (6%), systemic adverse events (3%), or the numbers withdrawing due to an adverse event were the same for topical NSAID and placebo. The reviewers also observed that 3 trials found no difference when comparing topical and oral NSAIDs. They concluded topical NSAIDs are effective and safe in treating chronic musculoskeletal conditions for two weeks. *(Note, no information is provided on pain site or type of musculoskeletal disorder. A text search of the article for terms such as wrist, arm, elbow, hand, shoulder etc reveals these words have not been used at all in the article).*

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(Meijer et al. 2005) Systematic review	Evaluation of effective return-to-work treatment programs for sick-listed patients with non-specific musculoskeletal complaints: a systematic review Eighteen high quality studies reporting on 22 treatment programmes. Overall, the findings were inconsistent: only 7 programmes resulted in faster return to work, though none had negative findings. What appeared to be essential to the success of treatment programs was knowledge, psychological, physical and work conditioning, possibly supplemented with relaxation exercises. However, most of the high study populations (64%) were limited to low back pain patients – four studies did include patients with a wide variety of musculoskeletal disorders but did not itemize the treatment effects on return to work by sub-population. No studies were found that examined the effect of treatment programs on return to work by itemized region of the musculoskeletal system, such as non-specific upper extremity musculoskeletal complaints.
(Muller et al. 2004) Systematic review	Effectiveness of hand therapy interventions in primary management of carpal tunnel syndrome: a systematic review The reviewers included studies in English, where the patients had a diagnosis of CTS, and one or more physiotherapeutic interventions (that could be used by physiotherapists/hand therapists/occupational therapists according to their scope of practice) were evaluated. 24 studies were included, and the quality of each study was evaluated (24 criteria, Structured Effectiveness Quality Evaluation Scale). Grades of recommendations were made based on the level of evidence (grade A = consistent level 1 studies, to grade D = level 5 evidence, from inconsistent or inconclusive studies). These recommendations were made for the following interventions (Grades): Splinting (B & C), Ultrasound (B), Nerve Gliding Exercises (B), Addition of Nerve and Tendon Gliding Exercises to Splinting (B & C), Magnetic Therapy (B), Low-level Laser (C), Yoga (B & C), Acupuncture (D), and Combined Therapies (B & C). The reviewers concluded, "current evidence demonstrates a significant benefit (grade B recommendations) from splinting, ultrasound, nerve gliding exercises, carpal bone, mobilization, magnetic therapy, and yoga". *(Note, these reviewers have simply repeated the significant finding from each study they included, without attempting to pool information or data, or to explain inconsistencies or equivocal results. This means the 9 studies on splinting have yielded 9 recommendations, such as "Full-time splinting improves median nerve conduction more than night splinting alone" and "Full-time splinting does not reduce symptom severity or improve function more than night splinting alone". It is not at all clear how recommendations such as these could be translated into best clinical practice guidance).*
(Nash et al. 2004) Systematic review	Resting injured limbs delays recovery: A systematic review The authors noted that rest is commonly used as primary treatment, rather than just palliation, for injured limbs. They identified 49 eligible RCT's of immobilisation for soft tissue injuries and fractures of both upper and lower limbs (total of 3,366 subjects), in order to seek evidence of benefit or harm from immobilisation or mobilisation of acute limb injury in adults. The outcomes considered by the reviewers included pain, swelling, cost, range of motion, days lost from work, and complications from treatment. The reviewers noted that all the studies concluded there was either no difference between rest and early mobilisation, or there was a benefit from early mobilisation over rest. The reported benefits included: earlier return to work; decreased pain, swelling, and stiffness; and, a greater preserved range of joint motion. Furthermore, early mobilisation caused no increased complications, deformity or residual symptoms. The reviewers concluded there is strong evidence that early mobilisation decreases pain, swelling and stiffness, especially in the short-term, without longer-term cosmetic or radiologic deformity. They also found there is moderate evidence to conclude patients usually (but not always) prefer early mobilisation, and return to work sooner. The final conclusion was that we should not assume any benefit from resting or immobilising acute upper or lower limb injuries in adults, and that therefore rest appears to be an overused treatment. *(Note, only two studies were identified that compared rest and mobilisation for upper limb non-fracture injuries. One non-randomised study compared early mobilisation with immobilisation in flexor tendon repair in Zone II, and found a significant benefit on range of motion from early activation. A RCT compared immobilisation with early mobilisation for posterior luxation of the elbow in adults, and found benefits from early activation with respect to loss of amplitude of elbow movement (particularly extension), stiffness, instability, relapses, pain and ossification. The authors concluded therefore that early mobilisation allows recovery of better quality elbow function without inducing instability or recurrence. However, 21 studies were found for lower limb non-fracture injuries, supporting the overall conclusions of the review). (See also Buckwalter 1995).*

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(National Research Council 2001) ∫ Narrative review	Musculoskeletal disorders and the workplace The weight and pattern of the evidence supports the conclusion that primary and secondary prevention interventions to reduce the incidence, severity and consequences of MSDs in the workplace are effective when properly implemented. The most effective strategies involve a combined approach: mediate physical stressors, involve employees, and employer commitment. No specific design, restriction, or practice for universal application is supported by the scientific literature. *(Essentially a 'panel consensus' document, albeit comprehensively reviewing the literature. Focused on evidence for causation and on ergonomics interventions as opposed to 'rehabilitation' or RTW). (Also in Table A1).*
(NHMRC 2004)‡ Clinical guidelines	Management of acute musculoskeletal pain (National Health and Medical research Council) Australian evidence-based clinical guidelines for management of a variety of painful musculoskeletal conditions. Conditions covered comprise: acute low back pain, acute thoracic pain, acute neck pain, acute shoulder pain, acute knee pain. (*Occupational issues and return to work were not the focus of this guidance, but the recommendations regarding activity are of relevance to work*). For neck pain, encouraging the resumption of normal activities and movement of the neck is more effective than a collar and rest. For shoulder pain, although pain may make it difficult to carry out usual activities, it is important to resume normal activities as soon as possible. *(No guidelines produced for other ULDs).*
(Nørregaard et al. 1999) Narrative review	A narrative review on classification of pain conditions of the upper extremities Local and regional musculoskeletal discomfort and pain in the shoulder girdle or upper extremities are often reported, especially in the working population. Describes the most important problems and factors when classifying musculotendinous pain in the upper extremities and shoulders, including an detailed analysis of four common diagnoses: wrist tenosynovitis, lateral epicondylitis, rotator-cuff tendinitis, myofascial pain syndrome) fulfil basic criteria of validity. It is evident that there are some serious problems regarding the validity of the current classification of the conditions. Clinical criteria are often poorly defined and the reliability insufficiently tested. The relationship to objective pathoanatomic or physiological findings seems inconsistent. The prognosis with and without treatment also seems heterogeneous and can vary between studies. A generally accepted terminology is lacking in the pathogenetically complex regional muscle pain conditions. *(It seems clear that many people with common upper limb symptoms will be misdaignosed).*
(O'Connor et al. 2003) Cochrane	Non-surgical treatment (other than steroid injection) for carpal tunnel syndrome Twenty-one trials involving 884 people were included. Current evidence shows significant short-term benefit from oral steroids, splinting, ultrasound, yoga and carpal bone mobilisation. Other non-surgical treatments do not produce significant benefit.
(Piligian et al. 2000)∫ Narrative review	Evaluation and management of chronic work-related musculoskeletal disorders of the distal upper extremity Includes de Quervain's disease, tendonitis, epicondylitis, cubital tunnel syndrome, hand-arm vibration syndrome. Diagnostic criteria are an issue. Dearth of studies evaluating clinical treatment or ergonomic interventions: most treatment recommendations based on consensus. Aim of treatment seen as reduction of pain and disability + restoration of function. Workplace ergonomic modification seen as critical adjunct to medical management: in absence of ergonomist, clinician should take steps. *(Suggests that management options are basically 'healthcare', but role of workplace modification recommended for all the conditions)*.
(Pransky et al. 2002) ∫ Narrative review	Stress and work-related upper extremity disorders: implications for prevention and management Stress and work-related upper limb disorders are linked. Although evidence is incomplete, it is suggestive that individual and workplace interventions (targeted at stress reduction) delivered in primary care or workplace may be helpful. Examples studied included: numerous outcomes including stress, upper limb symptoms, and work outcomes; numerous (combined) interventions including stress reduction techniques, CBT, physical rehabilitation, pain management. Tabulated examples indicated that effects of 'ergonomics-only' interventions were inconsistent. Further research warranted. *(Preliminary evidence that combining ergonomics and stress management/rehabilitation interventions may be effective).*

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(Proper et al. 2003) ‡ Systematic review	Worksite physical activity programs and physical activity, fitness and health Fifteen randomised trials and 11 non-randomised trials of high quality. Strong evidence was found for positive effect of a worksite physical activity program on physical activity and musculoskeletal disorders *(as elsewhere, MSDs are generically considered as a group)*. Limited evidence was found for a positive effect on fatigue. For physical fitness, general health, blood serum lipids, and blood pressure, inconclusive evidence or no evidence was found for a positive effect. To increase the level of physical activity and to reduce the risk of musculoskeletal disorders, the implementation of worksite physical activity programs is supported. *(The conclusion that activity programmes can reduce the risk of MSDs was based on three RCTs, but inspection of these source studies confirmed they all used self-report of symptoms as outcome data. None collected incidence, or claim data. The relevance of self-reported pain ratings to MSDs, or the likelihood that a person will complain of symptoms, is not clear. Note also they excluded two studies of only slightly lower quality that found no effect. The reviewers themselves noted that other systematic reviews have tended to conclude the associations between physical activity and fitness and problems such as low back pain are unclear. Hence, this review suggests, at most, that worksite physical activity programmes may reduce the likelihood that participants will experience symptoms of musculoskeletal pain, such as back pain).*
(Scholten et al. 2004) Cochrane	Surgical treatment options for carpal tunnel syndrome Carpal tunnel syndrome is a common disorder, for which several surgical treatment options are available. This review included 23 studies, with fair to good methodological quality. The reviewers concluded there is no strong evidence supporting the need for replacement of standard open carpal tunnel release by existing alternative surgical procedures (such as endoscopic) for the treatment of carpal tunnel syndrome.
(Selander et al. 2002) ∫ Quasi-systematic review	Return to work following vocational rehabilitation for neck, back and shoulder problems: risk factors reviewed Musculoskeletal problems were defined as neck, back and shoulder problems. Multidisciplinary treatment more effective than single-mode treatment. Education may be more effective than work training. Inconsistent evidence for value of early vocational rehabilitation. Involvement of client/patient in vocational rehabilitation seen as important. A vocational rehabilitation counsellor to guide client through system may be helpful, but depends on competences. *(As elsewhere MSDs are generically considered as a group. Focus of the review was largely on 'obstacles': no programme details given in discussion of 'effective' rehabilitation).*
(Smidt et al. 2005) Systematic review	Effectiveness of exercise therapy: a best-evidence summary of systematic reviews The goal of this review was to summarise the available evidence on the effectiveness of exercise therapy for patients with disorders of the musculoskeletal, nervous, respiratory, and cardiovascular systems. Reviews were selected by two reviewers that included at least one RCT investigating the effectiveness of exercise therapy, used clinically relevant outcome measures, and were written in English, German or Dutch. Then 13 independent and blinded reviewers were asked to participate in review selection, quality assessment, and data extraction. The authors reported that 104 systematic reviews were selected, of which 45 were considered to be "reasonable or good quality". The reviewers concluded that exercise therapy is effective for patients with knee osteoarthritis, sub-acute (6 to 12 weeks) and chronic (≥12 weeks) low back pain, cystic fibrosis, chronic obstructive pulmonary disease, and intermittent claudication. Furthermore, there are indications that exercise therapy is effective for patients with ankylosing spondylitis, hip osteoarthritis, Parkinson's disease, and for patients who have suffered a stroke. However, they found there is currently insufficient evidence to support or refute the effectiveness of exercise therapy for patients with neck pain, shoulder pain, repetitive strain injury, rheumatoid arthritis, asthma, and bronchiectasis. They also concluded that exercise therapy is not effective for patients with acute low back pain.
(Struijs et al. 2002) Cochrane	Orthotic devices for the treatment of tennis elbow Five small RCTs were included in the review, but the authors concluded no definitive conclusions could be drawn concerning effectiveness of orthotic devices (eg forearm straps) for lateral epicondylitis. (See also Borkholder et al 2004)

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(Thien et al. 2004) Cochrane	Rehabilitation after surgery for flexor tendon injuries in the hand Post-operative rehabilitation of the flexor tendons in the hand consists of a short period of immobilisation while pain and swelling diminish, followed by progressive mobilisation to maximize the range of motion of the affected fingers. By altering the time of immobilisation and the manner of subsequent mobilisation different rehabilitation regimes are created. This review aimed to determine the optimal rehabilitation strategy, but found insufficient evidence from RCTs to define it.
(Trinh et al. 2004) Systematic review	Acupuncture for the alleviation of lateral epicondyle pain: a systematic review Authors stated from their experience in this area, that they felt the Cochrane review by Green et al (2001). on lateral epicondyle pain was heterogeneous, in which case meta-analysis might not be the most appropriate method of synthesizing the evidence. Since that review, 4 new trials have been identified. Systematic review of 6 randomised and quasi-randomised controlled trials; all rated high quality. All the studies suggested that acupuncture was effective in the short-term relief of lateral epicondyle pain. Due to heterogeneity, a best evidence synthesis approach was used. Five of six studies indicated that acupuncture treatment was more effective compared to a control treatment. Noted an absence of a consistent definition of lateral epicondyle pain in the literature. *(See also Green et al 2001).*
(Trudel et al. 2004) Systematic review	Rehabilitation for patients with lateral epicondylitis: a systematic review 31 studies were included in this review. Each was assessed for methodological quality, and levels of evidence. The reviewers concluded there is evidence that nearly all the interventions they considered (namely ultrasound, acupuncture, Rebox (Rehabilitation Box, is an electrotherapeutic device, similar but different to a TENS unit), exercise, mobilization and manipulations, and ionisation with diclofenac) show positive effects in the reduction of pain and in the improvement of function for those with lateral epicondylitis. They added there is also evidence to show that pulsed electromagnetic fields, and laser are ineffective in the management of this condition.
(Van Eerd et al. 2003) Systematic review	Classification systems for upper-limb musculoskeletal disorders in workers: a review of the literature The reviewers' goal was to provide a review of the available classification systems and to describe their similarities and differences. 27 classification systems were found that described disorders of the muscle, tendon, or nerve that may be caused or aggravated by work, and these were included in the review. The authors focused on comparing three aspects of the classification systems: the diagnostic labels applied, the disorders identified, and the criteria described for the disorders. The authors found 88 distinct labels for disorders, ranging from neck to fingers and encompassed muscle, tendon, joint, and nerve (neurologic) injuries. The types of disorders also ranged from those with specific diagnoses (e.g., triceps tendinitis) to less well defined entities (e.g., nonspecific diffuse forearm pain or nonspecific discomfort). Relabelling disorders reduced the number from 88 to 44 cluster labels (e.g., rotator cuff tendinitis and supraspinatus tendinitis were clustered under the label "rotator cuff tendinitis"). In attempting to compare disorders across classification systems the reviewers noted the systems ranged from describing a single disorder, through to 22 disorders. The maximum number of disorders in common between systems was 15 of 44 possible disorders. It was observed that although a number of systems may describe the same disorders, they may not all use the same criteria to define them. The reviewers concluded overall that there is little agreement across the systems.
(Verdugo et al. 2003) Cochrane	Surgical versus non-surgical treatment for carpal tunnel syndrome Surgical treatment is widely preferred for carpal tunnel syndrome to non-surgical or conservative therapies for people who have overt symptoms, while mild cases are usually not treated. This review aimed to compare the efficacy of surgical treatment of carpal tunnel syndrome with non-surgical treatment. Only 2 RCTs were included, with 198 subjects in total. The reviewers concluded that surgical treatment of carpal tunnel syndrome relieves symptoms significantly better than splinting, but noted that further research is needed to discover whether this conclusion applies to people with mild symptoms.
(Verhagen et al. 2007)	Exercise proves effective in a systematic review of work-related complaints of the arm, neck, or shoulder The Netherlands has achieved consensus about the term "complaints of the arm, neck, and/or shoulder" (CANS), which can be either work-related or not work-related. Work-related CANS can be divided into specific conditions such as carpal tunnel syndrome, which has relatively clear diagnostic criteria and

Table A2. Reviews on interventions and classification	
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Systematic review	pathology, or nonspecific conditions such as tension neck syndrome, which is primarily defined by the location of complaints and whose pathophysiology is less clearly defined or relatively unknown. Systematic review of articles published up to March 2005: 26 randomised studies of frequently performed interventions in work-related upper extremity musculoskeletal disorders. Findings: Exercises: There is limited evidence that exercises are more effective compared to massage. There is conflicting evidence concerning the efficacy of exercises over treatment or as add-on treatment, and no differences between various kinds of exercises can be found yet. Behavioural therapy *(the term used by the authors, but actually refers mostly to relaxation therapy)*: There is conflicting evidence about the effectiveness of behavioural therapy when compared to no treatment or waiting list controls. Ergonomics: There is conflicting evidence concerning the effectiveness of ergonomic programs over no treatment, although there is limited evidence that breaks during computer work are effective. There is limited evidence for the effectiveness of some keyboards in people with carpal tunnel syndrome compared to placebo but conflicting compared to other keyboards. Group therapy vs individual therapy: There is conflicting evidence concerning the effectiveness of individual vs. group therapy. Massage: There is limited evidence for the effectiveness of massage as add-on treatment to manual therapy. Manual therapy: There is limited evidence for the effectiveness of manual therapy as add-on treatment to exercises. Energized splint: There is one low-quality study comparing an ''energized splint'' with placebo, but no data are available Because of heterogeneity (of the interventions, the quality of studies and the definitions of work-relatedness), drawing firm conclusions about the efficacy of treatment becomes difficult. Nevertheless, the review contributed to the body of knowledge of nonspecific work-related disorders. Although including more studies than Konijnenberg et al (2001), the main conclusions in both reviews that no strong evidence was found for the effectiveness of conservative treatments still remains. In conclusion, this review shows limited evidence for the efficacy of specific keyboards with an alternative force displacement or geometry only for patients with carpal tunnel syndrome. There is limited evidence for the efficacy of exercises when compared to massage, adding breaks during computer work, massage as add-on treatment to manual therapy, and manual therapy as add-on treatment to exercises in patients with nonspecific work-related complaints. Furthermore, the review clearly shows a need for defining what can be considered a ''work-related disorder''. *(See also Konijnenberg et al 2001).*
(Verhagen et al. 2006) Cochrane	Ergonomic and physiotherapeutic interventions for treating work-related complaints of the arm, neck or shoulder in adults Conservative interventions such as physiotherapy and ergonomic adjustments (such as keyboard adjustments or ergonomic advice) are frequently offered as treatments for most work-related complaints of the arm, neck or shoulder. This review aimed to determine their effectiveness. 21 studies (mostly with low methodological quality) were included, evaluating 25 interventions. The authors concluded there is limited evidence for the effectiveness of keyboards with an alternative force-displacement of the keys or an alternative geometry, and limited evidence for the effectiveness of exercises compared to massage; breaks during computer work compared to no breaks; massage as an add-on treatment to manual therapy; and manual therapy as an add-on treatment to exercises. *(See also Boocock et al 2007; Williams et al 2004).*
(Walker-Bone et al. 2003a) Narrative review	Criteria for assessing pain and nonarticular soft-tissue rheumatic disorders of the neck and upper limb The aim of this article was to undertake a systematic review of the literature on diagnostic criteria for soft-tissue rheumatic disorders of the neck and upper limb to describe the criteria used and the evidence underpinning them. Altogether, the search identified 117 relevant research articles, among which 69 included a physical examination component, but few specified diagnostic criteria. Evidence supported respectable levels of between observer repeatability regarding: symptom questionnaires; measurement of shoulder range of motion with a goniometer; tests for carpal tunnel syndrome; and demonstration of neck tenderness. The Katz hand diagram, and combinations of physical signs of carpal tunnel syndrome, show reasonable sensitivity and specificity for that diagnosis but only among patients referred to specialists with that putative diagnosis; no such validity has been shown among the general population. Only 1 diagnostic examination schedule has published data on both the reliability and the validity of its criteria and diagnoses. For the remaining soft-tissue upper-limb disorders, diagnostic criteria rely apparently on face and content validity and reliability data have not been published. At present, the diagnosis of most of these conditions relies heavily on the clinical opinions of investigators and there are insufficient data to indicate that these criteria are repeatable,

Table A2. Reviews on interventions and classification	
Authors	Key features *(Reviewers' comments in italic)*
	sensitive, or specific. As a result of the choice and use of different case definitions and diagnostic criteria, epidemiologic research enquiries have necessarily produced varying estimates of occurrence and risk associated with exposures. So far as nonspecific arm pain is concerned, terms such as RSI and CTD seem unsatisfactory because they may be misnomers, and because loose use of these terms has impeded proper communication about the range of diagnostic entities being studied or reported.
(Williams et al. 2004) Systematic review	Effectiveness of workplace rehabilitation interventions in the treatment of work-related upper extremity disorders: a systematic review Methodological considerations reduced 53 initially selected papers to 8 for analysis. The findings indicate there is insufficient evidence to identify effective workplace rehabilitation interventions for work-related upper extremity disorders. Although the evidence may be poor, it tends to favour a positive impact for several workplace interventions such as ergonomic modifications in keyboard designs *(see also Boocock et al 2007; Verhagen et al 2006)*, rest and exercise breaks, nurse case managers' training on accommodations *(see also Hanson et al 2006)*, and exercise programmes.

[CANS = complaints of the arm, neck, and/or shoulder; CBT = cognitive behavioural therapy; CTS = carpal tunnel syndrome; CTD cumulative trauma disorder; ESWT = extracorporeal shock wave therapy; MSD = musculoskeletal disorder; NSAID = nonsteroidal anti-inflammatory drug; RCT = randomised controlled trial; RSI = repetitive strain injury; RTW = return to work; ULD = upper limb disorder]
[∫ = data extraction (adapted) from Waddell & Burton 2004. ‡ = data extraction (adapted) from Waddell & Burton 2006]

Table A3. Conceptual reviews, texts, and guidance

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Authors	Key features *(Reviewers' comments in italic)*
(Buckle & Devereux 1999) Narrative review	Work-related neck and upper limb musculoskeletal disorders A scientific research information project launched by the European Agency for Safety and Health at Work examined the evidence on the work-relatedness of ULDs. Diagnostic difficulties recognised. Understanding of pathogenesis varies greatly with regard to the specific disorders (w*ith difficulties in establishing agreed pathogenesis of symptoms, the word 'disorder' may not be entirely appropriate for many of symptomatic states)*. It was felt that scientific reports, using defined criteria for causality, established a strong positive relationship between the occurrence of some work-related ULDs and the performance of work, especially where workers were highly exposed to workplace risk factors. Consistently reported risk factors requiring consideration in the workplace are postural (notably relating to the shoulder and wrist), force applications at the hand, hand-arm exposure to vibration, direct mechanical pressure on body tissues, effects of cold work environment, work organisation and worker perceptions of the work organisation (psychosocial work factors). There is debate about the issue of repetitiveness; repetitiveness within work is linked to the concept of work/recovery. When a worker is not actively engaged in the task under investigation, it is frequently assumed that recovery time is being provided. However, this may not be the case if that worker moves from the task to another with similar postural or force demands. Repetitive continuous work was considered to be work involving rapid hand movements which were almost continuous and involved rapid steady motion. It is mentioned that there is some research evidence suggesting that when daily exposure time exceeds four hours, the rates of ULD complaints increase in the shoulder/neck, particularly for seated tasks such as VDU operation. However, it was considered that further debate on this issue is required. There is some consensus that fatigue is a potential precursor for some ULDs. Notes growing belief that the social dimension to ULDs may require additional strategies for prevention. (*Ergonomic focus on physical work-related risks and scope for prevention rather than biopsychosocial issues*).
(Clauw & Williams 2002) Conceptual review	Relationship between stress and pain in work-related upper extremity disorders: the hidden role of chronic multisymptom illnesses This article critically reviews the case definitions of the new class of stress-mediated illness or chronic multi-symptom illness (CMI) and evaluates the existing evidence supporting centrally mediated physiological changes (e.g., sensory hypervigilance, dysautonomia) that manifest as symptoms of pain and fatigue in some individuals experiencing chronic stressors. While explanations for prolonged pain and fatigue have historically focused on mechanisms involving peripheral pathology or psychiatric explanations, ample evidences support the role of altered Central Nervous System function in accounting for symptom manifestation in CMI. Symptom expression (e.g., pain and fatigue) from central dysregulation would be expected to occur in a subset of individuals in the population, including a subset of individuals with work-related upper extremity disorders. Thus when symptoms such as pain and fatigue persist beyond a reasonable period, consideration of CMI and associated assessment and interventions focused on central mechanisms may be worthwhile. There has been little work examining whether workrelated injuries might represent a localized or regional form of CMI. But there are many reasons that this would be plausible. First, there are a large number of other regional or localized pain syndromes that have been established as being related to CMI, including irritable bowel syndrome, temporomandibular joint syndrome, and chronic low back pain. Just as with other CMI, the severity of the initial injury (stressor) in the workplace seems to be less important in predicting chronicity than the environment in which the injury occurs. Finally, peripheral factors (e.g., tissue damage or biomechanical factors) do not typically explain the chronic symptoms that occur in workplace injuries, but neither do purely psychological factors. The primary reason to determine whether a CMI may be present is that these conditions involve prominent central rather than peripheral mechanisms, and thus both the pharmacologic (e.g., low doses of tricyclic compounds instead of nonsteroidal antiinflammatory drugs) and non-pharmacologic (e.g., aerobic exercise and cognitive behavioural therapy) approaches would be quite different. *(CMI seems to be an alternative term for what have been described elsewhere as common health problems (Waddell & Burton 2004) or subjective health complaints (Eriksen & Ihlebaek 2002), and thus are best viewed from a biopsychosocial perspective).*

Table A3. Conceptual reviews, texts, and guidance	
Authors	Key features *(Reviewers' comments in italic)*
(Coggon et al. 2007) Position statement	Occupation and upper limb disorders *(This editorial is included here as a carefully reasoned and referenced presentation of various issues and (at that time) unresolved questions surrounding the work-relatedness of ULDs)*. In epidemiological terms, when relative risks are small (*<3, which is typically found for physical risk factors associated with ULDs – see Walker-Bone & Cooper 2005 – Table A1*) there is doubt about the true relationship. Development of upper limb symptoms and disability is complex and depends on psychosocial and cultural influences as well as physical factors: it is notable that the problem of ULDs has come to prominence when physical demands of work have generally declined. If psychosocial influences are especially important, it is possible that placing a strong focus on ergonomics might create a culture in which workers believe they are at high risk, and this perception itself generates disease. Advice to rest is frequently given, but it is unclear whether restricting activity is the best approach: a strong emphasis on reducing activity in patients with non-specific ULDs may reinforce perceptions of injury and encourage long-term disability (as found with back pain). Further research needs to focus on resolving the major uncertainties in relation to prevention and management, which requires a satisfactory diagnostic classification that can be applied in longitudinal studies.
(Dembe 1996) Conceptual textbook	Occupation and disease: how social factors affect the conception of work-related disorders Examines the ways in which what are termed 'Key Social Factors' have influenced the recognition of cumulative trauma disorders, back pain and noise-induced hearing loss as work-related conditions. Each social factor's apparent impact in shaping the medical conception of the occupational nature of each of the three disorders was assessed on the basis of an interpretation of the entire case history, taking into account such considerations as the timing and magnitude of increases in medical reporting of the disorder subsequent to the social development, the apparent strength of association between the social factor and reports of the disorder, and physicians' own statements and writings concerning their understanding of the relationship between their characterization of the disorder as occupational and the particular social factor. Based upon such considerations, each social factor was ranked according to whether it appeared to have a high, moderate, low or no impact for each type of disorder. Wide variations in the suggested impact of each social factor on the three types of disorder. For cumulative trauma disorders: 'Cultural Stereotyping' is suggested to have had a HIGH impact; 'New Technologies', 'Financial Compensation', 'Economic Instability', 'Media Attention' and 'Political Action' are suggested to have had a MODERATE impact; 'Medical Specialisation', 'Marketing Efforts', 'Military Conflicts' and 'Economic Costs' are suggested to have had a LOW impact; and 'Environmental Concerns' are suggested to have had a NO apparent impact. (*This study clearly reflects a subjective, North American perspective and, given the 'evidence' advanced, the validity of the rankings of the impact of some of the social factors that are suggested to have shaped physicians' recognition and conception of occupational disorders is open to question. Nevertheless, a rare and thought-provoking attempt at examining possible 'social' aspects of the ill-defined concept of 'psychosocial factors' that cites a substantial literature*).
(Derebery et al. 2006) Collection of narrative reviews	*(A series of commissioned articles in an issue of Clinics in Occupational and Environmental Medicine devoted to occupational injuries and diseases of the upper extremity, only the most pertinent of which are extracted below)* Prevention of delayed recovery and disability of work-related upper extremity disorders (Derebery & Tullis 2006) argues that when a worker experiences delayed recovery and unexpected disability, significant contributing psychosocial factors must be assessed for and managed appropriately. A maladaptive belief or understanding about the condition and disability by a patient presents an obstacle to successful treatment. Using cognitive behavioral therapy techniques may be an effective means of managing this challenge for the clinician. Ergonomic considerations in work-related upper extremity disorders (Pearce 2006) argues that an ergonomics approach, correctly applied, can reduce the likelihood of work-induced disorders and can assist in accommodating those with work-related disorders, but that it cannot eliminate disorders which have been (mistakenly) attributed to work by social processes. A 'contextual' model of work-related upper limb disorders is proposed which explicitly acknowledges that factors extrinsic to work can shape perceptions of upper extremity disorders and influence the process of somatic interpretation and the health outcomes. Epidemiology of work-related upper extremity disorders: understanding prevalence and outcomes to impact provider performances using a practice management reporting tool (Giang 2006) provides data on the prevalence and pattern of 187,030 work-related upper extremity disorders and their outcomes and costs.

Table A3. Conceptual reviews, texts, and guidance	
Authors	Key features *(Reviewers' comments in italic)*
	Tendinitis and tendinosis of the elbow, wrist, and hands (Wainstein & Nailor 2006) suggest that tension overload and shear stress are the two mechanisms most likely responsible for most upper extremity tendinopathies. Clinical presentation includes localized pain and tenderness. Most treatment options have yet to undergo evaluation for efficacy in well-designed clinical trials, yet there is a generally favourable response to nonoperative or conservative management. Cases resistant to conservative treatment may require surgical intervention. Compression neuropathies of the upper extremity (Corwin 2006) discusses the anatomy, neurophysiology, and electrodiagnosis of nerve compression. Common and uncommon compression and entrapment syndromes of the upper extremity are described. Errors in diagnosis occur when the neurologic or electrodiagnostic examinations are incomplete or inaccurate. Work-related carpal tunnel syndrome: the facts and the myths (Derebery 2006) argues that the concept of work-related carpal tunnel syndrome has grown to such proportion (in the US) as to be problematic for society, having spawned health care industries to support a cultural concept and a largely mythical medical paradigm. Because of these social and economic forces, cultural perceptions and expectations have adjusted to this flawed medical model. Success in improving patient management and making the best use of sound medical evidence depends on the concurrent use of educational strategies addressing social influences and attitudinal changes of physicians, patients, and third-party administrators. Rheumatic diseases that can be confused with work-related upper extremity disorders (June 2006) suggests that rheumatic illnesses are a common cause for musculoskeletal complaints in the general population and can affect all ages including people in the prime of their working years. Secondary problems, such as entrapment neuropathies, enthesopathies, and Raynaud's syndrome, can be associated with various inflammatory arthritides. A detailed history and physical are the most important tools in screening for potential inflammatory disease in workers with upper extremity complaints. Complex regional pain syndrome type I in the upper extremity (Doro et al. 2006) focuses on CRPS type 1 as it pertains to the upper extremity. In general, patients who have complex regional pain syndrome suffer from pain, sensory changes, oedema, sweating, and temperature disturbance in the afflicted extremity. Chronic changes can involve the skin, nails, and bone. The pathophysiology of this condition remains unclear and is probably multifactorial, involving persistent inflammation, the sympathetic nervous system, the central nervous system and external stimuli. Treatment should be based on a multidisciplinary experienced team approach that is focused on functional restoration. Fibromyalgia and myofascial pain syndromes and the workers' compensation environment: an update (Hayden et al. 2006) suggests controversy exists as to whether fibromyalgia and myofascial pain syndromes represent a specific pathology or are merely terms to describe clinical conditions that provide patients with the reassurance that their symptoms are real and help clinicians with therapeutic direction. In the occupational health setting, this uncertainty can lead to significant difficulty in determining short- and long-term disability and assigning culpability to an individual's work environment. Occupational and physical therapy for work-related upper extremity disorders: how we can influence outcomes (Driver 2006) argues that physical and occupational therapy plays a crucial role in the management of upper extremity disorders. Skilled therapy intervention requires that a therapist be able to identify and treat an injured worker in a holistic manner by looking at the whole individual, including issues that involve mechanical dysfunctions, psychosocial issues that include job satisfaction, and other age-related organic comorbidities. Therapists who work with injured employees must be highly skilled in identifying behavioural and organic disorders and must be confident in communicating these findings to various members of the health care team to help facilitate further medical testing.
(Devereux 2003) ∫ Conceptual review	Work-related stress as a risk factor for WMSDs: implications for ergonomics interventions Epidemiological and psycho-physiological evidence implicating work-related mental stress and development of work-related musculoskeletal disorders. Ergonomic interventions in the workplace are needed to reduce the risks of physical and psychosocial work risk factors for musculoskeletal disorders via organisation design changes. Individual susceptibility should be an increasing concern for ergonomists. *(As elsewhere MSDs are generically considered as a group. Focus was on ergonomic primary intervention, but concept of targeting organisational (stress) factors and individual susceptibility may have implications for rehabilitation).*

Table A3. Conceptual reviews, texts, and guidance	
Authors	Key features *(Reviewers' comments in italic)*
(European Agency for Safety and Health at Work 2007) Factsheet	Work-related neck and upper limb disorders Many workers, in a wide range of jobs, develop WRULDs and they are the most common form of occupational disease in Europe, accounting for over 45 % of all occupational diseases. Although some work-related upper limb disorders (WRULD) result from the acute application of extreme force, most are caused by the effects of many repeated, apparently moderate applications of force, sustained over an extended period. These can result in muscle fatigue and microscopic injuries in the soft tissues of the neck and upper limbs, and WRULDs. Activities increasing the risk of developing WRULDs: In the *neck and shoulders*: ■ working in positions where the weight of parts of the body has to be supported, or objects held, such as working with elevated arms; ■ prolonged work in static postures, involving the continuous contraction of the same muscle groups, e.g. working with microscope; ■ repeated lifting of the arms or turning the head to the side. In the *elbow, wrist and hands*: ■ use of great muscular force to handle objects, e.g. grasping with a large grip or pinch grip; ■ working with the wrists in deviated postures, e.g. turned inwards or outwards; ■ repeating the same wrist movements. Further risk factors for WRULDs include the following: Work environment; Individual factors; Organisational and psychological factors. All of these factors may act separately, but the risk is greater if several risk factors work together. *The Agency's stance is focused on the risks of work and the prevention of harm through the risk assessment-control approach, which owes more to concepts of 'safety' that do not fully accommodate work-relevant aspects of 'health'. However, in the previous factsheet (FACTS 71) the potential value of work seems to be acknowledged*: Keeping workers with MSds at work should be an integral part of workplace MSD policy. A special emphasis should be placed on multidiscplinary approaches, which combine prevention and rehabilitation. Particulalry important is the role of social and organisational support in enabling workers with MSDs both to return to work and to stay in work.
(Feuerstein et al. 2004) Conceptual review	From confounders to suspected risk factors: psychosocial factors and work-related upper extremity disorders Argued that the search for identifying bio-behavioural mechanisms underlying psychosocial variables contribution to work-related upper extremity disorders has been hindered by broad scope of the psychosocial domain, with too many variables. Suggested that 'workstyle' may be a plausible and measurable factor, defined as how a worker performs tasks in response to increasing work demands. It is considered to be an enduring set of learned and reinforced strategies for completing, responding to, or coping with increased job demands, and is not considered to be a personality factor. They outlined a workstyle model that proposes this factor is predictive of upper extremity symptoms. A subsequent publication (Feuerstein et al. 2005) described the development of a 136-item scale to measure workstyle. *(The model outlined fails to differentiate between factors that might predict onset of symptoms, the report of symptoms, and the development of disability and work loss. The utility of the model remains open to empirical testing, but it may generate useful hypotheses)*
(Feuerstein & Harrington 2006) Conference consensus	Secondary prevention of work-related upper extremity disorders: recommendations from the Annapolis conference Narrative summary of recommendations from a 2005 conference aimed at preventing disability due to work-related ULD's. Consensus conclusions included the following: (1) new conceptual models are required with a broad biobehavioural perspective (2) the workplace is dynamic with continuously changing characteristics of fluctuating demands, tasks, work areas, and postures (3) effective interventions seem to need an interdisciplinary approach (4) the ergonomics field needs to expand in order to adapt to the changing workplace (5) non-occupational health practitioners are neither prepared nor knowledgeable about ergonomics and other risk factors in the workplace (6) programmes with both management and worker participation are likely to be best (7) insurance systems fail to account for all relevant costs appropriate to an injury, and this prevents focus on secondary prevention. *(Supports concepts of work-related upper extremity disorder as a biopsychosocial phenomenon, and disability prevention requires all players onside).*

Table A3. Conceptual reviews, texts, and guidance	
Authors	Key features *(Reviewers' comments in italic)*
(Franche & Krause 2002) Conceptual review	Readiness for return to work following injury or illness: conceptualizing the interpersonal impact of health care, workplace, and insurance factors These authors defined RTW as a behaviour that is influenced by a variety of physical, social, psychological, and economic factors. They argue there are two prevailing models of work disability: the Readiness for Change Model that originated from the health promotion field, and addresses motivation for changing behaviour; and, the Phase Model of Disability developed for epidemiological study of work disability that addresses the developmental and temporal aspects of disability. Both models allow for a timing of interventions in the RTW process, the first based on the motivational state of the employee and the second on duration of work disability. There is evidence for the phase-specificity of predictors of work disability after occupational injury or illness, with specific predictors of disability during the acute, subacute, and chronic phases of disability. They propose a Readiness for Return-to-Work Model that places the injured/ill employee as the primary agent of change, as he/she interacts with various parties in the RTW process. It does not comment on the interpersonal impact of the employee on the employer, health care provider, and insurer, but focuses solely on the unidirectional impact of these parties on the employee. They argue that both the Readiness for Return-to-Work Model and the Phase Model of Disability should be used in combination when designing intervention and risk factor studies. They believe that the former will allow research to identify motivation for and behaviour of RTW, and the latter to identify functional ability and pain severity, which are clearly related to time elapsed since time of onset, as well as RTW outcomes. *(The potential benefit from the proposed conceptualization could be more focused research designs that allow identification of specific contributing/risk factors as well as the components of successful intervention that might contribute to specific outcomes, such as RTW without symptom modification).*
(Hadler 2005) Conceptual textbook	Occupational musculoskeletal disorders Lays out evidence-based argument for a model of the experience of MSDs (including ULD):- a 'well person' who experiences ULD is faced with a predicament that requires numerous influences to be processed (intensity of symptoms and incapacity, beliefs and attitudes (self and others, including constructions of treatment providers). The outcomes (options) of the processing are: [a] persist as a person and deal with the experience; [2] choose to be a patient with an illness, [3] choose to be a claimant with an illness. The choice process is driven largely by psychosocial influences, reflecting coping ability. The preferred term is regional musculoskeletal disorders (which reflects the subjective experience and does not presuppose a specific cause or pathology), and they should be characterised as an illness not an injury. Everyone experiences regional musculoskeletal pain (repeatedly); most episodes pass and are forgotten; some episodes may be disruptive and challenge coping – physicians need to understand that seldom is "My arm is hurting" the chief complaint: rather, it is a case of "My arm is hurting, but the reason I'm here is because I can't cope with this episode myself". Diagnostic uncertainty prevails; labels suggestive of cause/pathology are harmful; undue medicalization is unhelpful (especially surgery) – management of ULDs should be targeted at helping people cope, and avoid the contest of blame. Most arm pain is a predicament of life – work is rarely the cause, but the symptoms may be more relevant because of some aspect of work. Work should be comfortable when we feel well and accommodating when we do not. *(A partisan stance that will appeal to many and offend others – however, a powerful, skilfully argued case promoting a biopsychosocial approach that references a substantial literature).*
(Helliwell 1999) Narrative review	The elbow, forearm, wrist and hand Pain in the forearm is relatively common in the community: non-specific forearm pain is more frequent (9–20%) than specific soft-tissue syndromes, although carpal tunnel syndrome has a prevalence of 9%. Absence of agreed criteria hinders attempts to compare the results of different studies. Both specific and nonspecific disorders probably occur more often in work involving frequent repetition, high forces, and prolonged abnormal postures. Nevertheless, other factors are involved in the presentation and continuation of the pain. Notable among these factors is the workplace environment: the attitude to workers and their welfare, the physical conditions and the design of the job. Management of regional musculoskeletal pain using the medical model of illness may be inappropriate; rather it should be multidisciplinary, taking a wider look at the problem, although there is some evidence that primary prevention, with active surveillance using sensitive criteria and early intervention, is effective. Treating the pain while ignoring the associated fear, distress, anxiety, and depression may not resolve the problem. Physical treatments have not been extensively evaluated except for local steroid injections, which have a modest beneficial effect. Cognitive behavioural therapy has benefit in the mid term, but is costly.

Table A3. Conceptual reviews, texts, and guidance	
Authors	Key features *(Reviewers' comments in italic)*
(HSE 2002) Workplace guidance	Upper limb disorders in the workplace (Health & Safety Executive) Guidance for employers in the UK on the prevention and management of work-related upper limb disorders (WRULD). Suggests that following the guidance will normally be doing enough to comply with the law (*but makes no explicit reference to legal precedents that appear to be inconsistent with the guidance*). Acknowledges that not all upper limb disorders (ULD) are work-related but suggests that experience has shown that ULDs are often directly linked to workplace activities, or if due to a non-work cause, often made worse by work. Suggests psychosocial and physical risk factors are of equal importance, but simplistically summarises (in an appendix) evidence *(mostly derived from NIOSH (1997) see table A1)* of association with occupational activity for: bursitis/cellulitis; carpal tunnel syndrome; cramp of the hand; cubital tunnel syndrome; De Quervain's disease; Dupuytren's contracture; epicondylitis; ganglion; osteoarthritis; rotator cuff tendinitis-bicipital tendinitis; shoulder capsulitis; stenosing tenosynovitis; tenosynovitis; and vibration white finger. Also comments on non-specific pain syndromes. Advocates a seven-stage framework for the management of ULD risks: understand the issues and commit to action; create the right organisational environment; assess the risks of ULDs in your workplace; reduce the risks of ULDs; educate and inform your workforce; manage any episodes of ULDs; and carry out regular checks on programme effectiveness. Section on managing episodes of ULDs comments on continuing to work with symptoms and suggests it is often possible to return to work before symptoms have resolved and that in some cases this may be advantageous, but acknowledges that this depends on medical advice and the nature of the underlying condition.
(HSL (Lee & Higgins) 2006) Workshop report	Musculoskeletal disorder and RTW workshop (Health and Safety Laboratory) *(Workshop divided into low back pain and upper limb disorders + literature review with focus on modified work: just upper limb disorders data extracted here)*. Modified work not always needed - many people with MSDs self-manage, don't seek healthcare, and either don't take time off work or soon return to their usual work. For others, work modifications (transitional work arrangements) may enable return more quickly. Specific diagnosis in ULDs probably not critical to fitness for work activities unless inflammatory. It seems likely that advice to 'stay active' should apply to the majority of people: consensus that messages in 'The Back Book' should also be used for people with ULDs (similar booklet needed for ULDs following more work on evidence base). General recognition of problem of health professionals inappropriately prescribing rest and issuing sick notes: health professionals need to be informed that pain does not mean necessarily that individual cannot work: evidence needed to clarify circumstances when rest required, but consensus suggested appropriate only in minority of cases (ie inflammatory, though this not formally confirmed). Numerous obstacles to RTW – inappropriate diagnosis, poor advice, waiting lists, psychosocial factors (yellow and blue flags), lack of support. It was considered the biopsychosocial model can be a useful 'tool', though concern raised about skills to handle psychological issues *(distinction between the model aiding understanding and interventions based on the model perhaps not fully appreciated by participants).*
(HSL (Lunt et al) 2007) Scoping review	Applying the biopsychosocial approach to managing risks of contemporary occupational health conditions Review commissioned by HSE to identify (1) employers' practices in applying risk management to common health problems, (2) biopsychosocial mechanisms by which such problems develop and are maintained, (3) individual, work environment and socio-demographic influences on well being. The uptake of the biopsychosocial approach has been hampered (for various reasons) despite the approach's greater scope in explaining the development and progression of common health problems CHP). Biopsychosocial mechanisms can be implicated in the onset of most occupational health conditions - conditions can be distinguished according to whether the main cause concerns physical of psychosocial hazards: CHPs appear to fall into the latter category. The biopsychosocial mechanisms that maintain occupational health conditions, by comparison, appear more consistent across all conditions, regardless of original cause. Onset of psychosocial-induced symptoms appears predisposed by a vulnerability generated from a combination of biological, psychological and environmental risk factors. A sudden increase in, or continuation of external stressors can act to 'tip the balance' and precipitate symptom expression. Social gradient, job control, effort-reward balance, social support, and health behaviours appear to strongly predispose vulnerability. Beliefs about the cause, consequences and controllability of common health problems are an important determinant of the ways in which employees respond to a health condition and maintenance of the condition. External reinforcers such as compensation, sickness benefits, avoidance of situations perceived as pain inducing,

Table A3. Conceptual reviews, texts, and guidance	
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	avoidance of unwanted responsibilities or undesirable situations can also help maintain 'being sick' where the underlying physiological pathology indicates otherwise. In the event that biopsychosocial risk factors cannot be reduced, ensuring the presence of well-being resources, such as increased social support, or positive health behaviours, should buffer any adverse effects of stressors. *(Focused on common health problems in general but, assuming ULDs are CHPs, then principles likely to apply).*
(Huang et al. 2002) Conceptual review	Occupational stress and work-related upper extremity disorders: concepts and models Descriptive article about models of occupational stress and their applicability to work-related upper limb disorders. Provides overview of concepts and definitions for occupational stress, models of occupational stress and health, the Siegrist model of effort-reward imbalance at work, the demand/decision latitude model, multivariable models of work-related musculoskeletal symptoms/disorders, dose-response models, epidemiological models, ecological models, the biopsychosocial model of job stress, the balance theory of job design and stress, and the workstyle model. The authors offer the conclusion that few of the psychological, psychophysiological, and behavioural mechanisms integral to the models have been empirically substantiated.
(Jerosch-Herold et al. 2006) Conceptual systematic review	A systematic review of outcomes assessed in randomized controlled trials of surgical interventions for carpal tunnel syndrome using the International Classification of Functioning, Disability and Health (ICF) as a reference tool Review of outcomes used in RTC's of surgical interventions for carpal tunnel syndrome, and comparison of these with biopsychosocial concepts contained in the International Classification of Functioning, Disability and Health (ICF, part of the family of classifications developed by WHO). 28 relevant RCT's were identified. The most frequently assessed outcomes were self-reported symptom resolution, grip or pinch strength and return to work. The majority of studies used outcome measures that assessed impairment of body function and body structure. A small number of studies used measures of activity and participation, such as measures of hand dexterity, use of hand in activities of daily living, and/or functional status. Only a quarter measured satisfaction. The authors concluded that studies to date have focused primarily on assessment of impairment and less on the activity limitations and participation restrictions. They suggested that a minimum set of outcome measures should include patient-reported scales of symptom severity and functional status, clinical measures of motor and sensory function and everyday performance in self-care, work and leisure as well as health-related quality of life.
(Lucire 2003) Historical and conceptual text	Constructing RSI: belief and desire (*An account and explanation, by a forensic psychiatrist who was intimately involved, of the 1980s Australian repetitive strain injury (RSI) 'epidemic'*). Two incommensurable paradigms of explanation guided diagnosis and management of the Australian epidemic of arm symptoms. These were the injury paradigm and the somatization paradigm. In the injury paradigm, symptoms were seen as evidence of a musculotendinous injury caused by a preceding task or by various characteristics of the workplace. The epidemic was to be managed by control of traumatizing agents and the subject, usually female, was not to be held responsible either for her condition or for her recovery. The injury paradigm claimed the dominant position. The notion of overuse, interested unions and industrial activists who sought to control output and protect jobs threatened by word processors which seemed to threaten job security. The unions wanted to have medical justification. The physicians who became involved in providing this justification contributed to a campaign of preventive medicine and workplace improvement. RSI was promoted by unions and accepted by government because, being ideologically based, it served social functions which were considered legitimate at the time. The epidemic of RSI is better explained as somatization than as injury. The somatization paradigm interpreted undiagnosable symptoms as a functional disorder or, if a pathological entity was known to have preceded their onset, as functional overlay. However, to say that a claimant was somatizing, one would have to disregard the social implications of the patient having been given a diagnosis of RSI. The diagnosis effectively ruled out any investigation of the ethical position of the somatizing subject since, for the duration of the incapacity, the physician assumed responsibility for the patient's illness behaviour and for determining fitness for work. Somatizing theory focused on the vulnerable affected subject. It failed to accommodate the role of the physician in guiding the emergence and the succession of symptoms. It did not accommodate the societal and cultural factors that made somatizing an acceptable, even desirable, way of being in the world. Blaming the workplace, through diagnosing injury, or medicalizing the patient by diagnosing somatization, both served the interests of the medical profession. The epidemic highlighted the extent to which society can eschew scientific knowledge in favour of inappropriate beliefs. (*A skilfully argued case that will appeal to some and offend many. References a substantial literature*).

Table A3. Conceptual reviews, texts, and guidance	
Authors	Key features *(Reviewers' comments in italic)*
(Melhorn 2005)∫ Physician guidance	Working with common upper extremity problems *(A chapter from an American Medical Association guide book presenting evidence-based advice to physicians involved in workability assessments – the approach involves consideration of risk, capacity, and tolerance at the individual level).* Takes a biopsychosocial approach - medical treatment should be used as appropriate, whilst early RTW is beneficial and prolonged absence undesirable. Uses concepts of 'risk', 'capacity' and 'tolerance'. Risk refers to chance of harm to patient or general public. Capacity refers to limitations in terms of strength, flexibility, endurance, etc - if it is not objectively obvious that the individual lacks the current ability to do certain job tasks, whether they will work is usually a question of tolerance. Tolerance is the ability to tolerate sustained work or activity at a given level; symptoms such as pain or fatigue are what limit the ability – the individual may be capable of the task but not to be able to perform it comfortably: when there is no objective pathology (rather only symptoms) working despite symptoms poses no major risk. Returning an individual with an upper extremity problem to work requires a balance between the demands of the job and the capability/tolerance of the patient. Shoulder impingement/rotator cuff syndrome: staying at work or RTW is primarily based on tolerance: most can return to previous employment levels after treatment: temporary modified work helpful (including after surgery): capacity limited in chronic cases by decreased shoulder motion: severe imaging changes may dictate change of work. Rotator cuff tear: risk increases with age: staying at work or RTW is primarily based on size and duration of tear; permanent task modifications (limit hand-over-shoulder tasks) to usual job may be required: long-term discomfort with activities likely. Epicondylitis: staying at work or RTW is primarily based on tolerance rather than capacity or risk: temporary modified work can help return to previous employment levels: symptoms tend to be chronic with activities, but not progressive: return to very heavy work may be difficult (patient must decide whether rewards of work outweigh the pain. Ulnar nerve entrapment (elbow): staying at work or RTW is primarily based on tolerance: early diagnosis and treatment important to minimise risk of neurological damage: most can return to previous work with permanent task modification (rotation; limited exposure to vibrating hand tools). Carpal tunnel syndrome: aetiology controversial and diagnosis difficult: for early cases staying at work or RTW is primarily based on tolerance: residual functional loss rare if treatment is early: most can return to previous employment levels, perhaps with permanent task modification (rotation; limited exposure to vibrating hand tools). De Quervain's tenosynovitis: staying at work or RTW is primarily based on tolerance: symptoms may be chronic with activities though not progressive: most can return to previous employment levels: returning to very heavy work for extended periods may be difficult (possibly change job). Trigger finger/thumb: staying at work or RTW is primarily based on tolerance: surgery often has good outcome: most can return to previous employment levels: temporary modifications may help. Non-traumatic soft tissue disorder: synonymous with regional arm pain: although pain associated with physical activities, cause-effect not established: staying at work or RTW is based on tolerance, not risk or capacity: cases frustrating for clinicians to manage because symptoms can remain disproportionate despite appropriate healthcare and modified work: interventions must be based on biopsychosocial model. Severe conditions require the consideration of risk (work restrictions) and capacity (work limitations). Most often, the factor hindering RTW is tolerance (of symptoms). Return the individual to work requires a balance between the demands of the job and the capability of the person. Communication and education are key to addressing tolerance issues. Temporary workplace guidance for tolerance must allow for speedy return to work, with the interests of the person being the primary responsibility –reducing work disability, improving outcome for work-related injuries, and advancing the quality of life.
(Moon & Sauter 1996) Conference papers	Beyond biomechanics – psychosocial aspects of musculoskeletal disorders in office work *(A somewhat dated collection of viewpoints arising from a multidisciplinary conference in 1993 that addressed non-biomechanical influences on musculoskeletal disorders in office work. Many of the contributors have since gone on to publish articles that are extracted in other tables. Primarily of interest now in that some of the contributions reflect the concerns that the adoption of a biopsychosocial approach may encounter).* A psychosocial view of cumulative trauma disorders: implications for occupational health and prevention (Moon 1996) suggests that even at its simplest, a biopsychosocial approach to cumulative trauma disorders (CTD) predicts complex research issues and hurdles to practical application; but ethical issues may

Table A3. Conceptual reviews, texts, and guidance	
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	be the greatest concern. The central ethical concern is the danger of blaming workers for the CDT phenomenon. Raising the psychosocial issue at all may be risky. Social consequences of disclosing psychosocial concomitants of disease and injury (Skelton 1996) questions whether it is advisable to devote resources to identifying psychosocial concomitants of CTDs and whether the likelihood that disclosure of such concomitants, if they are discovered, will be misconstrued by the public, creating harmful repercussions for workers afflicted with CTDs. An ecological model of musculoskeletal disorders in office work (Sauter & Swanson 1996) suggests an important feature of the model is that psychological mediation of musculoskeletal disorders is discussed in terms of normal psychological processes which are fairly well understood in social and health psychology. Notes that the rather extensive psychological literature on the perception and attribution of symptoms has received little or no attention in ergonomics and occupational health. Some social and cultural anthropologic aspects of musculoskeletal disorders as exemplified by the Telecom Australia RSI epidemic (Hocking 1996) postulates an 'iceberg of disease', the iceberg representing a mass of ill-defined bodily sensations and subclinical disease, but only the tip is perceived as pain or clinically presented illness. Many other symptoms are coped with and remain subclinical. However, the iceberg floats in a social sea. If the density of the surrounding sea, the social environment, increases, due to organisational change or medical, media or legal influences, the iceberg rises, the tip enlarges, and more illness is presented.
(Palmer et al. 2007a) Physician guidance	Fitness for work *(A Faculty of Occupational Medicine book presenting the medical aspects of fitness for work for those involved in addressing the health issues associated with employment)*. The chapter on 'support and rehabilitation - restoring fitness for work' (Aylward & Sawney 2007) focuses on common health problems which de facto generically includes ULDs: authors take a strong biopsychosocial stance stressing the health and social benefits of (return to) work – vocational rehabilitation needs to address obstacles and engage all key players. The chapter on 'orthopaedics and trauma of the limbs' (Cox & Nugent 2007) outlines diagnostic criteria, extent of work-relatedness and medical treatments; return to work aspects discussed only for some upper limb conditions - *(ULDs are a relatively small component of this chapter, which takes a strongly biomedical stance)*.
(Schultz et al. 2000) Conceptual review	Models of diagnosis and rehabilitation in musculoskeletal pain-related occupational disability A systematic analysis of the theoretical and empirical literature on pain-related disability was undertaken to identify current conceptual models of diagnosis and rehabilitation. Five conceptual models were reviewed: the biomedical model, the psychiatric model, the insurance model, the labour relations model, and the biopsychosocial model. The authors provide an overview of the theoretical tenets of each model, the underlying values, and the implications for clinical practice, and management by compensation and healthcare systems. The authors concluded that while none of the models of diagnosis and rehabilitation in pain-related disability have proven to be of no benefit in conceptualizing and planning care for individuals with pain, each of the models possess unique applications and limitations. The principal tenet of the biopsychosocial model is the recognition of the complexity of the phenomenon of pain within humans. The second tenet involves a conceptual distinction between impairment and disability. The third is that organic pathology does not reliably predict impairment and disability. Psychological and sociocultural factors play a major role in defining pain and mediating the reaction to injury and subsequent disability. The biopsychosocial model tends to be labour intensive, time consuming and expensive, requiring an organizational structure that supports teamwork, and high treatment motivation on the part of the individual with the pain condition, and appears to constitute too luxurious a model for simple injuries with an acute pain component that occurs to adaptable people who possess well-developed coping skills. *(The authors' concept of applying the biopsychosocial model seems to rest with rehabilitation programmes, yet they clearly recognise the applicability of biopsychosocial principles for managing pain and disability)*. ' It is evident that the applicability of a given model of rehabilitation of pain-related occupational disability depends largely on two factors: (1) time since injury and (2) the clinical complexity of the case as determined by the interaction of pain presentation, functional tolerances, comorbid conditions, pre-existing factors, current environmental stressors, workplace demands and resources, and individual coping skills and adaptability. *(It seems clear that we are destined to live in a "house of many paradigms", yet the management of healthcare invariably fails to reflect this).*

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(Shaw et al. 2002) ∫ Conceptual review	Secondary prevention and the workplace Conceptually, 'secondary prevention interventions in the workplace' may focus on early detection and treatment of mild/moderate symptoms, and on accommodating temporary functional limitations to aid recovery and reduce likelihood of recurrence. Review examines several interventions aimed at physical work environment, modified duty, educational and exercise approaches, case management, and programmes for supervisors. Integrating care and facilitating communication among workers, health-care providers and the workplace emerge as salient features. As a whole the evidence shows that there is considerable potential to reduce disability and longer-term problems associated with work-related musculoskeletal pain. Efforts to reduce ergonomic risk factors, to enhance education and fitness, and to influence case managers and supervisors provide opportunities for effective secondary prevention. Integrating care and facilitating communication among workers, health care providers and the workplace emerge as particularly salient. *(A carefully conducted and argued review displaying the potential for modern joined-up management, though robust scientific evidence limited*).
(Staal et al. 2007) Narrative review	Aetiology and management of work-related upper extremity disorders Chapter that reviews both localised and widespread problems of the upper limbs that are work related. The Dutch authors use the term Work-related upper extremity disorders (WRUED), and note this is an umbrella term used for a range of symptoms and disorders localised in the neck, shoulder, elbow, forearm, wrist and/or hand. These symptoms may include pain, swelling, stiffness, numbness, tingling, clumsiness, loss of coordination, loss of strength, skin discoloration and temperature differences, and give rise to limitations in activities either at work or during leisure time. The discussion of risk factors notes they are usually subdivided in to work-related physical risk factors, work-related psychosocial risk factors, and personal risk factors. However, the reviewers observed that current evidence points to a multifactorial aetiology. They also noted that patient with chronic WRUED should be viewed from a psychological or even social standpoint, rather than purely focusing on the pathophysiological mechanisms that underlie upper limb symptoms. That is, they are advocating a biopsychosocial approach. Following consideration of available evidence from RCTs and systematic reviews, the authors concluded that among the many available treatment options both exercises and ergonomic measures may be considered as the most promising treatment alternatives for WRUED. However, they urged caution, given the limited evidence-base.
(Szabo & King 2000) Conceptual review	Repetitive stress injury: diagnosis or self-fulfilling prophecy? *(Arguably a partisan view reflecting one side of the US public debate of the time, yet citing appropriate, if selected, scientific literature)*. • The vague definitions of so-called repetitive stress injuries are indicative of the fact that scientific studies have failed to show that repetitive motion causes injury. • Given the uncertainty about causation, work-related musculoskeletal disorders (WRMSDs) is a more readily accepted term to describe these phenomena. • There is little doubt that most ergonomic interventions increase comfort in the work environment, which is of great benefit to the worker. • Many proponents of ergonomics assert that the elimination of certain risk factors related to force, repetition, and posture can prevent or even cure work related musculoskeletal disorders of the upper extremity. However, there is little scientific support for this position. • Undue reliance on ergonomics to treat musculoskeletal disorders, to the exclusion of proper diagnosis and attention to medical and health risk factors, can have adverse consequences for the patient. • Science rather than politics and public policy should determine what causes injury and disease. *(The authors' discussion leads to a somewhat biomedical view on interventions and (not extracted here) focuses on litigation issues).*
(Waddell & Burton 2004) Conceptual review	Concepts of rehabilitation for common health problems *(This review covered a range of common health problems, but only the information related to musculoskeletal disorders is noted here)*. Evidence is presented to support the view that common health problems (inclusive of ULDs in general) are best understood through the biopsychosocial model, and that this impacts on rehabilitation and management. The negative consequences of obstacles to recovery (inclusive of popular myths) are highlighted. Musculoskeletal disorders: There seem to be common strands to the different musculoskeletal symptoms/disorders: a general consensus that a

Table A3. Conceptual reviews, texts, and guidance	
Authors	Key features *(Reviewers' comments in italic)*
	multidisciplinary approach to management with all the key players onside is most appropriate. A broadly similar range of approaches has been used for the management and rehabilitation of all musculoskeletal disorders, irrespective of the actual disorder or its assumed cause. Medical treatment may differ depending on the specific symptoms or diagnosis, but restoration of function involves issues that are independent of the condition. Early interventions are advocated, though too early an intervention may be inappropriate and even counter-productive in some settings. Multidimensional interventions (inclusive of addressing psychosocial and psychological issues) are considered to offer the greater potential; achieving vocational outcomes requires more than just healthcare – occupational and ergonomic interventions should be integrated, and have the potential to impact on psychosocial factors (including reduction of workplace stress) as well as reducing physical exposures. Modified work should be a temporary measure to accommodate reduced capacity; it facilitates early return to normal duties, assuming the risks are suitably assessed and controlled – assignment to permanent modified work can be harmful. The outstanding theme is the importance of linking rehabilitation interventions to the workplace (inclusive of appropriate education to get all players (healthcare; worker; workplace) onside. *(The data extractions concerning ULDs are included in the evidence tables for the present review: identified by ∫).*
(Waddell & Burton 2006) Quasi-systematic review	Is work good for health and well-being? *(This review covered a range of common health problems, but only the information related to musculoskeletal disorders is noted here).* Evidence on musculoskeletal conditions (inclusive of ULDs in general) supports four main themes: a) the high background prevalence in the general population; b) work can be a risk factor; c) psychosocial factors are important modifiers; d) the need to combine clinical and occupational interventions. The high background prevalence of musculoskeletal symptoms means that a substantial proportion of musculoskeletal conditions are not caused by work. Most people with musculoskeletal conditions continue to work; many patients with severe musculoskeletal diseases such as rheumatoid arthritis remain at work and experience health benefits. Musculoskeletal symptoms (whatever their cause) may make it harder to cope with physical demands at work, but that does not *necessarily* imply a causal relationship or indicate that work is causing (further) harm. Intense exposures to physical demands at work can be risk factors for musculoskeletal symptoms, 'injury' and certain specific musculoskeletal conditions. However, causation is usually multifactorial and the scientific evidence is somewhat ambivalent: much depends on the outcome of interest. Physical demands at work can precipitate or aggravate musculoskeletal symptoms and cause 'injuries' but physical demands of work only account for a modest proportion of the impact of musculoskeletal symptoms in workers. The physical demands of modern work (assuming adequate risk control and except in very specific circumstances) play a modest role in the development of actual musculoskeletal pathology. Sickness absence and disability depend more on individual and work-related psychosocial factors than on biomedical factors or the physical demands of work. It is unhelpful to view physical demands from a purely negative perspective, ie 'hazards' with potential only to cause 'harm'. Physical activity is fundamental to physiological health and fitness and an important part of rehabilitation from injury or illness. Work can be therapeutic. Thus, modern clinical management for most musculoskeletal conditions emphasizes advice and support to remain in work or to return as soon as possible. People with musculoskeletal conditions who are helped to return to work can enjoy better health (level of pain, function, quality of life) than those who remain of work. The return to work process may need organisational interventions: risk reassessment/control, and modified work: the duration of modified work depends on the condition - for common musculoskeletal conditions such as neck or arm pain it should be temporary and transitional. *(The data extractions concerning ULDs are included in the evidence tables for the present review: identified by ‡).*

[CHP = common health problem; CTD = cumulative trauma disorder; ICF = International Classification of Functioning, Disability and Health; MSD = musculoskeletal disorder; RCT = randomised controlled trial; RTW = return-to-work; RSI = repetitive strain injury; ULD = upper limb disorder; VDU = visual display unit; WRUED = work-related upper extremity disorders; WRULD = work-related neck and upper limb disorder]
[∫ = data extraction (adapted) from Waddell & Burton 2004. ‡ = data extraction (adapted) from Waddell & Burton 2006]

Table A4. Individual studies of particular relevance

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Authors	Study type	Topic	ULD condition	Key findings *(Reviewers' comments in italic)*
(Abásolo et al. 2005)	RCT	Work disability	Regional MSDs	A health system program to reduce work disability related to musculoskeletal disorders Large RCT with n=7805 control and 5272 intervention subjects with episodes of MSD-related temporary work disability in two health Madrid districts, with 4-year follow-up. The control group received standard primary care management, with referral to specialised care if needed. The intervention group received a specific program, administered by rheumatologists, in which care was delivered during regular visits and included 3 main elements: education, protocol-based clinical management, and performing medical administrative duties (such as writing prescriptions, and sick notes). The intervention consisted of avoidance of bed rest, early mobilisation, avoidance of splints, stretching exercises, ergonomic training, provision of educational booklets, and suggestions for optimal levels of physical activity. Return to work was never forced. Specific protocols for regional MSD's were created, including ones for shoulder, and arm and hand. The exact proportion of cases with upper limb disorders was not reported, but non-spine problems appear to have been about 50% of total cases. Temporary work disability, long-term work disability, and costs were significantly decreased in the intervention group. The net economic benefit was €11 for each euro spent. Furthermore, patients in the intervention group were significantly more satisfied. *(This study illustrates the potential benefit from considering work disability due to MSD's to be a relevant health problem worthy of intervention. The personal and financial impact of such problems may be mitigated by participating in a similar programme that combines patient education with protocol-driven early rehabilitation based on biopsychosocial principles, although this was not explicitly stated by the authors).*
(Adams & de C Williams 2003)	Mixed cross-sectional survey, and retrospective case series	RTW	Chronic upper limb pain	What affects return to work for graduates of a pain management program with chronic upper limb pain? The authors observed that chronic upper limb pain often causes work loss, yet rates for RTW after attending a (biopsychosocial) pain management programme are disappointingly low. The study aimed to identify factors relevant to RTW in sample of 103 patients with chronic upper limb pain. Data were collected by telephone interview. Data (writing and typing speed, self-efficacy, catastrophising, medication use, and adherence to pain management techniques 1-month after programme) was also available from before and after treatment. They reported that 55 individuals were working or in training after the programme, whereas 54 had been in the 3 months before. There were changes in employment status: 30 participants improved their work status, 10 reduced it, and 61 remained stable. Higher self-efficacy, lower catastrophising, faster writing speed, and less medication use significantly predicted RTW. Use of pain management strategies, and typing speed, did not. The authors suggested that non-workers may be characterised as

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				predicating work on considerable adaptations or flexibility in conditions, not expecting much help from employers in providing these, and not believing themselves fully capable of sustaining a job. The overall conclusion offered was that RTW depended on specific beliefs concerning work-relevant strategies.
(Alizadehkhaiyat et al. 2007)	Case-control	Psychological and functional status	Tennis elbow	Pain, functional disability, and psychologic status in tennis elbow Small study comparing tennis elbow patients with healthy controls for pain and functional disability, and evaluated the relationship between the 2 major psychological factors (anxiety and depression) and tennis elbow. 16 subjects per group. Tennis elbow patients showed markedly increased pain and functional disability. Significantly elevated levels of depression and anxiety (on Hospital Anxiety and Depression Scale) in tennis elbow patients: according to the anxiety and depression subscales of the, 55% and 36% of patients, respectively, were classified as probable cases. Authors recommended psychological assessment in the development of supportive and treatment strategies for tennis elbow patients.
(Baldwin & Butler 2006)	Retrospective survey + narrative review	RTW	ULDs	Upper extremity disorders in the workplace: costs and outcomes beyond the first return to work Noted that majority of workers compensation claims in Quebec for work-related upper extremity disorders are resolved quickly and the worker returns to work, although a small but significant proportion experience unusually lengthy spells of work absence. A small fraction of injured workers with the longest spells of work absence have extremely low probabilities of returning to work. These imply large productivity losses for employers. Mean workers compensation claim costs in the US are between $5000 and $8000, but this is not a good measure due to the highly skewed nature of the duration distribution for upper extremity claims. The total cost burden of work-related upper extremity disorders is large because of the relatively high incidence of the conditions. Estimates of the costs of work-related upper extremity disorders derived from administrative data are certain to underestimate the true costs on society, however, because many cases go unreported, and because indemnity benefits may not cover periods of prolonged or recurrent spells of work absence. Some evidence suggests that recurring spells of work absence may increase the disability burden further, but this hypothesis is not well documented. Approximately one-third of workers with upper extremity disorders are at risk of prolonged employment instability following their injury. The goal of the retrospective study was to determine post-injury employment patterns and return-to-work probabilities in a sample of 1,317 workers with upper extremity disorders, up to 5 years. It was found that most workers with cumulative trauma disorders of the upper extremities (CTD) return to work at least once, but a first return does not necessarily mark the end of work disability. Two-thirds workers with CTD or work-related back pain experience injury-related absences after their first return to work. Focusing on the first return to work is misleading for both injury groups, but even more so for CTD, as they appear to be even

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				more susceptible to multiple spells of work absence. *(The results of this study have two important implications. First, studies of predictors for RTW in upper limb disorders should consider longer-term work outcomes, rather than merely first return to work. Second, that rehabilitation approaches may need to target work-maintenance and sustainability, in addition to RTW).*
(Beaton et al. 2007)	Physician workshops	Classification system	Upper limb disorders in workers	A pattern recognition approach to the development of a classification system for upper-limb musculoskeletal disorders of workers Questionnaire and physical assessment of 242 workers: physical examination findings dichotomized to normal/abnormal: experienced physicians attending workshops led through pattern recognition (clustering and naming clusters) to arrive at classification system: good face value but low interobserver reliability: revised to produce a triaxial classification system with good reliability. The signs and symptoms axes quantified areas involved in upper limbs: third axis described the likelihood of a specific diagnosis being made and degree of certainty. (*The following extracts from the introduction and discussion of this study are of most relevance to the present project*)): Inconsistencies over classification has led to wide-ranging debates over the causes, pathology, and even existence of these disorders; this threatens to divert attention away from the real goal of their management – to reduce the burden at a personal, workplace and societal level. This classification system is of value to epidemiologists and to clinicians: it provides an overall view of the location of both symptoms and signs (none, local, regional, diffuse), and permits the clinician to describe a level of certainty (none, possible, probable, definite) around the diagnosis. Viewing the symptoms and signs axes as descriptive of the complexity of the worker's state, and the potential diagnosis axis as important for directing early effective treatment. As in the case of back pain and whiplash associated disorders, it may be that by returning to a simple description of the presentation rather than pursuing very specific diagnoses, a system can be developed that distinguishes patients likely to recover quickly from those who may be slower to recover. The debate over the diagnosis of musculoskeletal disorders may be hampering the ultimate goal – to advance our understanding of work-related pain and reduce its impact on peoples' lives and productivity. *(This is very much a clinical approach to (prognostic) classification and does not involve psychosocial variables; nevertheless, the observed parallels with back pain and whiplash disorders are of interest and call into question the ultimate value of a specific diagnosis for many cases).*
(Bisset et al. 2006)	RCT	Clinical management	Lateral epicondylitis	Mobilisation with movement and exercise, corticosteroid injection, or wait and see for tennis elbow: randomised trial Single-blind Australian randomised comparison of physiotherapy (n= 66), no treatment (n= 67), and corticosteroid injections (n= 65) in total of 198 subjects with clinically diagnosed tennis elbow (of >6 weeks duration, mean = 22 weeks). Outcome measures were global improvement, pain-free grip force, and assessor's rating of severity (at 3, 6,

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				12, 26, & 52 weeks). Results indicated that corticosteroid injection was not superior to either physiotherapy or wait-and-see in the short-term. In the longer-term it was inferior to both. The authors concluded that physiotherapy combining elbow manipulation and exercise has a superior benefit to wait and see in the first six weeks and to corticosteroid injections after six weeks, providing a reasonable alternative to injections in the mid to long term. *(The results of this study lend support to the use of corticosteroid injections within the first six weeks, but do not really support the provision of physiotherapy subsequent to that, since the outcomes were similar to wait-and-see. Furthermore, the cost was higher – requiring 8 sessions versus 1 or 2 for wait-and-see). (See also Smidt et al 2002)*
(Bonde et al. 2003)	Longitudinal	Prognosis	Shoulder tendinitis	Prognosis of shoulder tendonitis in repetitive work: a follow up study in a cohort of Danish industrial and service workers The physical and psychosocial work environment is expected to modify recovery from shoulder disorders, but knowledge is limited. Follow up study of musculoskeletal disorders in industrial and service workers, 113 employees were identified with a history of shoulder pain combined with clinical signs of shoulder tendonitis. Some 50% of workers recovered within 10 months (95% CI 6 to 14 months) - this estimate is most likely biased towards too high a value. Recovery of clinically verified shoulder tendonitis in industry and service workers is in most cases a matter of several months. While higher age substantially slows down the rate of recovery, physical work characteristics seem not to be important modifiers of the course of the disease. Perception of high job demands, low job control, and social support at the workplace are strongly related to slow recovery, but may be a consequence rather than a cause of the disorder. Occupational health management and counselling of patients with clinical shoulder disorders should acknowledge the favourable but often slow course of shoulder tendonitis.
(Burton et al. 2005) RR323	Workforce survey	Psychosocial factors + absence	General MSDs *(mainly back pain)*	Obstacles to recovery from musculoskeletal disorders in industry Results confirmed a general association between perceptions of the psychosocial work environment and self-reports of previous symptoms/disability related to musculoskeletal disorders. Several different aspects of work and the work environment (blue flags) were associated with symptoms and previous workloss. The associations were additive and similar to that of psychological distress (yellow flag). Prospectively, scores beyond statistically determined cut-off points on both blue and yellow flags predicted the likelihood of future absence, but not its duration.
(Calnan et al. 2005)	Postal survey + interviews	Patient evaluation of healthcare services	ULDs	Evaluating health-care: the perspectives of sufferers with upper limb pain A qualitative study using postal survey of 2781 upper limb patients in the UK was augmented by interviews with 47 of these subjects to identify patient evaluation of their healthcare experiences. Lack of precise diagnosis, or conflicting explanations resulted in the majority of patients adopting the explanation that was accompanied by the most

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				successful alleviation of symptoms. Medication was seen as a superficial treatment that fails to address root causes, that will lose effectiveness over time, and that may mask doing further damage. Patients are generally convinced that treatments are only partially effective, but the scepticism is aimed at the treatments and not the healthcare providers. Complementary treatments are not usually a first choice for people with ULDs unless they have prior experience, but when they do see these therapists following informal referral they are usually satisfied with care received. *(The findings from this study indicate the need to provide accurate information to patients about the effectiveness of treatments, the limitations of treatment, and the role for self-management approaches. This may have the potential to limit 'shopping around', and seeking ineffective complementary therapies).*
(Cheng et al. 2002)	Retrospective case series	Outcomes relevant to employer, provider, and employee	Work-related upper extremity disorders	Employer, physical therapist, and employee outcomes in the management of work-related upper extremity disorders Retrospective file review of 221 upper extremity cases treated on-site at a workplace clinic at a large company (n=4000 employees). Diagnoses included tendonitis, sprain/strain, capsulitis, joint restriction, muscle weakness, and compression neuropathy over the shoulder, elbow, and wrist/hand areas. Patients with cervical-related upper extremity disorders, and those whose problem was not considered to be work-related, were excluded. Two experienced therapists reviewed all physiotherapy records. Outcomes were measured from three different perspectives: provider, employer, and patient. Provider outcome was defined as "achieving" or "not-achieving" PT goals and was subjectively determined by the direct care-providing physical therapist at the end of case closure based upon their clinical judgement. Patient outcomes were measured with the SF-36. Employer outcome was categorized as "remaining-on/returning-to regular job" or "job change", based on a comparison of discharge work status with initial work status. 81% of the patients achieved PT goals at discharge. 77% remained-on or returned-to pre-injury jobs at time of case closure. On the SF-36 the bodily pain and physical functioning scores showed significant improvement after PT, but the role limitations due to physical problems did not significantly change. *(Case series is one of a group of descriptive studies that by their very nature do not test the hypothesis of treatment efficacy, and this means results need to be interpreted cautiously. At best, they indicate further research is warranted, ideally with a control group).*
(Cheng & Li-Tsang 2005)	Cross-sectional survey	Return to work	Low back pain and work-related upper limb disorder	A comparison of self-perceived physical and psycho-social worker profiles of people with direct work injury, chronic low back pain, and cumulative trauma Small cross-sectional survey (n=64, of which had 24 LBP, and 40 had work-related upper limb disorder) with the goal being to identify characteristics of injured workers that are associated with work-readiness (measured by self-report questionnaire). Results indicated that self-perceived pain and physical functioning were significant factors influencing the readiness for returning to work.

Table A4. Individual studies of particular relevance				
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(Cheng & Hung 2007)	RCT	Work hardening rehabilitation	Rotator cuff disorder	Randomised controlled trial of workplace-based rehabilitation for work-related rotator cuff disorder The researchers noted that workplace factors are often neglected by healthcare providers when attempting to return people with occupational injuries to work. They ran an RCT using 103 subjects with work-related rotator cuff syndrome, allocated to a work hardening programme in either the clinic or at the workplace. The control group were given traditional generic work hardening training, while experimental group received workplace-based work hardening training with input specific to the pathology and biomechanics of rotator cuff disorder and specific to their job tasks. At four week follow-up there was a significant difference between the groups with 71% of the workplace group back at work versus 37% of the control group. They also observed a significant reduction in complaints of shoulder problems and functional limitations at work. They concluded that it is more effective to deliver RTW intervention in the workplace, since this integrates psychosocial workplace factors related to being off work and absent from work routine. *(This study had a short follow-up period and therefore it is not known whether the RTW outcomes were sustained, or if there were any differences in recurrence or re-injury rates. Despite this, the findings are indicative that delivery of an intervention that addresses psychosocial workplace factors, in addition to biological and biomechanical ones, can be useful and effective at enhancing RTW outcomes following upper limb injury)*.
(Christmansson et al. 1999)	Case series	Ergonomics – organisational redesign	Work-related ULDs	Task design, psycho-social work climate and upper extremity pain disorders – effects of an organisational redesign on manual repetitive assembly jobs Case series analysing effect of job redesign in a manufacturing company on assembly workers (before n= 17; after n =12). This resulted in changes to the overall organisation of the production system, control systems, and work design. Assembly jobs were considered to be more varied, less repetitive, and more autonomous. No major changes were made in product mix, product designs, or workplace layouts and there were thus no major changes in the assembly operations. Medical assessment indicated that 8/17 workers before, and 9/12 after, experienced upper limb pain disorders. The authors concluded that changes in work design did not prevent work-related musculoskeletal disorders. Furthermore, the efficiency of production was not improved. *(Suggests that ergonomics alone is unlikely to prevent work-related ULDs).*
(Coutu et al. 2007)	Prospective	Distress	MSDs	Level of distress among workers undergoing work rehabilitation for musculoskeletal disorders Objective was to examine workers' distress levels before they start work rehabilitation and to compare it to those in a healthy population; and to assess the correlations between distress and biopsychosocial factors. 228 workers on sick leave due to persistent pain from an MSD and who were referred to an interdisciplinary work rehabilitation program. The workers had very high distress levels compared to normative data. Multiple

Table A4. Individual studies of particular relevance				
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				regression showed that duration of absence, high occupational stress, perception of disability, and fear of movement and (re)injury were significantly associated with distress. Distress is not just a predictor of work disability, but an independent outcome measure: this shift of paradigm could provide a more comprehensive approach in the understanding of workers' disability.
(Descatha et al. 2007)	Surveillance	Epidemiology – predictive factors for incidence	Upper-limb work-related musculoskeletal disorders	Predictive factors for incident musculoskeletal disorders in an in-plant surveillance programme Surveillance of workers in a large shoe factory (n=166 followed up): the predictive role of general, personal, and occupational factors was explored for the incidence of upper-limb work-related musculoskeletal disorders over the following year. Incidence rate was 26%: work pace and prior history were the only significant predictors. In multivariable model (where input variables included distress, physical fatigue, repetitiveness, task precision) only prior history remained in the model. The annual incidence rate 3 years later was 23%: a multivariable model retained the prior history along with psychological distress as significant predictors. *(Importantly)*, some generally accepted risk factors such as repetitiveness, work pace, forceful awkward postures, were not associated with incidence. Surveillance programmes need to take account of personal factors including prior history of symptoms. *(This result mirrors the experience with back pain where the strongest predictor of future trouble seems to be previous trouble, leading to the suggestion that upper-limb work-related musculoskeletal disorders also represent a recurrent phenomenon with work factors having a relatively limited predictive role in the generation of symptoms)*.
(Devereux et al. 2002)	Cross-sectional survey	Epidemiology – physical + psychosocial factors at work	Neck and upper limb symptoms	Epidemiological study to investigate potential interaction between physical and psychosocial factors at work that may increase the risk of symptoms of musculoskeletal disorder of the neck and upper limb Cross-sectional postal survey of 869 manual handlers, delivery drivers, technicians, customer services computer operators, and general office staff from 26 randomly selected UK sites (response rate 59%, from 1514). Each worker was classified into one of four mutually exclusive groups (by measuring physical exposure, based on lifting and frequency of specific loads, and variables such as vibration; and, psychosocial exposure, based on mental demands, job control, and social support): (1) low physical & low psychosocial, (2) low physical & high psychosocial (3) high physical & low psychosocial exposure (4) high physical & high psychosocial. Subjects classified as (3) or (4) tended to be younger, and all were male. About one-third of the sample reported experiencing symptoms (musculoskeletal symptoms in the neck, shoulders, elbows, and hands or wrists were defined by aches, pain, or discomfort during the 7 days preceding completion of the questionnaire). Workers with both high physical and high psychosocial exposures were much more likely to report symptoms (OR for neck =1.25, wrist/hand=7.55, upper limb (including shoulders)=3.74). Psychosocial factors were more important when exposure to

Table A4. Individual studies of particular relevance				
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				physical factors were high than when they were low. The authors concluded this suggests an interaction between physical and psychological risk factors that increase the risk of reporting upper limb problems. Furthermore, this suggests that interventions should focus on both types of factors.
(Devereux et al. 2004)	Prospective epidemiological cohort study	Stress and musculoskeletal disorders	Musculoskeletal disorders (including upper extremity subset)	The role of work stress and psychological factors in the development of musculoskeletal disorders: the stress and MSD study Research commissioned by the HSE in the UK, to establish the role of stress and other psychological factors in the development and reporting of MSD's. Initial response rate to survey was 39% (of 8,000) and subsequently 3,139 workers were followed for about 15 months. Subjects were from 20 organisations, across 11 industrial sectors. Results indicated that high perceived job stress was an intermediate factor between high exposure to both physical and psychosocial work risk factors and self-reported low-back, upper back and hands/wrists complaints. The authors concluded that psychosomatic symptoms, depression, and perceived life stress might act independently to increase the likelihood of developing musculoskeletal complaints. Psychosocial risk factors for high perceived job stress were: extrinsic and intrinsic effort, role conflict and verbal abuse or confrontations with clients or the general public were workplace risk factors for high perceived job stress. Individual demographics, traits, attitudes, or wellbeing factors were not implicated in the causation of self-reported musculoskeletal complaints. High exposure to both physical and psychosocial work risk factors resulted in the greatest likelihood of reporting musculoskeletal complaints. *(This study provides good evidence of causal relationships, due to the large sample size and prospective design).*
(de Mos et al. 2007)	Retrospective cohort	Epidemiology – incidence rate	Chronic regional pain syndrome	The incidence of complex regional pain syndrome: a population-based study Chronic regional pain syndrome can occur in an extremity after any type of injury or spontaneously. Large 10-year retrospective cohort study in Dutch primary care records. Incidence rate estimated as 26.2 per 100,000 person years (four times higher than the one previous population estimate): females affected more than males (OR 3.4): females in age category 61-70 most commonly affected: upper extremity > lower extremity, and fracture most common precipitating event.
(Dziedzic et al. 2007)	Cross-sectional survey	Epidemiology – impact/disability	Musculoskeletal hand problems	The impact of musculoskeletal hand problems in older adults: findings from the North Staffordshire Osteoarthritis Project (NorStOP) Survey of 7878 subjects who responded to a baseline questionnaire; participants defined as having hand problems were sent a second questionnaire, which included questions about hand pain and disability. One-year period prevalence of hand problems was 47% and estimated 1-month period prevalence of hand pain was 31%. These figures varied little with age. Severe hand-related disability affected 12% of this sample, was significantly more common in females than males, and increased in prevalence to the oldest age-groups. In summary: musculoskeletal hand problems are common, painful and

Table A4. Individual studies of particular relevance				
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				have a significant influence on many dimensions of health. Women and the very old appear especially vulnerable to the effect of hand problems on their daily activities. Only a minority of the study group were seeking or using healthcare for their hand problems.
(Eltayeb et al. 2007)	Cross-sectional survey	Epidemiology - prevalence	Complaints of arm, neck and shoulder – computer office workers	Prevalence of complaints of arm, neck and shoulder among computer office workers and psychometric evaluation of a risk factor questionnaire Survey of complaints of arm, neck and shoulder (CANS) among computer office workers (n= 264). The one-year prevalence rate of CANS indicated that 54% of the respondents reported at least one complaint in the arm, neck and/or shoulder. The highest prevalence rates were found for neck and shoulder symptoms (33% and 31% respectively), followed by hand and upper arm complaints (11% to 12%) and elbow, lower arm and wrist complaints (6% to 7%) - "right side" complaints were more frequently reported than "left side" complaints or "both sides" complaints (except for shoulder where "both sides" which were more frequently reported than single sided. Females reported higher prevalence rates for the various upper extremity regions.
(European Agency for Safety and Health at Work 2000)	Survey of European states	Epidemiology – prevalence	RSI	Repetitive strain injuries in the member states of the European Union: the results of an information request Among the Member States of the European Union, various terms are used to describe upper limb musculoskeletal disorders that refer to complaints ranging from the neck to the fingers. Few governments have a definition for the term RSI, although the media frequently use the term. The prevalence of RSI-related complaints varies substantially among Member States; of the four Member States that replied solely or mainly regarding RSI related to VDU work, only France specified that there are apparently no significant problems related to VDU work. However, in The Netherlands there is some public concern about the proportion of RSI-related complaints among VDU users (which, it is said, could affect 56% of the workers in some sectors), and Denmark reported that there was now sufficient proof of a relationship between VDU work and RSI-related complaints. Some Member States reported that these disorders were more common in blue-collar workers than in white-collar workers, and that females are affected more than males. Six of fifteen Member States (including the UK) reported that legal proceedings against employers occur in order to claim compensation for RSI-related health damage.
(Feuerstein et al. 2000b)	Uncontrolled outcome study	Multicomponent intervention	Work-related upper extremity disorders	Multicomponent intervention for work-related upper extremity disorders Reports on an uncontrolled group outcome study of the effects of a multicomponent intervention for both asymptomatic sign language interpreters (n=53). Outcomes: number of cases reported to human resources, workers' compensation indemnity, and medical costs assessed annually for 3 years following the intervention and compared with pre-intervention levels. Multicomponent intervention (eleven 1.5 hour group sessions) focused on education of workers, and supervisors as well as reducing biomechanical exposures. Results indicated a 69% reduction in the number of cases reporting upper

Table A4. Individual studies of particular relevance				
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				extremity problems in the 3 years following the intervention. Indemnity costs were reduced by 64% and were maintained over the next 2 years. Health care costs had smaller change. A partial rebound in all outcome measures observed in Year 3. But, in the previous year there was an initial consultation to inform the intervention and modify workloads: the authors acknowledge the benefits may reflect the initial consultation rather than the formal intervention. *(This study is best considered as an initial investigation of simultaneously educating the players, but the authors' interpretation seems over-optimistic - meaningful conclusions are compromised by weak methodology).*
(Feuerstein et al. 2000a)	Prospective	Outcome predictors	Work-related upper extremity disorder	Development of a screen for predicting clinical outcomes in patients with work-related upper extremity disorders Prospective study of 70 upper extremity disorder subjects (n=61 at 12-month follow-up) to investigate ability of a variety of variables to predict clinical outcomes. These included demographic, occupational, medical, symptom, physical, ergonomic, occupational psychosocial, work demands, social support, employer practices, and individual psychosocial variables. Clinical outcome was measured with a composite index of median scores split into "good" or "poor" that included symptom severity, function, days off work, and mental health. The various outcome variables were only moderately correlated. They were combined in linear fashion, using simple summation. Predictors of outcome were derived from a logistic regression model: at 1-month (correct classification rate 74%) by upper extremity comorbidity, pain severity within past week, ergonomic risk exposure, job support, and catastrophising; at 3-months (classification 81%) by symptom severity scale, job stress, and catastrophising; at 12-months (classification 82%) by number of prior treatments or providers, recommended for surgery, and catastrophising. The authors concluded it is possible to predict clinical outcomes from various combinations of self-reported medical history, symptom severity, ergonomic exposures at work, job stress, level of job support, and pain coping style. *(Unfortunately no analysis was performed to identify predictors of specific outcomes, such as return to work, level of disability, symptom severity)*
(Feuerstein et al. 2003b)	Cross-sectional survey	Modified work	Work-related ULDs	Clinical and workplace factors associated with a return to modified duty in work-related upper extremity disorders Cross-sectional postal survey 165 US federal government employees (response rate 29%, from 573: 127 females, 38 males) who were unable to resume their normal work after filing a workers compensation claim for a work-related upper extremity disorders (with ICD-9 diagnosis). Measures included pain and symptoms; upper limb functional limitations; self-reported ergonomic exposure; general health; problem solving; physical exertion at work; work style; and treatment helpfulness rating. Subjects not working, compared to those on modified duties, were more likely to report a diagnosis of mononeuropathy; higher pain; greater functional limitations; and, higher level of ergonomic stressors (OR=3.16, 1.43, 1.63, 1.62 respectively). The authors concluded

Table A4. Individual studies of particular relevance				
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				these results support an independent association of upper extremity pain, functional limitation, and workplace ergonomic exposure with the ability of employees to return to modified duties at work. They suggested rates of returning to modified duties may be enhanced by assessing perceived functional limitations and ergonomic exposures in addition to type and severity of symptoms. *(See also Shaw & Feuerstein 2004)*
(Feuerstein et al. 2003a)	RCT	Integrated case management	Work-related upper extremity disorders	Integrated case management for work-related upper-extremity disorders: Impact of patient satisfaction on health and work status Randomised trial comparing "usual care" (which involved nurse case managers focusing on medical management and workplace accommodation) with "integrated case management" (ICM), where the nurse case managers had been trained in the integration of ergonomic and psychosocial assessment and intervention into work-related upper extremity disorder care and recovery). ICM resulted in significantly higher levels of patient satisfaction. Direct comparisons of other outcomes were not made between the two groups. Instead, the authors conducted multiple linear regression analyses to identify baseline predictors of specific outcomes, and this included group membership. Upper extremity symptom severity was predicted by patient satisfaction at 6-months but not at 12-months; by ergonomic exposures at 12-months; and, by general distress at both 6- and 12-months. Upper extremity functional limitation was predicted by female gender at both 6- and 12-months; by general distress at both 6- and 12-months; by patient satisfaction only at 6-months; and, by treatment group only at 12-months. Longer duration for successful RTW was predicted by older age, upper extremity functional limitations, and lower patient satisfaction. The authors concluded that ICM is associated with improved clinical and work outcomes among those with persistent work-related upper extremity disorders and work loss. They suggest that it provides a pragmatic context to individually consider and address those unique ergonomic and psychosocial factors within the work environment. *(The lack of direct statistical comparisons between outcomes by treatment group undermines the strength of these otherwise intriguing conclusions)*
(Feuerstein et al. 2005)	Cross-sectional survey	Questionnaire to measure workstyle	Upper extremity pain	Workstyle: development of a measure of response to work in those with upper extremity pain Questionnaire development to measure workstyle (defined as the behavioural, cognitive, and physiological responses to increases in work demands) administered to 282 symptomatic and asymptomatic office workers, to determine psychometric properties. 136 items divided into two sets of items for the final workstyle measure: a set of characteristic responses to work and a set of emotional/physiological responses to increased work demands (dichotomous responses). Results of factor analysis yielded subscales theoretically consistent with the construct under study, including: working through pain, social reactivity at work, limited workplace support, deadlines/pressure, self imposed work pace/workload, breaks, mood, pain/tension, autonomic response, and numbness tingling.

Table A4. Individual studies of particular relevance				
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				Furthermore, results indicated acceptable psychometric properties (internal consistency, test-retest reliability, and construct & discriminant validity). *(Supports biopsychosocial influences on the experience of work-related upper extremity pain)*.
(Gimeno et al. 2005)	Prospective survey	Return to work after surgery	Carpal tunnel	The role of job strain on return to work after carpal tunnel surgery The goal of this study was to examine the impact of job strain (defined as high psychological job demands and low job control, measured by questionnaires including subset of Job Content Questionnaire) on RTW and work role functioning (measured with 26-item questionnaire) following carpal tunnel release surgery (measured at 2 months (n=128) and 6 months (n=122)). Logistic regression results indicated that early RTW (at 2-months) was less likely for those with high demands and high control (active work), and medium-term RTW (at 6-months) was less likely for those with having a job with higher demands than job control (high strain). The authors concluded these findings emphasise the potential role for psychosocial work conditions to influence the RTW process, and that this is consistent with the demand-control model.
(Greening et al. 2003)	Exploratory case-control study	Assessment/ diagnosis technique, without independent reference standard	Non-specific arm pain	Sensory and autonomic function in the hands of patients with non-specific arm pain (NSAP) and asymptomatic office workers This study addressed the hypothesis that NSAP has a neuropathic cause, using three groups of subjects matched for age and gender: patients with NSAP (n=47), office workers using VDU >40% of time but without NSAP (n=40), and an asymptomatic control group of office workers using VDU <40% of their time (n=44). Measures included: flare responses to iontophoresis of histamine (a sensory C-fiber effect) in the median innervated area of the hand; sympathetic vasoconstrictor responses to ice stimulation over C7; and, vibration threshold over areas of the hand innervated by the median, ulnar and radial nerves was evaluated using a 100 Hz vibrameter. Significant differences from controls were found on all three measures for the NSAP patient group and on two measures for the office workers. Flare area was reduced by 33% in the patients and by 30% in the office workers. Reflex vasoconstriction was reduced by 20% in the patient group but was not altered in office worker group. Over the median innervated area on the hand, vibration threshold was elevated by 47% in the patients and by 21% in the office workers. These results indicate reduced function associated with both small and large sensory fibers, and functional change in sympathetic fibers, in the NSAP patients. The office workers using VDU >40% of the time demonstrated a similar but smaller trend for reduced nerve function associated with both small and large sensory fiber function, but had no change in the sympathetic reflex. The authors suggested these findings were consistent with NSAP patients having a minor neuropathy. *(This small exploratory study has provided interesting findings. However, it is unclear whether the observed differences may be contributing causes of the chronic pain problem, effects from it, or a mixture of both. Furthermore, the homogeneity of NSAP patients recruited from physiotherapy, rheumatology and orthopaedic clinics is not clear. Should these findings be replicated, and*

Table A4. Individual studies of particular relevance				
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				indeed turns out to have a neuropathic component, the key question will be to determine how relevant this factor might be compared to other factors that contribute to this multifactorial problem)
(Greening et al. 2005)	Exploratory case-control study	Assessment/ diagnosis technique, without independent reference standard	Whiplash and non-specific arm pain	In vivo study of nerve movement and mechanosensitivity of the median nerve in whiplash and non-specific arm pain patients This study addressed the hypothesis that patients with whiplash or NSAP can be differentiated on the basis of nerve movement and nerve trunk mechanosensitivity. 9 whiplash patients were compared with 8 controls, and 8 NSAP patients with 7 controls. Measures included: ULTT1 (consisting of 90^0 shoulder abduction, and elbow and wrist extension; has been shown to tension the median nerve and brachial plexus); mechanical allodynia over the carpal tunnel; mechanical allodynia just proximal to the carpal tunnel; mechanical allodynia at cords brachial plexus in the supra clavicular fossa; and, TOS (Roo's Test). Longitudinal nerve movement in the forearm was reduced by 71% in the post-whiplash patients, and by 68% in NSAP patients compared to controls. In the whiplash patients the pattern of transverse median nerve movement at the proximal carpal tunnel was significantly different to controls (patient mean=2.57+/-0.80 mm (SEM) in a radial direction; control mean=0.39+/-0.52 mm in an ulnar direction). Signs of neural mechanosensitivity (i.e. painful responses to median nerve trunk and brachial plexus pressure and stretch) were apparent in both patients groups. The authors concluded that these observed changes are contributors to symptoms of whiplash and NSAP. *(This very small exploratory study does not provide information about the reliability of any measures. It is unclear whether the observed differences may be contributing causes to chronic pain problems, effects from it, or a mixture of both)*
(Gummesson et al. 2003)	Cross-sectional survey	Epidemiology – population prevalence	Chronic upper extremity pain	Chronic upper extremity pain and co-occurring symptoms in a general population A postal survey with an 83& response rate was used to identify the prevalence of chronic upper extremity pain in a Swedish general population sample. It contained items concerning general health, bodily pain, and physical function, as well as questions involving the upper extremities and about the presence, location, duration, frequency, and severity of the symptoms of pain, numbness, and tingling. There were also questions regarding morbidity, sociodemographic data, smoking habits, and physical exercise. Chronic upper extremity pain associated with physical impairment was reported by 21% (of these, 68% were female). The shoulder and upper arm was the most common painful area. 11% reported chronic numbness or tingling. Of those with chronic upper extremity pain associated with physical impairment, 7% reported coexisting chronic numbness or tingling. Chronic pain in multiple areas (neck, low back, or lower extremity) was reported by 81% of those with chronic upper extremity pain associated with physical impairment. Subjects reporting physical impairment-associated upper extremity pain, or pain with coexistent numbness or tingling, were significantly more likely to be blue-collar or manual

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				workers, long-term work absentees, overweight (only among women), and current or former smokers (except for women with numbness or tingling). The authors concluded that chronic upper extremity pain associated with physical impairment, with or without numbness and tingling, is common in the general population. Furthermore, multiple chronic pain sites were also frequent.
(Haahr & Andersen 2003)	RCT	Prognostic factors	Lateral epicondylitis	Prognostic factors in lateral epicondylitis: a randomized trial with one-year follow-up in 266 new cases treated with minimal occupational intervention or the usual approach in general practice Danish RCT to compare a brief occupational intervention with standard GP care in new cases (n=266, age 18-66) of lateral epicondylitis. The intervention group received a clinical examination and were then given information: the main message was that lateral epicondylitis is usually a self-limiting condition with a favourable prognosis, and variable pain intensity. Patients were also informed that no specific treatment seems to improve the overall long-term prognosis. Advice was given against complete rest and the patients were encouraged to stay active, but with advice to avoid activities found to exaggerate the pain. In cases with a history of strenuous job tasks, the patient was encouraged to adjust work conditions if possible. The patients were then seen by an ergonomist, who gave instructions in performing a graded exercise programme, which was to be used as long as symptoms persisted. Pain reduction was similar in both groups at 1-year follow-up. The intervention group used less treatment and fewer treatment modalities, but there was no reduction in the number of GP and physiotherapist visits. Poor overall improvement was associated with employment in manual jobs (OR=3.0), high level of physical strain at work (OR=8.5), high level of pain at baseline (OR=2.3). Pain reduction less than 50% was associated with manual jobs (OR=2.3), high physical strain at work (OR=3.6), high baseline distress (OR=1.9) and symptoms on dominant side (OR=3.1): no relation was found between the type of medical treatment given/chosen and prognosis. This may have implications for the future management of lateral epicondylitis in terms of a greater focus on interaction with the workplace regarding job modification to reduce physical demands during recovery. *(See also Bissett et al 2006; Smidt et al 2002).*
(Harman & Ruyak 2005)	Case-control (laboratory)	Task performance	Persistent pain (80% shoulder-neck)	Working through the pain: a controlled study of the impact of persistent pain on performing a computer task A large percentage of employees experience persistent pain while at work. Controlled study examining the impact of persistent pain on performance in a working population 40 participants (20 pain, 20 controls: 80% cases were working) undertook a computer-based series of tests. People with persistent low-level pain demonstrate a reduction in performance compared with controls (presenteeism). *(Mirrors other studies showing high levels of MSD pain among people in work. Whilst the pain may affect aspects of work performance, that does not equate to detrimental effects on the workers)*.

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(Harrington et al. 1998)	Delphi consensus	Case definition	ULDs	Surveillance case definitions for work related upper limb pain syndromes To establish consensus case definitions for several common work related upper limb pain syndromes for use in surveillance or studies of the aetiology of these conditions. Questionnaire sent to multidisciplinary group of health professionals plus a consensus conference. Consensus case definitions were agreed for carpal tunnel syndrome, tenosynovitis of the wrist, de Quervain's disease of the wrist, epicondylitis, shoulder capsulitis (frozen shoulder), and shoulder tendonitis. The consensus group also identified a condition defined as "non-specific diffuse forearm pain" although this is essentially a diagnosis made by exclusion. The group did not have enough experience of the thoracic outlet syndrome to make recommendations. The criteria may also be useful in surveillance programmes and as aids to case management.
(Henderson et al. 2005)	Cross sectional patient survey	Biopsychosocial modelling	Chronic work-related diffuse upper limb pain or CTS	Chronic upper limb pain: an exploration of the biopsychosocial model Questionnaires for pain, disability, and personality; psychiatric morbidity assessed by interview. Illness behaviour measured by assessing coping strategies, illness beliefs, financial benefits, movements of affected limb. In both pain conditions, disability was positively correlated with present pain intensity, depression, helpless coping style, and receipt of state financial benefits; and was negatively correlated with age. Final model explained 15% of the variance and correctly classified 75% of all patients. Inclusion of diagnostic group has no effect on these models. The correlations between disability and pain intensity with both psychosocial and physical factors support the biopsychosocial model of disability (and pain to lesser extent) irrespective of the diagnosis.
(Hill et al. 2007)	Cross-sectional survey	Illness perceptions	Musculoskeletal hand problems	The illness perceptions associated with health and behavioural outcomes in people with musculoskeletal hand problems: findings from the North Staffordshire Osteoarthritis Project (NorStOP) Two-stage cross-sectional postal survey: individuals aged 50 yrs and over, registered with general practices in North Staffordshire. Stage 1, a Health Survey questionnaire, sent to 11 230 individuals and enquired about general health status, including anxiety and depression. Individuals reporting hand problems at Stage 1 were sent Stage 2, a detailed hand questionnaire. The results suggest that older people who consider their musculoskeletal hand problem to have negative effects on their life will be more likely to encounter difficulties that may lead them to consult, take medication or both. There was little difference between individuals who did and those who did not report their hand problem to be osteoarthritis with respect to perceptions or between perceptions associated with health and behaviour. Understanding these illness perceptions may identify opportunities for intervention.
(Huang & Feuerstein 2004)	Cross-sectional	Work disability	Low back and/or upper extremity	Identifying work organisation targets for a work-related musculoskeletal symptom prevention programme Questionnaire study of 248 US Marines (87% male, average age 27.9 years), selected

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			symptoms	from jobs (primarily office-based) considered to have higher rates of musculoskeletal conditions. Data collected included age, gender, marital status, education level, rank, length of service, military occupational specialty, and length of time in speciality. Additionally, biomechanical exposures/ergonomic factors, characteristics of work organization, individual psychosocial stressors, musculoskeletal symptoms, and general health were assessed. Logistic regression models derived for back pain only (20%), upper extremity only (21%), back pain plus upper extremity (29%), and asymptomatic (30%) groups. Those with concurrent low back and upper extremity symptoms were significantly older than asymptomatic individuals. Time pressure and ergonomic stressors (measured by the Job Requirements and Physical Demands Survey) were significantly associated with all symptomatic groups. Cognitive processing was associated with combined back and upper extremity pain. Interpersonal demands were associated with a lower risk of back pain only. Compared to asymptomatic individuals, all three symptomatic groups had significantly greater pain intensity and lower levels of physical function. However, the symptomatic groups did not differ from the asymptomatic group on a global measure of mental health suggesting that differential levels of distress cannot account for the observed findings regarding the risks of work organization on the symptoms. The authors concluded their findings suggest secondary prevention programmes should incorporate methods that target ergonomic factors and work organization that contribute to increased time pressure and cognitive stress.
(Hughes et al. 2007)	Experimental study	Risk factors whilst typing	ULDs	Effects of psychosocial and individual factors on physiological risk factors for upper extremity musculoskeletal disorders while typing Experimental 3x3 factorial study to test the effects of three levels of mental workload and three levels of time pressure on several physiological, performance and psychological variables. 18 typists completed nine experimental trials representing each combination of mental workload (imposed by using verbal arithmetic tasks) and time pressure (imposed by typing speed constraints). Authors concluded that the specific psychosocial and individual factors under investigation mediate physical factors during typing: while it is difficult to address some psychosocial factors in the workplace, allowing employees to arrange the order of activities can relive mental workload, and avoiding machine-paced work can relieve time pressure.
(Huisstede et al. 2007)	Delphi consensus	Classification	Complaints of the arm, neck and/or shoulder	Multidisciplinary consensus on the terminology and classification of complaints of the arm, neck and/or shoulder 47 experts in the field of upper-extremity musculoskeletal disorders were delegated by 11 medical and paramedical professional associations to form the expert panel. The experts reported the consensus in a model. This so-called CANS model describes the term, definition and classification of complaints of arm, neck and/or shoulder (CANS) and helps professionals to classify patients unambiguously. CANS is defined as ''musculoskeletal complaints of arm, neck and/or shoulder not caused by acute trauma or by any systemic

Table A4. Individual studies of particular relevance				
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				disease''. The experts classified 23 disorders as specific CANS, because they were judged as diagnosable disorders. All other complaints were called non-specific CANS. In addition, the experts defined ''alert symptoms'' on the top of the model. The expert panel decided to use ''complaints'' instead of ''complaints of pain'' because pain and also other sensations, such as tingling, can be involved. The factor ''work-relatedness'' is not mentioned in the CANS model, and is not a decision-making factor for including or excluding patients in the CANS model. The model does more justice to reality, as activities at work as well as activities in daily living, such as housekeeping, sports, hobbies and stress at home, can influence the complaints. The group did not develop consensus on the diagnostic criteria for these disorders because the aim of the project was to agree on an ''unambiguous language''. *(Conceptually the model seeks to reflect the high prevalence, subjective nature, and multifactorial origin of upper limb complaints. Applying the classification will requires the skills of health professionals. The 'alert symptoms' are not actually 'red flag' symptoms, but simply a reminder that upper limb symptoms can be due to organic pathology).*
(Ijzelenberg et al. 2004)	Cross-sectional	Risk factors	MSDs and sickness absence	Different risk factors for musculoskeletal complaints and musculoskeletal sickness absence Questionnaire survey with 87% response rate of laundry and dry-cleaning workers (n=373, 66% female). The 12-month prevalence of musculoskeletal complaints and related sickness absence were 50% for LBP, wth 14% taking sickness absence; 58% for upper extremity complaints (neck 31%, shoulder 45%, elbow/wrist/hand 24%), with 14% taking sickness absence. Logistic regression was used to identify factors associated musculoskeletal complaints, and taking sickness absence as separate dependent variables. The presence of upper extremity musculoskeletal complaints was associated with female gender, strenuous arm movements, and low job satisfaction, but the opposite for non-immigrants, and those actively involved in a sport. Sickness absence was associated with gender, being an immigrant, and strenuous arm movements. There were some differences for LBP. The authors concluded that work-related physical and psychosocial factors appear to determine the occurrence of musculoskeletal symptoms, whereas individual factors seem to determine whether these persons will take sick leave.
(Ijzelenberg & Burdorf 2005)	Longitudinal questionnaire survey	Risk factors: symptoms and healthcare	General MSDs (including low back pain)	Risk factors for musculoskeletal symptoms and ensuing health care use and sick leave Longitudinal questionnaire survey of industrial workers (590 eligible subjects, 505 (86%) responded, 407 available at 6-month follow-up (81%)). Variables included demographic and work-related factors, musculoskeletal symptoms, healthcare use, and sick leave. The one-year prevalence of neck/upper extremity symptoms was 56%, with a 62% recurrence rate during the 6-month study period. The proportion reporting chronic neck/upper limb symptoms was 10.8% at baseline and 13.8% at follow-up. At baseline 22.9% reported elbow, wrist or hand pain and this reduced to 19.9% at follow-up. According to the

Table A4. Individual studies of particular relevance				
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				multivariate analysis, risk for neck/upper limb symptoms was high job strain; for use of healthcare it was being female and high job strain; for sick leave it was being female, living alone, and high job strain. The results were slightly different for low back pain (risk of symptoms was due to high-perceived physical load, high job strain, and reduced social support from the supervisor; healthcare use was due to high-perceived physical workload and reduced social support from the supervisor; and, sick leave was due to older age and high job strain). The authors concluded that prevention strategies aimed at preventing onset of symptoms and reducing sick leave may need to target different sets of risk factors for different types of musculoskeletal problems.
(Kendall & Thompson 1998)	Narrative review and quasi-experimental comparative study	Multimodal RTW programme	Chronic musculoskeletal pain	A pilot program for dealing with the comorbidity of chronic pain and long-term unemployment Provides a narrative review of the role of cognitive-behavioural programmes for chronic musculoskeletal pain in the RTW process, and concludes there have been mixed results reported in the literature. At least part of the reason for this is methodological, with inconsistent methods for describing and measuring RTW outcomes. Furthermore, most studies fail to report whether patients have jobs open to return to. The authors describe four possible employment outcomes for chronic pain patients (SJSE-Same Job, Same Employer; DJSE-Different Job, Same Employer; SJDE-Same Job, Different Employer; and, DJDE-Different Job, Different Employer) and note that the majority of long-term chronic pain patients do not have jobs open for them, therefore the relevant RTW outcome involves either SJDE or DJDE. They hypothesise that for these cases the availability of a job may be an important determinant in the RTW process, but that this is more dependent on features such as job-seeking skills and labour market conditions than on health status. That is, many chronic pain patients experience the problems of long-term unemployment in addition to their pain problem. They describe the development of a conceptual approach for managing work-disability and chronic pain as comorbid problems. This involves simultaneously addressing problems such as identifying transferable skills, CV preparation, applying for a job and attending an interview, etc. along with developing pain management skills and coping strategies. They describe a waiting-list controlled study that found significantly improved RTW rates following delivery of this intervention.
(Macfarlane et al. 2000)	Prospective cohort study	Mechanical and psychosocial factors	Forearm pain	Role of mechanical and psychosocial factors in the onset of forearm pain: prospective population based study This study aimed to determine the relative contribution of (a) psychological factors, features of somatisation, and health anxiety and behaviour, (b) work related mechanical factors, and (c) work related psychosocial factors in the onset of forearm pain. 1,953 subjects aged 18 to 65 were selected from a much larger pool in another related study, who had been randomly selected from GP registers in Altrincham, Greater Manchester. The method was a 2-year prospective population-based cohort study, with retrospective assessment of workplace exposures. Baseline data was collected for 1.715 subjects by

Table A4. Individual studies of particular relevance				
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				questionnaire. At 2-year follow-up 1,398 subjects were available and complete data was collected for 1,260. Of these, 105 reported forearm pain of new onset lasting at least one day in the past month. Among these, 67% also reported shoulder pain, 65% back pain, and 45% chronic widespread pain. Increased risks of onset were associated with high levels of psychological distress (relative risk, RR 2.4), reporting at least two other somatic symptoms (RR 1.7), and high scores on the illness behaviour subscale of the illness attitude scales. The two work-related mechanical exposures associated with the highest risk of forearm pain in the future were repetitive movements of the arm (RR 4.1) or wrists (RR 3.4), whereas the strongest work-related psychosocial risk was dissatisfaction with support from colleagues or supervisors (RR 4.7). The authors concluded that psychological distress, aspects of illness behaviour, and other somatic symptoms are important predictors of onset of forearm pain in addition to work-related psychosocial and mechanical factors. They further argued that terminology such as "cumulative trauma disorder" or "repetitive strain injury" (which imply a single uniform aetiology) are misleading and should be avoided.
(Marhold et al. 2001)	RCT	CBT programme for RTW	Musculoskeletal pain	A cognitive-behavioral return-to-work program: effects on pain patients with a history of long-term versus short-term sick leave RCT with 72 female subjects aged 25 to 60 with a diagnosis of musculoskeletal pain, an open job, but on sick leave due to the pain problem. Half the subjects (n=36) were on long-term sick leave (>12 months) at the start of the program and the other (n=36) had a history of short-term sick leave (2-6 months). These groups were randomised to receive the experimental intervention, or the control condition (treatment-as-usual, in practice receiving treatment from doctors, physiotherapists, and nurses). This meant there were four groups with 18 subjects each. The treatment groups were admitted to a 12-session outpatient cognitive-behavioural return-to-work programme. This was conducted by a psychologist, and contained coping strategies such as applied relaxation, stress management, graded activity training and pacing; how to manage difficulties in their return-to-work process; and, how to generalise coping strategies to different risk factors at their workplaces. The CBT programme was more effective at reducing the number of days sick leave over the following 6-months, compared to the control groups. However, it was most effective for those with a shorter history of sick leave. The treatment programme also helped the patients on short-term sick leave to increase their ability to control and decrease pain and to increase their general activity level (measured by self-report questionnaires) compared to the control condition. These results emphasise the need for return-to-work strategies to delivered early to prevent long-term sick leave and disability. *(This is a good quality RCT that used a sample with musculoskeletal pain problems at a mixture of bodily sites. They were all soft-tissue in nature, but the focus was not exclusively on upper-limb pain. Given the likelihood that many persistent upper limb pain problems result from similar processes, no matter what the site, this approach may yield promise in general).*

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(Meijer et al. 2006)	RCT	Multidisciplinary treatment	ULDs	Cost-effectiveness of multidisciplinary treatment in sick-listed patients with upper extremity musculoskeletal disorders: a randomized, controlled trial with one-year follow-up Small trial (n=38) comparing multidisciplinary treatment with usual occupational health care. The intervention consisted of psychological and physical sessions provided by a medical specialist, a psychologist, a physiotherapist and an occupational therapist – it aimed at reconditioning, ''demedicalising'', unrestrained moving, and return-to-work. Multidisciplinary treatment affects individuals positively – improved physical disability, severity of complaint, kinesiophobia, and physical functioning. No significant difference in (cost-) effectiveness on the societal level (RTW) as compared to usual care.
(McBeth et al. 2003)	Prospective survey	Epidemiology – risk factors	Chronic widespread pain	The role of workplace low-level mechanical trauma, posture and environment in the onset of chronic widespread pain Population-based 3-year prospective survey of 1658 symptom-free working-age adults. Baseline data: work-related mechanical and environmental factors and individual psychosocial factors. In multivariate analysis, pushing/pulling heavy weights, repetitive wrist movements, kneeling, and other pain at baseline were somewhat associated with new-onset chronic widespread pain. However,the strongest predictor was a high score on the illness behaviour scale. There is only limited support for low-level mechanical injury being a risk factor for chronic widespread pain, the onset of which is multifactorial and strongly associated with individual psychosocial factors. *(Although there may be similarities, chronic widespread pain and regional pain are different entities).*
(McCluskey et al. 2006)	Controlled trial	Biopsychosocial workplace intervention	General MSDs *(mainly back pain)*	The implementation of occupational health guidelines principles for reducing sickness absence due to musculoskeletal disorders Occupational health nurses trained to implement a workplace intervention for MSDs that used biopsychosocial principles for overcoming obstacles to recovery and facilitating return to work (no specific healthcare component) – programme aimed to get all players onside. If delivered early, the programme improved return to work time for presenting spell, and also reduced further absence over ensuing 12 months. *(This was a pragmatic trial of an intervention package – not possible to disentangle the psychosocial components from the early delivery)*.
(Mikkelsen et al. 2007)	Observational study	Computer and mouse use		Validity of questionnaire self-reports on computer, mouse and keyboard usage during a 4 week period Self-reports on computer, mouse and keyboard usage times were positively associated with objectively measured activity, but the validity was low. Self-reports explained only between a quarter and a third of the variance of objectively measured activity, and was even lower for one measure (keyboard time). Self-reports overestimated usage times. Overestimation was large at low levels and declined with increasing levels of objectively measured activity. Mouse usage time proportion was an exception with a near 1:1

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				relationship. Variability in objectively measured activity, arm pain, gender, and age influenced self-reports in a systematic way, but the effects were modest and sometimes in different directions. Studies using self-reports to establish relations between computer work times and musculoskeletal pain could be biased and lead to falsely increased or decreased risk estimates.
(Morse et al. 1998)	Randomised population-based telephone survey	Economic and social costs	Work-related MSDs (upper extremity symptoms)	The economic and social consequences of work-related musculoskeletal disorders: the Connecticut upper-extremity surveillance project (CUSP) A population-based telephone survey was conducted in Connecticut to determine the social and economic impact of work-related musculoskeletal disorders (pain or discomfort was identifier of 'case'). Respondents had spent an average of $489 annually out-of-pocket. Only 21% of individuals who had had medical visits or procedures reported having them paid for by workers' compensation. The WRMSD cases reported much higher levels of difficulty in daily tasks rated by the activities of daily living scale, with odds ratios ranging from 8.2 (child care) to 35.2 (bathing). The cases were significantly more likely to have moved for financial reasons (OR = 2.41), including having lost a home (OR = 3.44). The cases were also significantly more likely to have lost a car due to finances (OR = 2.45), more likely to have been divorced (OR = 1.91), and less likely to have been promoted (OR = 0.45). The study supports significant externalization of costs for WRMSD out of the workers' compensation system and a substantial social and economic impact on workers. The overall results of the survey are contrary to the position that WRMDS are over-reported. *(Irrespective of purported cause and this being a US study, these social consequences might be avoidable with appropriate management of ULDs)*. *(Same sample as Warren et al 2000).*
(Munir et al. 2007)	Cross-sectional survey	Distress	Common health problems (incl. musculoskeletal pain)	Work factors related to psychological and health-related distress among employees with chronic illnesses Examined specific psychosocial factors associated with distress amongst a sample of 1029 employees managing either musculoskeletal pain (n=324), arthritis and rheumatism (n=192), asthma (n=174), depression and anxiety (n=152), heart disease (n=96) or diabetes (n=91). Low psychological well-being and high distress were associated with an increase in work limitations, poorer management of illness symptoms at work, high presentieesm, and low workplace support. To enable individuals to effectively manage both their illness and their work without serious repercussions, it is important for both healthcare professionals and employers alike, to improve the well-being of workers with chronic illness by supporting and facilitating their efforts to over-come health-related limitations at work. *(Although not focused on ULDs, this study has a general message regarding common health problems and work – accepting that work is desirable, workers need some help from the other players).*

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(Papanicolaou et al. 2001)	Cross-sectional survey	Epidemiology - prevalence of nerve compression symptoms	Carpal tunnel syndrome	The prevalence and characteristics of nerve compression symptoms in the general population The goal of this study was to evaluate the prevalence and intensity of nerve compression symptoms, and hence to estimate the prevalence of carpal tunnel syndrome (CTS) in the general population. It was conducted in response to the observed rise in the US in the incidence of disorders associated with repetitive trauma, of which the major portion is CTS. Complete data was collected by postal survey on 390 individuals, from a total pool of 1559. Telephone interview data were collected from 110 randomly selected non-responders, to allow for correction to the data collected from the responders. Three main measures were used: the Katz Hand Diagramme; the SF-36 general health questionnaire; and, the Carpal Tunnel Instrument. After correcting for non-responders the lowest estimate for prevalence of CTS in the US population was 3.7%.
(Porter-Moffitt et al. 2006)	Cross-sectional	Biopsychosocial profiles	MSDs including ULDs	Biopsychosocial profiles of different pain diagnostic groups Biopsychosocial profiles were examined for 7 different pain diagnostic syndromes (fibromyalgia, upper extremity pain, cervical pain, thoracic pain, lumbar pain, lower extremity pain, and headache). 661 patients (50% low back pain). In general, the lumbar, fibromyalgia, and lower extremity groups reported more physical/functional limitations, and the fibromyalgia and headache groups reported more psychosocial difficulties. Individuals with upper extremity disorders (n=32) were more likely to be involved in pending litigation, which could be due to the type of work that patients are involved in that would require upper extremity use. The upper extremity group had significantly more health care visits during the past 6 months; this could be due to the fact that upper extremity disorders can limit one's ability to perform daily tasks and activities, which could lead individuals to visit their physicians in search of relief or assistance. Also, this group scored high on measures of depression, and their high depression levels could also cause them to seek outside help and feel unsure that they could handle their pain alone. *(These data place ULDs firmly in the biopsychosocial arena).*
(Ratzon et al. 2006)	Longitudinal	RTW + surgeon recommendations	Carpal tunnel surgery	Time to return to work and surgeons' recommendations after carpal tunnel release Fifty consecutive employed patients undergoing carpal tunnel surgery were tested pre-operatively, and then post-operatively using both questionnaires and objective testing. Time to return to work was extremely variable ranging from 1 to 88 days. Post-operative recommendations by the surgeon varied widely from 1 to 36 days. Surgeons' recommendations were the strongest predictors of delayed return to work, with physical work and lack of self-rated health adding significantly to the predictive model. Patient symptoms and objective findings of disability did not add significantly to a logistic regression model either predicting return to work or the surgeon's recommendations. Physical leisure activity more common in those who returned early. Belief that early return will damage health more common in late returners. Authors suggest much sick leave

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				unnecessary, and conclude that workers will return to work in less than 3 weeks if recommended by the surgeon - regaining full preoperative function is not a prerequisite.
(Roquelaure et al. 2006) + (Melchior et al. 2006)	Random sample cross-sectional surveillance	Epidemiology - Physical work factors	ULDs	Why are manual workers at high risk of upper limb disorders? The role of physical work factors in a random sample of workers in France (the Pays de la Loire study) Random sample of 2656 French men and women (20–59 years old) participating in a study on the prevalence of work related upper limb disorders. More than 50% experienced non-specific musculoskeletal symptoms during preceding 12 months, and 30% experienced them in preceding week. Prevalence ratios (PR) of physician-diagnosed musculoskeletal disorders were calculated for manual versus non-manual workers (any of six principal upper limb disorders (rotator cuff syndrome, epicondylitis, cubital tunnel syndrome, extensor/flexor tendonitis/tenosynovitis, de Quervain's disease, and carpal tunnel syndrome): 11.3% of men and 15.1% of women were diagnosed with an upper limb disorder (rotator cuff > carpal tunnel syndrome > lateral epicondylitis). PRs increased with age and varied widely across economic sectors and occupations. The risk was especially high in manual workers (PRs: 1.40 to 2.10). Physical work factors accounted for over 50% of occupational disparities overall, 62% (men) to 67% (women) for rotator cuff syndrome, and 96% (women) for carpal tunnel syndrome. In working men and women, upper limb musculoskeletal disorders are frequent. Physical work exposures, such as repetitive and forceful movements, are an important source of risk and in particular account for a large proportion of excess morbidity among manual workers. (*Cross-sectional design, thus unable to address primary causation, but the study did provide data on occupational physician-diagnosed specific ULDs as well as self-reporting: but, confirms high prevalence of ULDs. Authors acknowledged that the occupational physicians who took part in the study may have been particularly concerned by workers' musculoskeletal health, and they had access to participants' data before the clinical examination, which may have lead to information bias in respect or occupational causation Authors concluded around 90% of cases could be classified as work-related (according to An expert criteria consensus document) but the cross-sectional design and the fact that work exposures were self-reported, limits their claim that there is a need for prevention programmes; the concept of work-relevant was seemingly not considered.*
(Shaw & Feuerstein 2004)	RCT + conceptual interpretation	Modified work + case management	Work-related ULDs	Generating workplace accommodations: lessons learned from the Integrated Case Management Study Modified duty and other accommodations by employers have been shown to be helpful in managing workplace disability associated with injuries and illnesses. The results of a randomized controlled study of case management services for work-related upper extremity disorders inform on improving accommodation efforts. To facilitate accommodations, case managers developed a written list of needed workplace accommodations that specified responsibilities and target dates for obtaining

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				management approvals and ordering, installing, or modifying equipment or workstations. Although this systematic approach led to more accommodations, 25% of those recommended were never implemented. Therefore, significant obstacles may remain for employers to allow or provide some accommodations, even when relatively rigorous approach to needs assessment and implementation is followed. Design of self-report measures of function, exposure, and accommodation should take into account the collaborative, back-and-forth process that may be necessary to reach agreement about accommodations that are helpful to workers and feasible for employers. Measures that list a variety of possible accommodations and provide physiological rationale might yield the best results. *(Emphasises that, whilst modified work can be advocated, achieving the optimal accommodations may require careful negotiation between employee, workplace, and healthcare) (See also Feuerstein et al 2003).*
(Shaw et al. 2007)	Longitudinal	Workplace management	General MSDs	A staged approach to reducing musculoskeletal disorders (MSDs) in the workplace: a long term follow-up New tools to measure organisational and worker stage of change with respect to MSDs were developed and then used to develop interventions tailored to manager and worker stage of change. The effectiveness of tailored compared to standard interventions was measured on a variety of levels, including stage of change and self-reported musculoskeletal discomfort. Evaluations were conducted 6 months after the implementation of the interventions. Tailored interventions were significantly more effective in promoting risk-awareness; promoting progression through the stages of change; promoting behaviour change and reducing self-reported musculoskeletal discomfort in a number of body areas. To determine if the positive findings seen at 6 months persist over the long term, the authors conducted a longer-term follow-up of the interventions at 15 months post-intervention and at 20 months post-intervention. The impact of the tailored interventions was sustained from 6 months post-intervention to 15 and 20 months post-intervention. For some body areas, there were further reductions in the percentage of workers reporting discomfort at 15 and 20 months compared to 6 months. While standard interventions showed some reductions in discomfort at 15 and 20 months, tailored interventions had a far greater impact in terms of changing behaviour and reducing MSD symptoms from 6 months to 20 months. *(The authors suggest)* The findings provide strong evidence for the long-term effectiveness of tailored interventions versus standard interventions in promoting behaviour change and reducing musculoskeletal discomfort. Wide adoption of this approach is likely to make a significant contribution to reducing both the prevalence and incidence of MSDs.
(Silverstein et al. 2006)	Longitudinal	Epidemiology – incidence, prevalence, persistence	Rotator cuff tendinitis	Natural course of nontraumatic rotator cuff tendinitis and shoulder symptoms in a working population Prospective study of 436 active workers conducted at 12 different worksites (mostly manufacturing) - follow-up of 62% of baseline cohort, which itself was a 65%

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				participation rate. Detailed health interviews, psychosocial questionnaires, and physical examinations were conducted at baseline and again after 1 year, with shorter evaluations at 4 and 8 months. Two-thirds had symptoms and/or signs at baseline, though they were still working. The prevalence of rotator cuff tendinitis at baseline was 7.6% right; 4.8% left, and for shoulder symptoms was 18.6% right; 11.2% left. The annual incidence of rotator cuff tendinitis was 5.5% right; 2.9% left. Higher proportions of participants with current symptoms or physical findings at baseline became clinical cases after 1 year. The 1-year persistence of symptoms was 41%; the 1-year persistence of clinical case status was 31%. There were significant differences at baseline between the asymptomatic participants and the clinical cases with respect to physical health on the SF-12, the perception of general health, and the frequency of high hand force exposure. Interference with work performance or productivity was notable for some of the clinical cases, but missed workdays were reported infrequently. Reported job changes were common across the population (not just among the cases). Symptoms and physical findings appear to predict clinical case status within 1 year. Shoulder problems appear to be frequent and volatile in their course. *(Workloss is not inevitable. These data emphasise the recurrent and persistent nature of symptoms and signs in rotator cuff tendinitis; previous trouble is a predictor of future trouble. Psychosocial factors were not used in prediction model).*
(Singh et al. 2004)	Prospective case series	Interdisciplinary pain management	Complex regional pain syndrome	The value of interdisciplinary pain management in complex regional pain syndrome type I: A prospective outcome study Authors reports that an intensive approach to upper extremity CRPS, combining physical and occupational therapy under-girded by an aggressive neuropsychological behavioural strategy, and aided by interventional and medical treatment, produced significant, persistent improvement in function. At 2-year follow-up 75% of patients were employed. *(A very heavy duty intervention)*.
(Sjögren et al. 2005)	RCT	Workplace exercises	Headache; neck or shoulder pain	Effects of a workplace physical exercise intervention on the intensity of headache and neck and shoulder symptoms and upper extremity muscular strength of office workers: a cluster randomized controlled cross-over trial Examination of the effects of a workplace physical exercise intervention (daily light resistance training) on the perceived intensity of headache and neck and shoulder symptoms, as well as on the extension and flexion strength of the upper extremities. The study was a cluster randomized controlled trial. The cross-over design consisted of physical exercise intervention (15 weeks) and no-intervention (15 weeks). The subjects (n=53) were office workers (mean age 47) who reported headache (n=41) symptoms in the neck (n=37) or shoulders (n=41), which had restricted their daily activities during the last 12 months. Physical exercise intervention resulted in a slight, but statistically significant, decrease in the intensity of headache and neck symptoms, as well as an increase in the extension strength of the upper extremities; the intervention had no effect on the intensity of shoulder symptoms or the flexion strength of the upper extremities.

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(Smidt et al. 2002)	RCT	Clinical management	Epicondylitis	Corticosteroid injections, physiotherapy, or a wait-and-see policy for lateral epicondylitis: a randomised controlled trial Patients (n=185) from primary care with >6 weeks symptoms randomly allocated to (1) treatment with corticosteroid injections (max 3), (2) physiotherapy (9 treatments of ultrasound, deep friction massage, and exercise programme, (3) wait-and-see following advice on spontaneous improvement and discussion of pain provoking activities + analgesics. At 6 weeks, corticosteroid injections were significantly better than all other therapy options for all outcome measures. However, the benefit only lasted a short time - recurrence rate in the injection group was high. Long-term differences between injections and physiotherapy were significantly in favour of physiotherapy. Physiotherapy had better results than a wait and-see policy, but differences were not significant. Patients should be properly informed about the advantages and disadvantages of the treatment options for lateral epicondylitis. The decision to treat with physiotherapy or to adopt a wait-and-see policy might depend on available resources, since the relative gain of physiotherapy is small. *(See also Bissett et al 2006).*
(Thomsen et al. 2007)	Prospective	Risk factors	Hand-wrist disorders	Risk factors for hand-wrist disorders in repetitive work Using questionnaires and physical examinations, the prevalence and incidence of hand-wrist pain and possible extensor tendonitis (wrist pain and palpation tenderness) were determined in 3123 employees in 19 industrial settings. With the use of questionnaires and video recordings of homogenous work tasks number of wrist movements, hand force requirements, and wrist position were analysed as risk factors for hand-wrist disorders, controlling for potential personal and psychosocial confounders. All participants were re examined three times during a follow-up period of three years. Force but not repetition and position was related to hand-wrist pain and possible tendonitis in the baseline analyses showing an exposure-response pattern. Odds ratios for the risk of hand pain was 1.7 and for possible tendonitis 1.9. There was no significant interaction between the ergonomic factors. In the follow-up analyses force remained a risk factor for hand pain (OR 1.4) and for possible tendonitis (OR 2.9). Repetition was also a risk factor for the onset of hand-wrist pain (OR 1.6). Increasing levels of force were associated with prevalent and incident hand-wrist pain and possible extensor tendonitis. The results for repetition were less consistent. Working with the hand in a nonneutral position could not be identified as a risk factor. *(The term hand-wrist disorders was defined as self-reported symptoms with or without palpation tenderness, thus the outcome here strictly is symptoms not a specific diagnosis or disorder).*
(Tsauo et al. 2004)	Comparative study	Exercise and health education	Neck and shoulder complaints	Physical exercise and health education for neck and shoulder complaints among sedentary workers To assess the effectiveness of 3 different health promotion exercise programs for work-related shoulder and neck pain, a total of 178 employees were recruited and grouped. Those in the "Self-exercise group" (n = 56) were given a lecture about the exercise

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				program and then performed the program by themselves during their office break. "Team-exercise group I" (n = 69) performed the program once under the supervision of a physiotherapist after the lecture. "Team-exercise group II" (n = 14) performed the program twice; once under a physiotherapist's supervision. When daily change of pain threshold (post-work - pre-work) was treated as an improvement index, the odds ratios for the self-exercise group, team-exercise group I and team-exercise group II were 1.39, 4.63 ($p < 0.05$) and 7.06 ($p < 0.05$), respectively, compared with the reference group. An intensive team-exercise program is beneficial in reducing neck and shoulder symptoms in sedentary workers.
(van den Heuvel et al. 2005)	Prospective cohort study	Epidemiology – psychosocial work characteristics	Neck and upper limb symptoms	Psychosocial work characteristics in relation to neck and upper limb symptoms Used 787 workers (mixed occupations) who reported no symptoms at baseline, and provided complete follow-up data at 3 years. The 3-year cumulative incidence was 24% for neck/shoulder symptoms and 15% for elbow/wrist/hand symptoms. Both univariate and multivariate analyses conducted. Variables controlled for were age and gender, physical risk factors, stress symptoms, and personal factors. High job demands predicted neck/shoulder symptoms (RR 2.1) and elbow/wrist/hand symptoms (RR 1.9). Low social support was identified as a risk factor for elbow/wrist/hand symptoms (RR 2.2).
(van den Heuvel et al. 2006)	Prospective cohort study	Epidemiology – physical factors of work	Neck and upper limb symptoms	Do work-related physical factors predict neck and upper limb symptoms in office workers? Examined the influence of physical exposure at work on neck and upper limb symptoms in office workers; prospective cohort study with a follow-up period of 3 years. Only a limited number of work-related physical factors were related to neck and upper limb symptoms in office workers: neck rotation and self-reported neck extension were identified as risk factors (small ORs) for neck-shoulder symptoms, whilst none of the physical variables were significantly associated with elbow–wrist–hand symptoms. There was non-significant indication of an adverse effect from longer working time.
(van Rijn et al. 2007)	Retrospective analysis of clinical data	Onset of movement disorder	Chronic regional pain syndrome	Onset and progression of dystonia in complex regional pain syndrome Complex regional pain syndrome (CRPS) may lead to movement disorders (MDs) in some patients. Retrospective evaluation of the clinical and temporal characteristics of MDs in patients with CRPS. 185 five patients suffered CRPS in one or more extremities. MDs occurred in 121 patients, with dystonia (91%) being the most prevalent. We conclude that dystonia in CRPS shows highly variable onset latency and is associated with younger age at onset and increased risk of developing dystonia in other extremities. The delayed onset and progression of dystonia in CRPS may indicate the involvement of a different underlying mechanism, possibly associated with maladaptive neuroplasticity.
(Walker-Bone et al. 2004b)	Cross-sectional survey	Epidemiology - pattern and determinants	Neck and upper limb pain	The anatomical pattern and determinants of pain in the neck and upper limbs: an epidemiologic study Community survey (62% response from 9,696 working-age adults) concerning pattern

Table A4. Individual studies of particular relevance				
Authors	Study type	Topic	ULD condition	Key findings *(Reviewers' comments in italic)*
				and determinants of neck, shoulder, elbow, wrist/hand pain. 1-week prevalence 44% for any site (neck 24% - shoulder 24% - elbow 11% - wrist/hand 21%). 1-week prevalence of difficulty with normal activities 31% for any site (neck 17% - shoulder 14% - elbow 7% - wrist/hand 15%). Pain frequently bilateral, in dominant arm, and at anatomically adjacent sites: pain at all sites far more common than statistically expected. Being female, unemployed, a blue-collar worker, or a smoker were independent risk factors for extensive pain, but strongest association was with psychological ill-health. The excess of symptoms in dominant arm could result from physical stresses, but also possible that higher levels of activity increase awareness of symptoms without necessarily causing local pathology in the arm.
(Walker-Bone et al. 2004a)	Cross-sectional survey	Epidemiology – prevalence and impact	Upper limb symptoms and disorders	Prevalence and impact of musculoskeletal disorders of the upper limb in the general population Study using 6,038 (who were responders from initial sample of 9,696 adults of working age, randomly selected from GP registers) that aimed to determine prevalence and impact of upper limb disorders in the general population. 3,152 (52%) reported symptoms (pain lasting 1 day or longer, or dysesthesia lasting at least 3 minutes) in the last 7 days. Allowing for overlap of symptoms (neck or upper limb) this corresponded to a 1-week prevalence of 24% for neck pain, 36% for upper limb pain, and 27% for sensory symptoms. All responders who reported symptoms in the previous week were invited to an assessment, and 1,960 accepted this offer. They did not differ from those who declined. Of subjects with pain, 44.8% had 1 or more specific soft-tissue disorders. Site-specific prevalence rates were: shoulder tendinitis 4.5% (male) and 6.1% (female); adhesive capsulitis 8.2%(male) and 10.1%(female); lateral epicondylitis 1.3% (male) and 1.1% (female); de Quervain's disease 0.5% (male) and 1.3% (female); other tenosynovitis of the hand or wrist, 1.1% (male) and 2.2% (female). The authors observed that their estimates of prevalence for specific disorders were similar to others found in the literature, and that specific disorders tended to cluster in individuals, with particular overlap at the shoulder. They also noted that upper limb disorders are disabling and interfere with everyday activities, and that individual sufferers use a lot of healthcare. *(These results indicate that upper limb pain is relatively common within the general population, and this results in a variety of specific disorders)*
(Walker-Bone et al. 2006)	Cross-sectional survey + physical exam	Classification	Specific and non-specific upper limb pain	Risk factors for specific upper limb disorders as compared with non-specific upper limb pain: assessing the utility of a structured examination schedule A questionnaire about upper limb pain and demographic, occupational and psychosocial risk factors mailed to primary care patients; those reporting arm or neck pain had structured physical examination and classified as specific or non-specific upper limb disorder (ULD). 10,420 questionnaires mailed; response rate 59%. Of 4,170 eligible respondents, 2,248 were pain free and 496 with persistent shoulder, elbow, or wrist pain were examined: 250 had specific disorder(s) but no non-specific pain; 176 had non-

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				specific pain but no specific disorder; 70 had mixed pattern of complaint. In general, physical risk factors were more strongly associated with specific disorders than with non-specific. Eg specific disorders at the shoulder and elbow were more frequently associated with being in blue-collar job than non-specific shoulder or elbow pain, and hand-wrist tendonitis was more commonly associated with repetitive keyboard work than non-specific hand-wrist pain. However, the pattern was not entirely consistent – non-specific shoulder pain showed stronger association with overhead work, and risks associated with repeated elbow bending were little different for epicondylitis and non-specific elbow pain. Associations with indices of mental health tended to be similar for specific and non-specific disorders at same site; this association between psychosocial factors and specific disorders was unexpected – possibly reflecting negative effect of the ULD on mental health or that psychosocial factors favouring persistence. Whilst the differences in association with risk factors between classification groups are consistent with the differences in pathology, the presence of physical signs might simply be an index of severity. *(These results from a cross-sectional study do not imply causation)*. Future work needs to test the prognostic ability of the classification scheme.
(Warren et al. 2000)	Case control	Epidemiology – biopsychosocial associations	Work-related MSDs (upper extremity symptoms)	Biomechanical, psychosocial, and organizational risk factors for WRMSD: population-based estimates from the Connecticut upper-extremity surveillance project (CUSP) Case-control study of a population-based telephone survey of 3,798 working adults: upper extremity symptoms (pain or discomfort was identifier of 'case') were associated with biomechanical, psychosocial, and organizational factors. In several models, biomechanical exposures with strong associations were static postures (odds ratios [ORs] = 2.00-5.45); repeated pushing, pulling, lifting (ORs = 1.86-12.75); and repeated neck bending (ORs = 1.07-12.8). Psychosocial and organizational factors consistently retained in these models were demands (ORs = 1.26-1.59) and organizational support (ORs = 0.53-0.79). Decision latitude entered less frequently (ORs = 0.30-0.49). This research may have implications for intervention strategies. First, reducing both biomechanical and psychosocial risk may be more effective than focusing solely on engineering controls. Second, organizational culture and policy may have strong implications for WRMSD prevalence and control. WRMSDs demonstrate strong associations with a complex web of biomechanical,psychosocial, and organisational factors. *(The associations here cannot be concluded to be causative, but the data do, as the authors say, provide an epidemiological broad brush, which supports the view that WRMSDs are a biopsychosocial phenomenon with implications for symptom management as well as (ostensibly) for prevention)*. *(Same sample as Morse et al 1998).*
(Waylett-Rendall & Niemeyer 2004)	Retrospective case analysis	RTW	Upper extremity cumulative	Exploratory analysis to identify factors impacting return-to-work outcomes in cases of cumulative trauma disorder A retrospective analysis was performed on 459 workers' compensation cases with upper

Table A4. Individual studies of particular relevance				
Authors	Study type	Topic	ULD condition	Key findings *(Reviewers' comments in italic)*
			trauma disorders + CTS	extremity cumulative trauma disorders and a subset of 312 with carpal tunnel syndrome. The outcome criterion was return to work as a dichotomous variable. Only two significant correlations with return to work were found: the therapist's estimate of rehabilitation potential and the patient's outcome expectation of the ability to work. Further investigation of the role of beliefs and expectations in the therapeutic process would be a productive area for prospective study. It is suggested that the dynamics of factors influencing return to work in individuals with upper extremity CTD may be quite different than for low back pain and merits further investigation *(though the two factors highlighted are also correlated with RTW in low back pain)*.

[CRPS = chronic regional pain syndrome ; CTD = cumulative trauma disorder; CTS = carpal tunnel syndrome; MSD = musculoskeletal disorder; ICM = integrated case management"; NSAP = non-specific arm pain; OR = odds ratio; RCT = randomised controlled trial; RSI (repetitive strain injury; RTW = return to work; ULD = upper limb disorder; WRMSD = work-related musculoskeletal disorder]

Table A5 Evidence grid for biomedical management of ULDs

	Acupuncture	Extracorporeal shockwave therapy, ESWT	Laser	Electromagnetic field and ionization	Ultrasound and phonophoresis	Rebox	Ergonomics	Exercise	Manipulation	Massage, deep transverse friction	Splinting, Orthotics, Taping	Injections, corticosteroid	Oral diuretics	Oral NSAIDs	Oral steroids	Pyridoxine, vitamin B6	Topical NSAIDs	Surgery	Yoga	
CTS (carpal tunnel syndrome)			- *	?	?				+ *		? *	+ * §	- ***	- *	+ * §	- **		+ **	- *	Andrew et al 2005; Crawford & Laiou 2007; Feuerstein et al 1999; Gerritsen et al 2002; Goodyear-Smith & Arroll 2004; Marshall et al 2007; O'Connor et al 2003; Scholten et al 2002; Verdugo et al 2003
Diffuse upper extremity pain; non-specific ULD; RSI; CTD; CRPS							+ *	+ *	? *	+ *										Konijnenberg et al 2001; Smidt et al 2005; Verhagen et al 2006; Verhagen et al 2007
Lateral epicondylitis; Medial epicondylitis	+ * §	- ***	- *	- *	+ *	+ *		+ *	+ *		?	+ *					+ *	?		Bisset et al 2005; Borkholder et al 2004; Buchbinder et al 2002; Buchbinder et al 2005; Crawford & Laiou 2007; Green et al 2002; Struijs et al 2002; Trinh et al 2004; Trudel et al 2004
Rotator cuff tendonitis (including supraspinatus and bicipital tendonitis)								+ ***	+			+ *		+ *						Buchbinder et al 2003; Crawford & Laiou 2007; Green et al 1998; Green et al 2003
Shoulder pain; impingement syndrome; shoulder capsulitis			+ *	+ * §§	+ * §§		+ *	+ *	?			+ *		+ *	+ ***					Buchbinder et al 2003; Buchbinder et al 2006; Cleland & Durall 2002; Crawford & Laiou 2007; Desmeules et al 2003; Green et al 1998; Green et al 2003; Smidt et al 2005; Verhagen et al 2006
Tension neck syndrome							+ *													Crawford & Laiou 2007
Tendonitis (fingers/hand/forearm)										- **	? §§§									Brosseau et al 2002; Thien et al 2004
Trigger finger												+ ***								Fleisch et al 2007
De Quervain's syndrome; 'Tenosynovitis'																				Crawford & Laiou 2007

+ evidence of effectiveness **-** evidence not effective **?** evidence inconclusive or equivocal ***** weak evidence ****** moderate evidence ******* strong evidence

Notes: The findings from Muller et al (2004) not included due to near impossibility with interpretation §=Short-term benefit only §§=Calcific tendonitis only §§§=Post-surgical only

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Management of upper limb disorders and the biopsychosocial model

This review, using a best evidence synthesis, examined the evidence on management strategies for work-relevant upper limb disorders and established the extent to which the biopsychosocial model can be applied. Articles were found through systematic searching of electronic databases together with citation tracking. Information from included articles was extracted into evidence tables. Themes were identified and the information synthesised into high level evidence statements, which were distilled into key messages. The main results are presented in thematic sections covering classification/diagnosis, epidemiology, associations/risks, and management/ treatment, focusing on return to work and taking account of distinctions between non-specific complaints and specific diagnoses.

Neither medical treatment nor ergonomic workplace interventions alone offer an optimal solution; rather, multimodal interventions show considerable promise, particularly for vocational outcomes. Early return to work, or work retention, is an important goal for most cases and may be facilitated, where necessary, by transitional work arrangements. The emergent evidence indicates that successful management strategies require all the players to be onside and acting in a coordinated fashion; this requires engaging employers and workers to participate.

The biopsychosocial model applies: biological considerations should not be ignored, but it is psychosocial factors that are important for vocational and disability outcomes. Implementation of interventions that address the full range of psychosocial issues will require a cultural shift in the way the relationship between upper limb complaints and work is conceived and handled. A number of evidence-based messages emerged, which can contribute to the needed cultural shift.

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