THE OCCUPATIONAL ERGONOMICS HANDBOOK

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Fundamentals of Surveillance for Work-Related Musculoskeletal Disorders

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64.1 Introduction

Scope

This chapter will address occupational **surveillance*** as it relates to the practice of industrial ergonomics and the prevention of work-related musculoskeletal disorders. Surveillance is a "continuous analysis, interpretation, and feedback of systematically collected data, generally using methods distinguished by their practicality, uniformity, and frequently their rapidity, rather than by their accuracy or completeness" (Last, 1995). Occupational surveillance provides the data needed to identify, control, and prevent work-related injuries and illnesses. Epidemiologists also use surveillance data to study "the distribution and determinants of health-related states or events in defined populations." Methods for conducting occupational surveillance programs are well documented, and reviews of surveillance concepts and methods have been presented elsewhere (Baker et al., 1989; Baker and Matte, 1994; Greife et al., 1995). This chapter will limit the discussion of surveillance to those issues that affect the work of the industrial ergonomist and the prevention of musculoskeletal disorders.

*This chapter contains a glossary of the terms in bold type.

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Purpose

The purpose of occupational surveillance is to track patterns of health and disease in groups of workers and to identify risk factors that influence these trends. Ultimately, this information should be used to direct the implementation of measures to prevent and/or control work-related disorders. Surveillance can answer questions such as, "Is there a problem?" or "Is there *still* a problem?" Establishing surveillance procedures is generally the first step in establishing an industrial ergonomics program. Surveillance serves to stimulate and focus prevention efforts and provides a method to assess the impact of corrective action.

64.2 Collecting, Analyzing, Intervening

Effective surveillance systems include the following components: (1) data collection, (2) analysis of the data, i.e., a mechanism to evaluate the meaning of the health/injury or hazard data, and (3) some action or response to ensure that surveillance activities are translated into preventive action. The response action may be directed toward individuals (e.g., providing medical treatment for symptomatic workers), or toward groups of workers (e.g., eliminating hazardous workplace conditions).

Several factors govern the strategy for collecting, analyzing, and acting upon surveillance data. These factors include the scope and urgency of the perceived problem, the resources available to the investigators, and the types of information systems already set in place. Many surveillance programs begin with efforts to document the number of work-related musculoskeletal disorders that have occurred in recent history (i.e., establish a baseline). Data for this effort can be obtained from a review of **existing records**. If existing records are incomplete or are unreliable as sources of surveillance information, or if additional information about current (rather than historical) conditions is needed, **questionnaires** or **worker surveys** may be used to determine how many workers are experiencing symptoms that could be caused by work activities. Additionally, because prevention of work-related musculoskeletal disorders depends on the identification and elimination of hazardous working conditions, **hazard surveys** or simple checklists can be used to identify jobs where risk factors for musculoskeletal disorders may be present.

For example, during an annual review of the OSHA 200 logs, an occupational nurse notices there has been a sudden increase in the number of workers reporting severe back strains on a new job. The surveillance plan would likely call for an immediate inspection of the worksite, along with interviews of workers and the supervisors to assist in identifying hazards. Once hazard control techniques had been identified and implemented, worker and hazard surveys would be administered at periodic intervals to determine the long-term effectiveness of the intervention.

Additional information about each of these data sources (existing records, worker surveys, and hazard surveys) will be provided later in this chapter.

Establishing Definitions and Criteria

Before data can be collected and analyzed, it must be defined. An obvious (and unfortunately common) problem in the surveillance of work-related musculoskeletal disorders is the lack of consistency or standardization in the way these disorders are defined. The resulting confusion can lead to inaccuracies or inconsistencies in the data that make comparisons between locations and over time difficult if not impossible.

Defining what is meant by terms like "musculoskeletal disorder" or "ergonomic hazard" can be especially difficult. "Musculoskeletal disorders" encompass a broad spectrum of illnesses; in a recent review, NIOSH (1993) listed more than 160 different musculoskeletal conditions that can be caused or aggravated by various work activities. Diagnosis of these conditions is often complicated since many of these disorders have nonspecific symptom patterns, long latency periods and complex etiologies (Schierhout and Myers, 1996). For surveillance purposes, work-related musculoskeletal disorders have been defined from self-reported symptoms, clinical signs, specialized medical tests, impairment, or disability.

TABLE 64.1 Examples of Case Definitions Used in Studies of Work-Related Musculoskeletal Disorders

Disorder	Defined as:	Determined by:	Applied to:	Reference
Carpal tunnel syndrome (CTS)	Pain or numbness in the hands or wrists, pain in the hand or wrists that awakens at night, or tingling in the hands and fingers.	Questionnaire	Supermarket cashiers	Margolis and Kraus, 1987
Cumulative trauma disorders (CTDs)	Inflammation or irritation of joints, tendons, or muscles (excluding strains, sprains, or dislocations), resulting from overexertion or nonimpact repetitive motion, occurring over a protracted or unknown period of time.	Review of workers' compensation records	Industrial workers in Ohio	Tanaka et al., 1988
Work-related carpal tunnel syndrome	Combination of 1. symptoms affecting the median nerve distribution of the hand (e.g., pain, paresthesia, numbness), 2. objective physical or electro-diagnostic findings suggestive of CTS, and 3. history of employment in a job involving frequent or repetitive hand movements, forceful hand exertions, awkward hand postures, use of vibrating tools, or prolonged pressure over the wrist or palm of the hand.	Clinical history and physical examination	Patients referred for neurophysiologic testing	Katz et al., 1991
Shoulder tendinitis	Pronounced palpable pain of the muscle attachment or pronounced pain reaction to isometric contraction in any of the rotator cuff or biceps muscles.	Clinical examination	Construction workers	Stenlund et al., 1993
Work-related musculoskeletal disorders	Symptoms of pain, aching, stiffness, numbness, tingling, or burning: 1. Not due to accident or sudden trauma; 2. Developed since working in current job; 3. Occurring within past year; 4. Lasting more than one week, or occurring at least once a month; 5. Reported as moderate or worse on a 5-point intensity scale.	Questionnaire	Newspaper workers	Bernard et al., 1994

Examples of **case definitions** used in various studies are found in Table 64.1. Two important considerations in the selection of a case definition are its **sensitivity** and **specificity**. The sensitivity of a case definition is the likelihood that the definition will identify diseased individuals. The specificity of a case definition is the probability that it will not label healthy individuals as diseased. In general, case definitions based solely on symptoms (e.g., pain, tingling in a particular body part) tend to be more sensitive but less specific than definitions that rely on physical findings or diagnostic tests; however, for surveillance purposes, it may be preferable to use definitions that are more inclusive or sensitive (Katz et al., 1991). In the face of uncertainty, the use of sensitive definitions will encourage investigators to examine suspect jobs and begin interventions at the earliest indication of a problem.

Implementing Standardized Reporting Procedures

Providing information in an accessible and usable format is critical to the success of a surveillance effort. Unfortunately, the data needed for surveillance are usually not centralized in a single location. Performing a comprehensive analysis of costs associated with absenteeism, turnover, injury morbidity, compensation, lost productivity, and poor quality can require a search of numerous record systems, many of which employ their own coding procedures. Although relational database management systems can greatly simplify this process, their success depends on the establishment of common linkages between record systems. One approach employed by some plant medical departments and occupational health clinics is to use the coding system provided in the International Classification of Diseases (ICD). Such a coding system should lead to greater consistency in collecting, analyzing, and reporting health data.

Calculating Rates and Percentages

Surveillance data are often reported as rates or percentages. Expressing the occurrence of injuries, illnesses, symptoms, complaints, etc. as a rate or percentage allows investigators to compare the occurrence across jobs/departments/plants that employ different numbers of workers and across periods of fluctuating employment. When the surveillance goal is to identify high-risk jobs that need attention, rates are most useful when they are computed for individual departments or even on similar jobs within a department.

The **incidence rate** is the rate of work-related musculoskeletal disorders appearing for the first time during a specific period (usually a year). The value commonly used in occupational health is the number of illnesses per 100 full-time workers per year and is calculated as follows:

$$\frac{\#\text{ new cases during the past 12 months} \times 200{,}000\text{ hours}}{\#\text{ work hours during the past 12 months}}$$

The information needed to compute the denominators for the rates can usually be obtained from personnel or payroll records. The assumption is that each employee works 2000 hours per year (8 hours a day, 5 days a week, 50 weeks a year). If the number of hours worked in the past 12 months is not known, it can be estimated by multiplying the number of full-time equivalent workers employed in the job, department, or plant by 2000 hours.

The **prevalence rate** is the percentage of all cases of disease/symptoms/complaints at a specific instance in time, regardless of when they first appeared. It is calculated as follows:

$$\frac{\text{total \# cases at a given point in time}}{\#\text{ workers at the same point in time}}$$

The **severity index** uses the number of lost or restricted workdays due to illness as a surrogate for the seriousness of the disorder. The severity index is calculated as follows:

$$\frac{\text{total \# lost or restricted workdays in the past 12 months} \times 200{,}000\text{ hours}}{\#\text{ work hours during the past 12 months}}$$

The magnitude of the severity index can be influenced by medical treatment practices, the health benefits available to employees, and the opportunity for transfer to jobs that are less stressful. The severity index can be skewed by unusually long illnesses suffered by a few employees.

Interpreting Incidence, Prevalence, and Severity

Although closely related, incidence and prevalence rates convey somewhat different information. Prevalence depends on the incidence and the duration of the disease from its onset to its resolution. For example, if the incidence of back pain is low, but recovery is slow, the prevalence will be high relative to the incidence. Conversely, if the incidence of musculoskeletal disorders among workers is high, the prevalence may be low relative to the incidence if workers recover quickly, or if they leave the workforce because of their condition (Hennekens and Buring, 1987).

From a surveillance perspective, incidence and prevalence rates serve as valuable *prevention tools* for guiding interventions to mitigate hazardous workplace conditions. Incidence and prevalence rates, however, are also being used as *management tools* to gauge the performance of supervisors and health and safety staff who are held responsible for workplace injuries and illnesses. Such measures, when used as an indicator of performance or compliance, can inadvertently penalize employers or safety and health personnel who have recently introduced an ergonomics program. Typically, the incidence and prevalence rates will initially increase in organizations in which ergonomics programs are implemented. This is often due to an increase in training-related awareness by the employees of the work-relatedness of their

conditions and represents better reporting rather than a true increase in the disorders. Moreover, the goal of an ergonomics program is to encourage employees to report problems early to allow immediate treatment and intervention, and thus reduce lost time and the risk of permanent injury. This goal may be undermined when incidence and prevalence rates are used as the sole measure to evaluate the effectiveness of an ergonomics program. For this purpose, the severity index may provide a more appropriate yardstick, since it reflects failures in early detection and prevention that represent real costs to the company. These failures are evident in the records of workers whose injuries have gone undetected, unrecognized, or unreported until the injuries reach a level of severity where restricted duty or lost time result.

Establishing Priorities for Intervention

Ultimately, surveillance should direct the allocation of resources toward groups at highest risk for musculoskeletal injury. A common question that arises in discussions of surveillance is "When does surveillance data become compelling?" i.e., when is there enough information to warrant intervention? Some suggest that even a single reported musculoskeletal disorder should be sufficient cause to trigger more focused evaluations of workplace conditions (ANSI, 1996). This recommendation is based on the recognition that formal surveillance activities usually detect only a small proportion of the musculoskeletal problems and that one reported case may lead to several times as many unreported cases.

If multiple problem areas are identified and resources are constrained, it is often necessary to rank order jobs for further analysis and intervention. Jobs can be ranked by incidence, prevalence, or hazard severity; many survey instruments are designed to provide guidance for directing intervention efforts. For example, a checklist developed for the automobile industry uses a series of questions and a three-level scale to rate the postural stress associated with a specific job (Keyserling et al., 1992; 1993). Jobs that receive one or more "stars" (indicating significant exposure to postural stress) are considered to have priority for additional investigation. Giving precedence to jobs that employ many people, or jobs where major changes are already planned, can also be a sensible and cost-effective approach.

64.3 Data Sources

Data sources for conducting occupational surveillance can be conveniently grouped into three classifications: (1) existing records, (2) worker surveys, and (3) hazard surveys.

Existing Records

Record-based surveillance involves reviewing and analyzing existing records or data systems for evidence of work-related musculoskeletal disorders. Because of its availability, these data can provide an initial gauge of the status of workers' health without a substantial investment of time or labor. Potential information sources include Occupational Safety and Health Administration (OSHA) 200 logs, on- and off-site medical records, workers' compensation records, and insurance claim data. Other records that can provide helpful information include absentee records, job transfer applications, employee grievances, or job satisfaction surveys. Although this information has been described as "passive surveillance data" (Fine et al., 1984), this description is not meant to minimize the importance of reviewing available records. Record reviewing is far from a passive endeavor, requiring great diligence in interpreting and coding the information in a consistent manner. Rather, the term serves to differentiate record reviewing from the "active" process of generating data of interest using targeted surveys.

OSHA Records. OSHA requires most employers to maintain records of work-related injuries and illnesses. Since 1978, the standard form for keeping these records has been the *Log and Summary of Occupational Injuries and Illnesses* (OSHA No. 200). In February 1996, OSHA proposed changes in record keeping requirements, including replacement of the OSHA 200 form with a new recording form, known as OSHA No. 300. These changes had not been adopted at the time of this writing. Whether or not new

requirements are enacted, OSHA-required records should be maintained at each facility or establishment where work activities are performed.

Under OSHA record keeping guidelines, musculoskeletal disorders must be recorded if (1) they were caused or exacerbated by work activities, and (2a) there is at least one physical finding (e.g., positive Tinel's or Phalen's test, swelling, loss of motion), or (2b) there is at least one subjective symptom (e.g., pain, numbness, burning) that resulted in medical treatment, lost or restricted workdays, or transfer/rotation to another job (OSHA, 1990). Determination of these conditions may be made by a physician, nurse, or other health care provider. Musculoskeletal conditions are generally recorded on the existing OSHA 200 form as an occupational illness under column "7f" ("disorders associated with repeated trauma"). These disorders are caused, aggravated, or precipitated by repeated motion, vibration, or pressure.

A review of OSHA logs will generally yield a count of the number of musculoskeletal disorders recorded within a given time frame. Although almost all worksites keep an OSHA log, its utility for musculoskeletal disorder surveillance can be limited. The form does not require a detailed description of the worker's job or the disorder, making it difficult to determine the exact cause and nature of the injury. Also, because most musculoskeletal problems tend to develop over time (i.e., do not result from a specific event), workers or medical personnel may not realize that these disorders are work-related, and hence, recordable.

The OSHA logs do provide a convenient basis for making internal comparisons within a company. The rates of injuries and illnesses can be compared over time and at different sites to assist in determining trends in injuries and illnesses. An industry can also use the data to compare itself against a national benchmark, such as the experience of other companies in the same Standard Industrial Classification (SIC).

For example, Company XYZ, a nursing home provider, employed 250 workers in 1991. This same year, workers reported 20 injuries and illnesses that resulted in a total of 100 lost workdays. Using payroll records, the company determined that employees had worked 450,000 hours during this period. They calculated an injury severity rate of 42.1 lost workdays per 100 full-time employees. Although the severity rate is high, this rate is less than the national severity rate of 61.2 for companies in SIC 805, individual and family services.

To find the national rate for the company's SIC code, refer to the Department of Labor's *Occupational Injuries and Illnesses in the United States by Industry*, available from the U.S. Government Printing Office each spring.

On-and Off-site Medical Records. Some companies maintain an onsite health clinic; others contract with external medical providers to provide care to workers injured at the job site. In either case, reports from these services, whether they are first-aid reports, dispensary logs, or employee medical records may provide useful information about potential work-related musculoskeletal disorders. At a minimum, these records may supplement information contained in the OSHA log.

For example, a review of the dispensary records at a poultry processing plant revealed no OSHA recordable injuries among workers on the trimming line in the previous year. However, the first aid medical reports showed that several employees who worked on that line on a daily basis requested anti-inflammatory medications and ice packs.

The utility of medical records for surveillance purposes can vary — they may or may not describe the reason for the visit or the condition underlying the prescribed treatment. Also, unless the information is routinely summarized, reviewing many medical records can be highly inefficient. Because medical records can contain sensitive information about employees, their contents must be treated confidentially. Routine access should be limited to health care personnel and public health agencies. Others should not have access without consent of the affected individuals.

Workers' Compensation Records. In many states, companies are required to obtain workers' compensation insurance to cover the medical and indemnity costs of employees who sustain injuries arising out of, and in the course and scope of their work. Where they exist, workers' compensation records can provide valuable information about the direct costs (medical and indemnity) associated with work-related musculoskeletal disorders. These costs include (1) payments made to outside hospitals, clinics, physicians, and other licensed medical personnel for the diagnosis, treatment (including surgery), and rehabilitation

of the injury, (2) payments made to the injured worker as compensation for lost work time, and (3) payments made as a lump sum settlement for permanent disability. The actual cost of musculoskeletal disorders is often higher than those covered by workers' compensation insurance. For example, the cost of medical treatments rendered directly by the employer or charged to the employee's health plan is not included. As a result, the total financial burden of these disorders to a company's balance sheet often goes unrecognized and unaddressed.

Workers' compensation claims are filed under specific rules and regulations that vary from state to state. Each workers' compensation law specifies what, how, and when work-related injuries and illnesses must be reported. To be covered, the worker must first choose to report the injury. Once the worker files a claim, there are issues of eligibility that govern whether the worker will receive benefits. Surveillance data based on the number of claims filed will differ from those based on the number of claims paid. As a result, workers' compensation data will often underestimate the true rates of work-related injuries and illnesses (Schwartz, 1987).

Misclassification and coding errors are also serious problems in using workers' compensation data. In an examination of workers' compensation data in Washington State, Franklin et al. (1991) found that only 72% of claims for carpal tunnel surgery were given an ICD code compatible with carpal tunnel syndrome.

Despite these limitations, workers' compensation data provide some significant advantages as a source of surveillance information. First, all records in the data set relate to conditions of suspected occupational origin. Also, workers' compensation records usually describe the circumstances of the disorder in a way that provides an understanding of the cause of the condition (Baker and Matte, 1994). If case identification leads to improvement of workplace conditions, the cost of compensation should be greatly reduced in future years.

Payroll Records. Payroll records are useful from two standpoints. First, payroll records can be used to determine the number of hours worked by employees on a particular job. This value is often used as a crude measure of employees' exposures to job hazards and is required for the incidence/prevalence/severity rate calculations described previously in this chapter. Second, payroll records can be used to identify jobs or departments where absenteeism or turnover is high. Although high turnover can result from several causes, physical stress is a common reason for leaving a job. If less stressful jobs are available, workers may choose to quit or bid out of their present, more stressful jobs. In a study by Lavender and Marras (1994), high rates of job turnover were identified as a useful indicator of jobs that posed a risk of overexertion injury leading to low back disorders. Although turnover can be affected by factors beyond the physical hazards posed by the job (e.g., the availability of higher paying positions, psychosocial factors), the results suggest that the sensitivity of surveillance programs based on existing records can be improved by using turnover rates to supplement injury rate data.

Summary. The quality and utility of existing record systems for surveillance purposes can vary. Musculoskeletal disorders often go unreported, and depending on the data source, striking differences in the incidence of work-related musculoskeletal disorders can be found (CDC, 1989). Even when records are complete, a lag will often exist between the appearance of a hazard and the onset of injury; therefore, records may not give an accurate picture of the current situation. Finally, linking injury/disease data with exposure to a hazard can be especially challenging. Job titles are often poor indicators of exposure to risk factors for musculoskeletal disorders. Additional data needed to link disorders to specific tasks or job processes may not exist.

Worker Surveys

Most work-related musculoskeletal disorders produce symptoms of pain or discomfort. Likewise, workers can provide valuable information about job attributes that cause fatigue or pain. Therefore, one of the most direct and effective methods for collecting surveillance data is to administer questionnaires or other surveys to workers. These techniques are sometimes called "active surveillance" measures because the investigator plays an active role in soliciting and collecting information specifically for surveillance

purposes. (In traditional public health surveillance, e.g., for infectious diseases such as tuberculosis, "active surveillance" means going out to hospitals and clinics to review patient records to detect cases. To avoid confusion, we do not use the term "active surveillance" here.)

Worker surveys can take several forms. They can be lengthy or quite short; they can be oral (i.e., administered by an interviewer) or written; and they may rely heavily on pictures or charts. Examples of worker surveys include the "body part discomfort scale" (Corlett and Bishop, 1976), the *Nordic Musculoskeletal Questionnaire* (Kuorinka et al., 1987), the *NIOSH Health Hazard Upper Extremity Questionnaire* (Hales et al., 1992), and the computerized "discomfort assessment system" (Saldana et al., 1994). Common features of surveys include the following:

- Use of body part diagrams, where workers can indicate the location of pain or other symptoms;
- Questions about the onset and duration of the symptoms;
- Questions about the nature of job activities;
- Use of numerical rating scales to indicate the severity of pain, fatigue, or discomfort.

Worker surveys are sometimes underrated as useful sources of surveillance data. A main reason stems from concerns that workers either may under- or over-report their symptoms. Inaccurate reporting may be more of an indication of a poorly worded survey, a lack of understanding, fear of job loss or recrimination, or simply a stoic attitude about discomfort. In situations in which worker surveys yield evidence of over-reporting of an occupational problem, investigators should not dismiss the findings until they are certain they understand the reason for their findings. In such cases organizational problems may be intertwined with safety and health problems (Schierhout and Myers, 1996).

To avoid concerns about reporting biases in worker surveys, some investigators have combined questionnaires with physical examinations of workers to identify musculoskeletal conditions (Bernard et al., 1994; Hales et al., 1994). These studies show that while symptoms of discomfort or pain may not always reflect an underlying pathology, the vast majority of employees with moderate to severe musculoskeletal symptoms have at least one positive physical finding on a concurrent physical examination (Baron et al., 1992).

Worker surveys should be conducted (1) when there is evidence from any data source of increased musculoskeletal injury or illness in the facility, (2) when new jobs or tasks are begun, or (3) when employees change jobs. The latter two surveys provide useful baseline data for determining the impact of the change on employee health. For example, one method to evaluate the effectiveness of a redesigned workstation would be to compare the pattern of shoulder, neck, and back discomfort recorded before the intervention with the pattern of discomfort for those same body segments after the improvements have been installed.

The advantages of using worker surveys as a source of information include the following: (1) The investigator can exert more control over the data collected. Once the investigator has decided what questions need to be answered, he or she can select the survey items that will elicit the most complete information that is needed. Because the investigator has control over the survey, there is also less chance that the information will change or become biased between administrations of the survey. (2) Surveys are easy to administer in the field — workers can complete the surveys at their convenience, and responses can be kept anonymous. These features can encourage high participation rates and candid responses, although the opportunities for follow-up surveillance are more limited. (3) Worker surveys can be readministered periodically to allow for early recognition of musculoskeletal disorders.

Worker surveys also have some inherent limitations. First, the time and resources required to develop and administer surveys may make them more costly than surveillance activities that rely on existing records. Second, the survey information may be unreliable if there is a lack of trust between management and workers. Third, the design of the questionnaire can have a dramatic effect on the quality of the responses and the number of workers who complete the survey. Key design issues include the length of the questionnaire, the phrasing of the questions, and method of administration. In a diverse or multilanguage

workforce, translating the questionnaires into several languages may be necessary. Finally, responses can be influenced by the workers' expectations about how much effort is required to perform a certain job. For example, a young warehouse worker may rate his job as only moderately strenuous, whereas an older worker using the same scale in a busy office environment may perceive his work to be very stressful in terms of work demands.

Hazard (Risk Factor) Surveys

Ideally, actions to prevent work-related musculoskeletal disorders should proceed before injuries and/or symptoms develop. In the last decade, a significant amount of research has been undertaken to improve our understanding of the risk factors that lead to the development of work-related musculoskeletal disorders (Gerr et al., 1991; Rempel et al., 1992). The process of examining jobs for these risk factors is known as hazard surveillance. Even without clear medical evidence that musculoskeletal problems exist, hazard surveillance activities can provide the data needed to begin an effective primary prevention program.

Because surveillance for ergonomic hazards is a relatively new notion, few industries maintain records that explicitly identify hazards for each job. However, many companies maintain job descriptions that identify the skills or abilities required to perform jobs in their facilities. In recent years, many industries have updated their job descriptions to include statements defining "Essential Job Functions" to comply with the Americans with Disabilities Act (ADA). According to the ADA, the descriptions should identify essential functions, or fundamental job duties, and the physical and mental abilities needed to perform these functions. If functional job descriptions are available, they can provide useful information for identifying potentially stressful jobs or jobs requiring unique skills or special endurance.

For example, a job description in a large assembly plant may list the ability to perform manual lifts, assemble parts, and use an impact wrench as requirements. Based on this description, an investigator could infer that the job might require high force exertions, awkward postures, repetitive hand movements, and exposure to segmental hand vibration.

Whether or not job descriptions exist, hazard surveillance efforts depend heavily on walk-through surveys. Investigators need to observe job activities, speak with workers and supervisors to obtain job information not apparent from observation, and use checklists to score job features against a listing of risk factors. The walk-through survey is differentiated from more formalized job analysis efforts by the amount of detailed information collected. The purpose of the walk- through is to identify risk factors that might otherwise go unnoticed and provide additional basis for prioritizing jobs for further evaluation.

Examples of checklists that might be used for hazard surveillance are provided in Tables 64.2, 64.3, and 64.4. Although most of the checklists are designed for use by non-experts, some minimal level of training is usually needed to use checklists properly. Hazard checklists can vary in length and in scope. At one extreme, there are "generic" checklists that are widely applicable, i.e., for use on nearly all jobs in all industries (OSHA, 1995). These checklists can be contrasted with more focused checklists, designed to evaluate a specific job or industry, e.g., carpenters or nurses' aides (Bhattacharya, 1992; Engkvist et al., 1995). While some checklists are intended to serve primarily as mnemonics (i.e., to remind users to evaluate a particular job characteristic), other checklists incorporate a scoring system for indicating the risk associated with a particular job or process. Attempts to validate various checklists as scoring instruments have yielded mixed results (Lifshitz and Armstrong, 1986; Keyserling et al., 1992; 1993; Shierhout et al., 1994; Kemmlert, 1995).

Hazard surveys should be administered (1) whenever a job, task, or process is changed substantially, (2) when new jobs are introduced, and (3) periodically (especially after new cases of musculoskeletal disorders are reported) to detect whether trends exist across jobs that use similar equipment, tools, or processes (ANSI, 1996). Hazard surveys can also be incorporated into regular safety and health inspections at the facility, expanding the scope of these inspections to include identification of musculoskeletal disorder risk factors.

TABLE 64.2 Ergonomic Hazard Identification Checklist*

[Answer Questions Based on the Primary Job Activities of Workers in Facility]

Never — Worker is never exposed to the condition

Sometimes — Worker is exposed to the condition less than 3 times daily.

Usually — Worker is exposed to the condition 3 times or more daily.

	Never	Some < 3	Usually > 3	If USUALLY, list jobs to which answer applies here
1. Do workers perform tasks that are externally paced?				
2. Are workers required to exert force with their hands (e.g., gripping, pulling, pinching)?				
3. Do workers use hand tools or handle parts or objects?				
4. Do workers stand continuously for periods of more than 20 mins?				
5. Do workers sit for periods of more than 30 mins without a chance to stand or move around freely?				
6. Do workers use keyboards, mice, joysticks, etc. for continuous periods of more than 30 mins?				
7. Do workers kneel for more than 5 min (one or both knees)?				
8. Do workers perform activities with hands raised above shoulder height?				
9. Do workers perform activities while bending or twisting at the waist?				
10. Are workers exposed to vibrations?				
11. Do workers lift or lower objects between floor and waist height, or above shoulders?				
12. Do workers lift or lower objects more than once/min. for continuous periods of more than 15 minutes?				
13. Do workers lift, lower, or carry objects weighing >12 lbs that are not held close to body?				
14. Do workers lift, lower or carry objects weighing more than 50 lbs.?				

*Developed by Grant, Habes, Fernandez, and Putz-Anderson, NIOSH, Cincinnati, Ohio, 1994.

Any response of: "*Usually*" to Questions 1-14 = Potential Risk Present: Follow-up

64.4 Conclusions

Surveillance is essential to the prevention/control of musculoskeletal disorders in the workplace. Unfortunately, surveillance efforts will ultimately be wasteful and ineffective if there are major breakdowns in any of the three major components: data, analysis, or intervention. In general, no single data source provides enough information to direct a program for preventing work-related musculoskeletal disorders. Therefore, effective surveillance programs make use of multiple data sources to identify problem areas and determine intervention priorities. Even in the absence of health data, hazard surveys conducted in workplaces where there are significant or well-defined hazards can provide the data needed to mount an effective primary prevention program for work-related musculoskeletal disorders.

Once established, surveillance should become an ongoing process. As corrective actions are taken, surveillance data can provide the information needed to show the beneficial effects of these efforts. By integrating surveillance efforts with existing quality assurance and cost containment programs, their utilization and success will be maximized.

TABLE 64.3 Manual Material Handling Checklist for Lifting, Carrying, Pushing, or Pulling*

Risk Factors		Yes	No
1. General			
1.1	Does the load handled exceed 50 lbs.?	[ ]	[ ]
1.2	Is the object difficult to bring close to the body because of its size, bulk, or shape?	[ ]	[ ]
1.3	Is the load hard to handle because it lacks handles or cutouts for handles, or does it have slippery surfaces or sharp edges?	[ ]	[ ]
1.4	Is the footing unsafe? For example, are the floors slippery, inclined, or uneven?	[ ]	[ ]
1.5	Does the task require fast movement, such as throwing, swinging, or rapid walking?	[ ]	[ ]
1.6	Does the task require stressful body postures, such as stooping to the floor, twisting, reaching overhead, or excessive lateral bending?	[ ]	[ ]
1.7	Is most of the load handled by only one hand, arm, or shoulder?	[ ]	[ ]
1.8	Does the task require working in environmental hazards, such as extreme temperatures, noise, vibration, lighting, or airborne contaminants?	[ ]	[ ]
1.9	Does the task require working in a confined area?	[ ]	[ ]
2. Specific			
2.1	Does lifting frequency exceed 5 lifts per minute?	[ ]	[ ]
2.2	Does the vertical lifting distance exceed 3 feet?	[ ]	[ ]
2.3	Do carries last longer than 1 minute?	[ ]	[ ]
2.4	Do tasks which require large sustained pushing or pulling forces exceed 30 seconds duration?	[ ]	[ ]
2.5	Do extended reach static holding tasks exceed 1 minute?	[ ]	[ ]

Comment: "Yes" responses are indicative of conditions that pose a risk of developing low back pain. The larger the percentage of "yes" responses, the greater the possible risk.

* Developed by Thomas Waters, Ph.D., CPE, NIOSH, Cincinnati, Ohio, 1994.

TABLE 64.4 Physical Exertion Questionnaire

The purpose of this questionnaire is to assess the amount of exertion you use in your job. Exertion is defined by (1) force, (2) repetitive motion, and (3) whole-body activity. The following pages contain three lists of activities, one for force, one for repetition, and one for whole-body activity. Use the activities in these lists to estimate the amount of exertion you use in your job.

To complete the questionnaire, read the activities on each page. Then compare the amount of force, whole-body activity, or repetitive motion (according to the particular list) the activities require, with the amount of force, whole-body activity, or repetition your work activities require. If you don't spend much work time doing **exactly** these activities, you may spend time doing activities that require **about the same amount** of exertion as the activities in the lists. Read the activities and think about an average workday. Then, in the boxes beside the activities, write in the number of hours and minutes during a typical workday, on the average, you spend doing activities that require about the same amount of exertion as those at each intensity level. **The total amount of time on each page should add up to about the length of your average workday.** Some of the intensity levels do not have activities to describe them. These levels stand for an amount of exertion that is halfway between the activities above and below. Write in the amount of time on those lines also. Think carefully about the amount of time you spend in low intensity activities, which may be more difficult to remember than high intensity activities.

As an example of completing the questionnaire, how much time during an average workday do you spend in activities that require about the same amount of whole-body activity as running up stairs? If you usually spend about 4 hours and 30 minutes during an average day, write this in the box beside the activity. Then estimate the amount of time you spend doing activities at the other intensity levels and write the time in the boxes. Please do not leave any of the boxes empty. Put a 0 in the box if you don't spend time doing activities at that intensity level.

Remember: The activities are only **examples** of amounts of exertion. The question is "Do you use the same amount of exertion as required by the different activities and not whether you perform the activities listed." The activities are only a guide for you to help you estimate your level of exertion, relative to the listed activity.

Whole-Body Activity Scale

On this page, you will indicate how much whole-body activity your job requires. Whole-body activity is any activity that increases heart rate and breathing, and involves movement mostly of the legs, such as pedaling a bicycle, or movement of the entire body. The activities below require whole-body activity; those near the top of the list require more whole-body activity than those near the bottom.

TABLE 64.4 (continued) Physical Exertion Questionnaire

Compare your work activities to the activities below in terms of how much whole-body activity your job requires. Then decide how much time on the average, you spend doing activities that require about the same amount of whole-body activity as those at each intensity level. *To help you estimate the intensity of your whole-body activity, think about how your body feels when you perform the activities in the scale, and compare this to the way you body feels when you perform your work activities.*

Remember: The activities below are only examples of amounts of whole-body activity for you to compare with your work activities. We are NOT interested in whether you perform the specific activities listed in the scale. Also think only about the amount of whole-body activity used to perform these activities, and not about the amount of force or repetitive motion the activities require.

Duration	Level	Equivalent Amount of Whole-Body Activity
	6	Running up stairs
	5	Between Level 6 and Level 4
	4	Climbing a vertical ladder
	3	Carrying boxes or packages from your house/apt to your car
	2	Making a bed (straightening the sheets and blankets)
	1	Rolling over from back to stomach while lying in bed
	0	No whole-body activity

The total number of hours and minutes on this page should equal about the length of your average workday.

Repetitive Motion Scale

On this page, we are interested in how much repetitive motion your job requires. Repetitive motion is movement that requires use of the same muscles and body parts to perform the same movements or sequence of movements over and over.

The activities below require repetitive motion. Those near the top of the list require more repetitive motion, meaning that the movements or sequence of movements take only a short time to complete before being repeated. Activities near the bottom of the list require less repetitive motion, and it takes longer before the same movement is repeated.

Please read the activities below and think about your **average** workday. Then write in the number of hours and minutes during a typical workday, **on the average**, you spend doing work activities that require about the same amount of repetitive motion as those at each intensity level. Please remember: The activities below are only examples of repetitive motion to be compared with your work activities. We are NOT interested in whether you perform the specific activities listed in the scale. Also, think only about the amount of repetitive motion used to perform these activities, and not about the amount of whole-body activity or force the activities require.

Duration	Level	Equivalent Amount of Repetitive Motion
	6	Stirring water with a spoon Manually grating cheddar cheese using a cheese grater
	5	Between Level 6 and Level 4
	4	Hammering nails into soft wood Cleaning windows/mirrors with a cloth or paper towel
	3	Between Level 4 and Level 2
	2	Taking notes using a pen/pencil and paper Removing groceries from a paper grocery bag Answering telephones and writing messages
	1	Between Level 2 and Level 0
	0	No repetitive motion

The total number of hours and minutes in the table should equal about the length of your average workday.

TABLE 64.4 (continued) Physical Exertion Questionnaire

Force Scale

On this page, you will indicate how much muscle force your job requires. In the boxes below enter the number of hours and minutes during a typical workday, on the average, you spend doing activities that require about the same amount of force as those at each intensity level.

The activities near the top of the list require more force, and activities near the bottom of the list require less force.

To help you estimate the amount of force you use in your job, think about how your body feels when you perform the activities in the scale, and compare this to the way your body feels when you perform your work activities. Remember: The activities are only examples of amounts of force. We are NOT interested in whether you perform the specific activities listed in the scale. Also, think only about the amount of force used to perform these activities, and not about the amount of whole-body activity or repetitive motion the activities require.

Duration	Level	Equivalent Amount of Force
		Pushing a refrigerator on a flat, smooth surface, such as tile, linoleum, or a wood floor (the refrigerator is not on wheels, a cart, or a dolly)
		Between Level 6 and Level 4
		Scooping hard, frozen ice cream out of a container Opening a new jar (a jar that has never been opened) of pickles or jelly
		Lifting a 12-pack of beer or pop using one hand Unscrewing a bottle cap on a new bottle or container or pop (a bottle or container of pop that has never been opened)
		Crushing an aluminum soda can or beer can with one hand (crushing it side-to-side, not top-to-bottom) Lifting a full gallon of milk Opening a car door with one hand
	1	Pulling the end of a cord out of an electrical wall outlet Lifting a telephone receiver Turning a doorknob
	0	Lifting a quarter Bending a piece of typing paper or notebook paper Lifting a cottonball

The total number of hours and minutes in this table should equal about the length of our average workday.

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Defining Terms

Case definition: Set of decision-making criteria, intended to assist health care providers in identifying work-related injuries and illnesses so that further investigation and preventive activities can be initiated.

Existing records: Records created for other purposes that may be useful in surveillance efforts. These records can include OSHA 200 logs, medical or health care records, workers' compensation claims, payroll records, sickness and accident reports, etc.

Hazard surveys: Assessments of jobs, workplaces, or processes for the purpose of identifying risk factors (e.g., biomechanical stress, vibration) that can lead to development of musculoskeletal disorders. Can be used to identify intervention targets before injuries or diseases have occurred.

Incidence rate: The rate of work-related musculoskeletal disorders appearing for the first time during a specific period.

Prevalence rate: The percentage of all cases of disease/symptoms/complaints at a given point in time.

Sensitivity: The probability that a case definition or screening procedure will identify individuals with the condition (disease) of interest.

Severity index: The rate of lost or restricted workdays due to musculoskeletal illness occurring within a specific period.

Specificity: The probability that a case definition or screening procedure will not label a healthy individual as diseased.

Surveillance: The continuous analysis, interpretation, and feedback of systematically collected data, essential to the planning, implementation and evaluation of occupational safety and health programs. Surveillance methods are often distinguished by their practicality, uniformity, and rapidity, rather than by their accuracy or completeness.

Worker surveys: Questionnaires and interview procedures developed to solicit information about signs, symptoms, and risk factors for musculoskeletal disorders from workers.

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