NIOSH

Comments to DOL

COMMENTS FROM THE
NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH
ON
THE OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION
PROPOSED RULE ON
ERGONOMIC SAFETY AND HEALTH MANAGEMENT

29 CFR Part 1910
Docket No. S-777

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service
Centers for Disease Control
National Institute for Occupational Safety and Health

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The National Institute for Occupational Safety and Health (NIOSH) supports the initiation of rulemaking on ergonomic safety and health management by the Occupational Safety and Health Administration (OSHA). NIOSH recognizes that "ergonomics" is a wide-ranging term with various applications. NIOSH has limited its comments to ergonomic hazards that relate to musculoskeletal problems. The standard should apply to all industries under OSHA jurisdiction, including general industry, agriculture, maritime, and construction.

As OSHA states in its advance notice of proposed rulemaking (ANPR), there is a significant increase in reported cases of ergonomic disorders in the workplace. The ANPR references substantial surveillance data indicating that work-related musculoskeletal disorders are a priority problem for U.S. industry. The importance of work-related musculoskeletal disorders is also reflected in NIOSH experience through its health hazard evaluation program and industrywide studies. NIOSH is conducting ergonomic research and responding to ergonomic concerns of employers and workers across the entire range of U.S. industries and a myriad of occupations, work tasks and operations.

NIOSH offers the following comments to assist OSHA in its development of a proposed rule on ergonomics.

I. INTRODUCTION

A. Definition of "Ergonomic Hazards" and "Ergonomic Disorders"

NIOSH Recommended Revised "Definition of Ergonomic Hazards":

Ergonomic hazards relative to work-related musculoskeletal disorders refer to physical stressors and workplace conditions that pose a risk of injury or illness to the musculoskeletal system of the worker. Ergonomic hazards include repetitive and forceful motions, vibration, temperature extremes, and awkward postures that arise from: improperly designed workstations, tools, and equipment; and improper work methods. The effects of ergonomic hazards may be amplified by extreme environmental conditions. In addition, ergonomic hazards may arise from potentially deleterious job designs and organizational factors such as: excessive work rates; external (versus self) pacing of work; excessive work durations; shiftwork; imbalanced work-to-rest ratios; demanding incentive-pay or work standards; restriction of operator body movement and confinement of the worker to a work station without adequate relief periods; electronic monitoring; and lack of task variety.

NIOSH Recommended Revised "Definition of Ergonomic Disorders"

NIOSH recommends that the term "ergonomic disorders" be replaced with the term "work-related musculoskeletal disorders" to be consistent with the NIOSH recommendation for scope of this standard. Work-related musculoskeletal disorders are those diseases and injuries

affecting the musculoskeletal, peripheral nervous, and neurovascular systems that are caused or aggravated by occupational exposure to ergonomic hazards. These disorders are variously referred to as "chronic trauma disorders," "repetitive strain injuries," "repetitive motion injuries," "repetitive trauma disorders," "cumulative trauma disorders," "wear and tear disorders," "overuse syndrome," and "degenerative joint diseases."

Work-related musculoskeletal disorders include damage to tendons, tendon sheaths, synovial lubrication of the tendon sheath, bones, muscles, nerves and ligaments of the hands, wrists, elbows, shoulders, neck, back, hips, knees, and ankles; joint injuries in which some of the fibers of a supporting ligament are ruptured, but the continuity of the ligament remains intact; overstretching or overexertion of some part of the musculature; and a variety of disorders marked by inflammation, degeneration, or metabolic derangement of the connective tissue structures of the body, especially the joints and related structures, including muscles, bursae, tendons and fibrous tissue.

The following diseases in the International Classification of Diseases (ICD) can be caused or aggravated by occupational exposure to ergonomic hazards. However, disorders such as carpal tunnel syndrome can also be caused or aggravated by nonoccupational factors such as carpal tunnel syndrome [Franklin et al. 1991].

ICD Code	Description of Disorder
353	Nerve root and plexus disorders
353.2	Cervical root lesions, not elsewhere classified
353.3	Thoracic root lesions, not elsewhere classified
353.4	Lumbosacral root lesions, not elsewhere classified
354	Mononeuritis of upper limb and mononeuritis multiplex
354.0	Carpal tunnel syndrome
354.1	Other lesion of median nerve
354.2	Lesion of ulnar nerve
354.3	Lesion of radial nerve
355	Mononeuritis of lower limb
355.1	Meralgia paresthetica
355.2	Other lesion of femoral nerve
355.3	Lesion of lateral popliteal nerve
355.5	Tarsal tunnel syndrome
355.7	Other mononeuritis of lower limb
443.0	Raynaud's syndrome (due to vibration)
712	Crystal arthropathies
715	Osteoarthrosis and allied disorders

716.1	Traumatic arthropathy
716.9	Arthropathy, unspecified
719	Other and unspecified disorders of joint
719.0	Effusion of joint
719.4	Pain in joint
719.5	Stiffness of joint, not elsewhere classified
719.7	Difficulty in walking
719.8	Other specified disorders of joint
720.2	Sacroiliitis, not elsewhere classified
722	Intervertebral disc disorders
722.0	Displacement of cervical intervertebral disc without myelopathy
722.1	Displacement of thoracic or lumbar intervertebral disc without myelopathy
722.2	Displacement of intervertebral disc, site unspecified, without myelopathy
722.3	Schmorl's nodes
722.4	Degeneration of cervical intervertebral disc
722.5	Degeneration of thoracic or lumbar intervertebral disc
722.6	Degeneration of intervertebral disc, site unspecified
722.7	Intervertebral disc disorder with myelopathy
722.9	Other and unspecified disc disorder
723.1	Cervicalgia
723.3	Cervicobrachial syndrome (diffuse)
723.4	Brachial neuritis of radiculitis NOS
723.9	Unspecified musculoskeletal disorders and symptoms referable to neck
724.1	Pain in thoracic spine
724.2	Lumbago
724.3	Sciatica
724.4	Thoracic or lumbosacral neuritis or radiculitis, unspecified
724.7	Disorders of coccyx
724.9	Other unspecified back disorders
726	Peripheral enthesopathies and allied syndromes
726.0	Adhesive capsulitis of shoulder
726.1	Rotator cuff syndrome of shoulder and allied disorders
726.10	Disorders of bursae and tendons in shoulder region, unspecified
726.11	Calcifying tendinitis of shoulder
726.12	Bicipital tenosynovitis
726.19	Other specified disorders
726.2	Other affections of shoulder region, not elsewhere classified
726.3	Enthesopathy of elbow region
726.30	Enthesopathy of elbow, unspecified

726.31	Medial epicondylitis
726.32	Lateral epicondylitis
726.33	Olecranon bursitis
726.39	Other
726.4	Enthesopathy of wrist and carpus
726.5	Enthesopathy of hip region
726.6	Enthesopathy of knee
726.60	Enthesopathy of knee, unspecified
726.61	Pes anserinus tendinitis or bursitis
726.62	Tibial collateral ligament bursitis
726.63	Fibular collateral ligament bursitis
726.64	Patellar tendinitis
726.65	Prepatellar bursitis
726.69	Other
726.7	Enthesopathy of ankle and tarsus
726.70	Enthesopathy of ankle and tarsus, unspecified
726.71	Achilles bursitis or tendinitis
726.72	Tibialis tendinitis
726.73	Calcaneal spur
726.79	Other
726.8	Other peripheral enthesopathies
726.9	Unspecified enthesopathy
726.90	Enthesopathy of unspecified site
726.91	Exostosis of unspecified site
727	Other disorders of synovium, tendon, and bursa
727.0	Synovitis and tenosynovitis
727.03	Trigger finger (acquired)
727.04	Radial styloid tenosynovitis
727.2	Specific bursitides often of occupational origin
727.4	Ganglion and cyst of synovium, tendon, and bursa
727.8	Other disorders of synovium, tendon, and bursa
727.9	Unspecified disorder of synovium, tendon, and bursa
728	Disorders of muscle, ligament, and fascia
729	Other disorders of soft tissues
729.1	Myalgia and myositis, unspecified
729.2	Neuralgia, neuritis, and radiculitis, unspecified
729.5	Pain in limb
729.8	Other musculoskeletal symptoms referable to limbs
840	Sprains and strains of shoulder and upper arm
840.0	Acromioclavicular (joint) (ligament)
840.1	Coracoclavicular (ligament)
840.2	Coracohumeral (ligament)
840.3	Infraspinatus (muscle) (tendon)
840.4	Rotator cuff (capsule)
840.5	Subscapularis (muscle)
840.6	Supraspinatus (muscle) (tendon)
840.8	Other specified sites of shoulder and upper arm
840.9	Unspecified site of shoulder and upper arm

841	Sprains and strains of elbow and forearm
841.0	Radial collateral ligament
841.1	Ulnar collateral ligament
841.2	Radiohumeral (joint)
841.3	Ulnohumeral (joint)
841.8	Other specified sites of elbow and forearm
841.9	Unspecified site of elbow and forearm
842	Sprains and strains of wrists and hand
842.0	Wrist
842.00	Unspecified site
842.01	Carpal (joint)
842.02	Radiocarpal (joint) (ligament)
842.09	Other
842.1	Hand
842.10	Unspecified site
842.11	Carpometacarpal (joint)
842.12	Metacarpophalangeal (joint)
842.13	Interphalangeal (joint)
842.19	Other
843	Sprains and strains of hip and thigh
843.0	Iliofemoral (ligament)
843.1	Ischiocapsular (ligament)
843.8	Other specified sites of hip and thigh
843.9	Unspecified site of hip and thigh
844	Sprains and strains of knee and leg
844.0	Lateral collateral ligament of knee
844.1	Medial collateral ligament of knee
844.2	Cruciate ligament of knee
844.3	Tibiofibular (joint) (ligament), superior
844.8	Other specified sites of knee and leg
844.9	Unspecified site of knee and leg
845	Sprains and strains of ankle and foot
845.0	Ankle
845.00	Unspecified site
845.01	Deltoid (ligament), ankle
845.02	Calcaneofibular (ligament)
845.03	Tibiofibular (ligament), distal
845.09	Other
845.1	Foot
845.10	Unspecified site
845.11	Tarsometatarsal (joint) (ligament)
845.12	Metatarsophalangeal (joint)
845.13	Interphalangeal (joint), toe
845.19	Other

846	Sprains and strains of sacroiliac region
846.0	Lumbosacral (joint) (ligament)
846.1	Sacroiliac (ligament)
846.2	Sacrospinatus (ligament)
846.3	Sacrotuberous (ligament)
846.8	Other specified sites of sacroiliac region
846.9	Unspecified site of sacroiliac region
847	Sprains and strains of other and unspecified parts of back
847.0	Neck
847.1	Thoracic
847.2	Lumbar
847.3	Sacrum
847.4	Coccyx
847.9	Unspecified site of back
955	Injury to peripheral nerves of shoulder and upper limb
959	Injury, other and unspecified
959.2	Shoulder and upper arm
959.3	Elbow, forearm and wrist
959.4	Hand

B. **Document Problem Using Injury/Morbidity Databases**

A number of sources of information exist that can provide documentation of the extent of the ergonomic hazards and work-related musculoskeletal disorders. Definitions and classifications of work-related musculoskeletal disorders, as well as industrial and occupational coverage, differ among these databases. However, while each of these databases are somewhat limited, they are complementary and provide a collective resource to determine high-risk industries and occupations. These databases may also provide information on trends in incidence of work-related musculoskeletal disorders. Available databases are:

1. **Occupational Injuries and Illnesses in the United States by Industry**

   This is a national sample conducted annually by the Bureau of Labor Statistics that covers all industries except state and local government and farms with fewer than 10 workers. It does not have information on occupation. The disease category that is relevant is "Diseases associated with repeated trauma." This category is defined by examples: conditions due to repeated trauma, vibration, or pressure, such as carpal tunnel syndrome; noise-induced hearing loss; synovitis, tenosynovitis, and bursitis; and Raynaud's phenomena.

2. Workers' Compensation - Bureau of Labor Statistics (BLS) Supplemental Data System (SDS)

This database contains data on workers' compensation that includes industry and occupation. Diseases are coded by a modified American National Standards Institute (ANSI) Z216.2 classification system that is somewhat more specific than the BLS annual survey. The disease categories that are relevant are sprains and strains; inflammation and irritation of joints, tendons, or muscles; and diseases of peripheral nerves and ganglia. This database also identifies the part of body affected. Therefore, any of these disease categories can be sorted by part of body affected, e.g., inflammation of knees. Examples from the BLS-SDS are attached as Exhibit 1. Some disadvantages of this database are that it does not cover all states and in the latest year, 1988, only 14 states were involved. Over the years many more states reported, but never all 50. The reporting parameters also varied. Some states reported closed cases, some reported cases occurring during the year, and some reported cases entered into their system during the year. Some of the data were first reports and a portion of these would not be valid claims. Another disadvantage is that the state laws vary with regard to the number of days of disability required, the requirements for coverage that may exclude chronic conditions, etc. A substantial advantage is that it covers all workers in agriculture, and state and local government.

3. Social Security Disability Data

This is a national database administered by the Social Security Administration that covers permanently disabled workers. A disadvantage is that work relatedness of the disability does not have to be established. Advantages are that it covers all employed workers, diseases are coded according to the ICD [DHHS 1989], industries are coded according to the Standard Industrial Classification (SIC) to the 3-digit level, and occupations are coded by the Dictionary of Occupational Titles. NIOSH analyses of the data, as summarized in Exhibit 2 for 1969-72 and 1975-76, give some information on disability by industry and occupation. More recent data could be studied. There is an annual summary of disease categories by major industry division that is included in Exhibit 2. The specificity of the disease classification of this database exceeds that of the two databases described in sections I.B.1. and I.B.2, and will be more useful for chronic diseases because it is more specific for disease and it is restricted to permanent disabilities. Therefore, the Social Security Disability database is useful for studying chronic diseases.

4. National Health Interview Survey (NHIS) - Core Data

The National Health Interview Survey conducted by the National Center for Health Statistics is an ongoing survey of health conditions in the non-institutionalized, civilian population of the United States. Each year about 50,000 households are surveyed, collecting information on about 120,000 persons. Information is collected on chronic conditions, using six condition lists. Each respondent is administered one of the lists. Conditions that are relevant for the surveillance of work-related musculoskeletal disorders are lumbago; sciatica; slipped or ruptured disc; repeated trouble with neck, back; or spine; bursitis; and any disease of the muscles or tendons. Current estimates from the 1988 NHIS reported 17.7 slipped or ruptured discs per 1,000 persons and 18.4 cases of bursitis per 1,000 persons. Frequencies for the other conditions were not reported. Information on the current occupation of those persons in the workforce is available but there is no definite information on the work-relatedness of the conditions.

5. National Health Interview Survey - 1988 Occupational Health Supplement

In 1988, supplementary questionnaires on various occupational health effects were added to the core questionnaire. Sections related to work-related musculoskeletal disorders were on back pain and hand discomfort including carpal tunnel syndrome. Based on stratified sampling of the population, this supplementary database provides statistically defined estimates of the self-reported conditions for various industry/occupation categories. It includes basic demographic information (age, sex, race, region), prevalence and rate of self-reported and medically-diagnosed carpal tunnel syndrome, back pain, and hand discomfort. Repetition, posture, and vibration are self-reported as exposure indicators for carpal tunnel syndrome. A disadvantage of these data is the cases are self-reported without medical validation. Self-reported cases without validation may result in an overestimate or an underestimate.

6. National Occupational Exposure Survey

The National Occupational Exposure Survey conducted by NIOSH in 1982-83 collected data on a number of ergonomic hazards. It can provide information on the number of workers exposed to a specific hazard by occupation and industry sector. A limitation of this database is that it did not cover all industries, or state and local government. Another limitation is the data were observational and were not quantified. It is important to note that this survey excluded finance,

insurance, real estate, restaurants, and government agencies, as well as most of the retail and wholesale trade, agricultural, and marine industries. Ergonomic disorders are a recognized occupational health problem in some of these industries.

NIOSH can provide descriptive analyses for 10 "Chronic Trauma" exposures (whole-body vibration, segmental vibration, passive postures, awkward postures, lifting postures, arm-transport movements, shoulder-transport, hand/wrist manipulations, finger manipulations, machine-paced work) plus two forms of vibration (whole body and segmental) defined in the Survey Manual of the 1981-1983 National Occupational Exposure Survey (NOES) [NIOSH 1988]. The following are the analyses that NIOSH can provide:

(1) Estimates of the number of workers (by gender) potentially exposed to each of the cited chronic trauma and vibration hazards.

(2) Stratification of the estimates described in section I.B.6.(1) by Standard Industrial Classification (SIC).

(3) Stratification of the estimates described in section I.B.6.(1) by 1980 census occupational codes and titles across industries.

(4) Estimates of the national number of facilities by Major Industrial Group (i.e., construction and manufacturing) and by 2-digit SIC in which workers are potentially exposed to ergonomic hazards that were included in the survey.

(5) Estimates of the number of facilities or potentially exposed workers as discussed in sections I.B.1. through I.B.4., produced in tabular form by industrial facility employment size ranges.

7. SENSOR Programs

Several state health departments entered into cooperative agreements with NIOSH in 1987 to pilot surveillance strategies for carpal tunnel syndrome based primarily on physician reporting of occupational disease cases. While the programs had varying success in ascertaining cases, the project resulted in two reports by the California Department of Health Services [1990; 1991]. One was a survey of 515 health care providers in Santa Clara County; the respondents estimated caring for 7,214 cases of carpal tunnel syndrome, of which 3,413 cases (45%) were considered to be work-related. The

second report summarizes the demographics, occupation, and industry of the 239 work-related Santa Clara County carpal tunnel syndrome cases reported to the surveillance system in 1989-91; patient questionnaire data, that have not been reported to NIOSH and may not yet have been analyzed, include information on symptoms, treatment, and occupational and non-occupational carpal tunnel syndrome risk factors.

Currently two states (Wisconsin and Massachusetts) are conducting SENSOR-sponsored surveillance for carpal tunnel syndrome. These data will include demographic, occupational, and some treatment and risk factor information on carpal tunnel syndrome cases identified through physician reporting, workers' compensation, and hospital reports of carpal tunnel release surgery. Data sources will include patient questionnaires, review of medical records, employer interviews, and, in select cases, workplace visits.

II. SCOPE AND APPLICATION OF ERGONOMICS STANDARD

NIOSH recommends that the standard be limited to ergonomic hazards that cause or aggravate work-related musculoskeletal disorders as defined in Section I.A., and that the standard apply to all industrial divisions under OSHA jurisdiction. Reasons for this are that all employers should be required to conduct a survey of the workplace to determine if workers are exposed to ergonomic hazards as defined in the standard and to conduct a survey of the workers' medical records to determine if there are reports of work-related musculoskeletal disorders. This approach is recommended for the following reasons. The biomechanical stresses on workers preforming repetitive tasks are extremely complex. Very small changes in initial conditions such as the amount of force exerted, the distance over which the force is exerted, the number of repetitions, the lengths of various bones and tendons in individual workers, the temperature, recovery times, and many other factors may result in extreme changes in the biomechanical stress exerted on various anatomical groups.

There are reports of excess work-related musculoskeletal disorders related to a number of specific job tasks such as upper body complaints among meat cutters in the meatpacking industry [OSHA 1990], hand-wrist problems in grocery checkout workers [Morganstern et al. 1991], knee injuries in carpet layers [NIOSH 1990] and dairy farmers [Anderson et al. 1989]. There are also studies reporting statistically significant increases in hand-wrist disorders and tasks involving high force and high repetition compared to tasks involving low force and low repetition in several industrial classifications [Armstrong et al. 1985].

The Bureau of Labor Statistics (BLS) Supplementary Data System (SDS), based on data from 25 states, reported for 1987 (see Exhibit 1):

- 541,000 cases of sprains and strains: 261,000 of those involved the back and 103,000 involved the lower extremities; 326,000 of these sprains and strains were reported as due to overexertion.

- 25,000 cases of dislocations: approximately one-half of the cases involved the back and one-tenth involved the lower limbs; over one-half were due to overexertion.

- 14,500 cases of inflammation or irritation of the joints, tendons, or muscles: 10,600 of these cases involved the upper extremities and 1,000 involved the lower extremities.

- 10,700 cases of diseases of the peripheral nerves: 8,400 of these involved the upper extremities.

Available surveillance data and NIOSH research and health hazard evaluation (HHE) studies suggest that work-related musculoskeletal disorders may exist in all industrial divisions. For example, in the 1988 BLS data from 14 states, 1209 4-digit SIC codes experienced one or more cases that meet the definition of work-related musculoskeletal disorders. The industries that experienced more than 1000 cases were:

BLS WORKERS' COMPENSATION CASES DUE TO
WORK-RELATED MUSCULOSKELETAL DISORDERS (1988)

Industry Description	SIC Code	Number of Cases
Oil & gas field services, NEC*	1389	1158
Residential building construction	1520	1647
Nonresidential building construction	1540	2074
Highway & street construction	1611	3097
Water, sewer & utility lines	1623	1074
Heavy construction, NEC	1629	1305
Plumbing, heating, air conditioning	1711	3145
Electrical work	1731	1731
Plastering, drywall & installation	1742	1552
Roofing and sheetmetal work	1761	1272
Concrete work	1771	1035

*NEC = not elsewhere classified.

Industry Description	SIC Code	Number of Cases
Special trade contractors, NEC	1799	1175
Meatpacking plants	2011	2372
Bottled & canned soft drinks	2086	1303
Men's & boy's work clothing	2328	1251
Sawmills & planing mills, general	2421	1902
Miscellaneous plastics products	3079	3996
Machinery, except electrical, NEC	3599	1027
Motor vehicles & car bodies	3711	1554
Motor vehicle parts & accessories	3714	3195
Trucking, local & long distance	4210	5291
Certificated air transportation	4511	1497
Refuse systems	4953	1926
Groceries & related products	5140	1331
Groceries, general line	5141	1612
Lumber & other building materials	5211	1412
Department stores	5310	1662
Department stores	5311	3786
Grocery stores	5410	3445
Grocery stores	5411	7666
New & used car dealers	5511	1469
Auto & home supply stores	5531	1017
Eating & drinking places	5810	3230
Eating places	5812	5255
Real estate operators & lessors	6510	1335
Hotels, motels, & tourist courts	7010	1081
Hotels, motels, & tourist courts	7011	2385
Building maintenance services, NEC	7349	1212
Personnel supply services	7360	1186
Temporary help supply services	7362	2423

Industry Description	SIC Code	Number of Cases
Miscellaneous amusement & recreational services	7990	1184
Nursing & personal care facilities	8050	1844
Skilled nursing care facilities	8051	4844
Nursing & personal care, NEC	8059	4518
Hospitals	8060	4791
General medical & surgical hospital	8062	9777
Psychiatric hospitals	8063	1498
Elementary & secondary schools	8210	3468
Elementary & secondary schools	8211	5614
Colleges & universities	8221	1688
Residential care	8361	1604

There are 422 occupations at the 3-digit coding level that experienced disability from work-related musculoskeletal disorders. Those occupations with more than 1000 cases of musculoskeletal disorders were:

OCCUPATIONS WITH MORE THAN 1000 WORKERS' COMPENSATION CASES, 1988, 14 STATES, MUSCULOSKELETAL DISORDERS

Occupation	1980 Census Code	Number of Cases
Managers, NEC	019	2651
Management related occupations	020	1505
Registered nurses	095	3931
Licensed practical nurses	207	2342
Health technicians, NEC	208	1263
Sales occupations, supervisors	243	2740
Retail sales workers	260	9365
Secretaries	313	1140
Shipping clerks	364	2598
Stock clerks	365	1810

Occupation	1980 Census Code	Number of Cases
General office clerk	379	1176
Firefighters	417	1914
Police & detectives	418	1793
Waiters & waitresses	435	1618
Cooks	436	2871
Kitchen workers, food preparation	439	1475
Miscellaneous food preparation	444	3025
Health aides, except nursing	446	1433
Nursing aides & attendants	447	15131
Maids & housemen	449	4306
Janitors & cleaners	453	9151
Farm workers	479	2860
Groundskeepers	486	2911
Automobile mechanics	505	2758
Truck mechanics	507	1485
Industrial machinery repairers	518	1442
Specified mechanics, NEC	547	1324
Not specified mechanics	549	2073
Construction supervisors	550	1179
Carpenters	567	4537
Electricians	575	1983
Painters	579	1234
Plumbers, pipefitters	585	2073
Construction trades, NEC	599	1311
Precision production supervisors	633	1649
Machinists	637	1159
Butchers & meat cutters	686	1891
Punching & stamping machine operators	706	1325
Molding & casting machine operators	719	1271

Occupation	1980 Census Code	Number of Cases
Textile sewing machine operators	744	1860
Packaging & filling machine operators	754	1980
Miscellaneous machine operators, NEC	777	6115
Machine operators, not specified	779	4432
Welders & cutters	783	3164
Assemblers	785	9021
Miscellaneous hand workers	795	1122
Production inspectors	796	1627
Truck drivers, heavy & light	804	14623
Driver - sales workers	806	3226
Bus drivers	808	1701
Industrial truck & tractor operators	856	1625
Miscellaneous material moving equipment	859	1132
Helpers, construction trades	865	1232
Construction laborers	869	6708
Production helpers	873	2371
Garbage collectors	875	1496
Stock handlers & baggers	877	5343
Machine feeders & offbearers	878	1622
Freight, material handlers, NEC	883	8523
Garage, service station occupations	885	1180
Hand packers & packagers	888	2042
Laborers, except construction	889	21991
Unclassifiable	999	2145

These data show the pervasiveness of work-related musculoskeletal disorders throughout standard industrial and occupational classifications, and also indicate that certain areas in the same industrial and occupational classifications do not exhibit equal risk. For this reason, NIOSH recommends that all industries be covered by the OSHA ergonomic safety and health management standard. However, NIOSH recommends a two-part approach for

addressing ergonomic hazards that would first require the employers to review job tasks and medical records, and second, based on the results of this review, proceed to a complete ergonomics management program. The first step would require the employer to conduct a workplace survey using methods described in section III.A. with concentration on simple methods such as checklists. The employer would also be required to review records in order to determine whether any cases of work-related musculoskeletal disorders are occurring using passive surveillance methods as described in section III.C.1. If there are ergonomic hazards and there is no evidence of work-related musculoskeletal disorders, a person trained in ergonomics should evaluate the ergonomic hazards to determine if there is a significant risk of work-related musculoskeletal disorders. If work-related musculoskeletal disorders are identified or a significant risk of work-related musculoskeletal disorders has been determined, the employer should develop a complete ergonomic management program to abate the ergonomic hazards and reduce the risks of injury.

Further analysis of the existing databases noted in I.B. and the results of ongoing research may identify specific industries, occupations, and job tasks where OSHA should require the development of an ergonomics management program regardless of the results of an employer review.

III. ELEMENTS OF AN ERGONOMICS MANAGEMENT PROGRAM

NIOSH presents in this section five elements of an ergonomics management program: 1) worksite analysis, 2) hazard control, 3) health surveillance, 4) medical management, and 5) training and education. An ergonomics management program should be tailored specifically to each location, its workers, and their unique problems.

Management commitment and worker involvement are critical to the success of an ergonomics management program [OSHA 1990]. Management commitment is demonstrated by a written ergonomics management policy, the establishment of an ergonomic task force or committee, and a commitment to regular review and accountability. Worker involvement is manifested by their role as active participants on the ergonomic task force, providing feedback, identifying potential ergonomic problems, developing solutions related to equipment and work procedures, and providing early reports of symptoms.

A. WORKSITE ANALYSIS

The purpose of worksite analysis (ergonomic hazard evaluation) is to identify hazards that cause work-related musculoskeletal disorders. The ergonomic hazard evaluation process can be divided into two parts. The first stage involves an evaluation of job demands to identify the requirements of the task. In the second stage, job demands are compared to known human capacities. If task requirements do, in fact, exceed the capabilities of the workforce, control measures may be indicated.

Evaluation of Job Demands

The demands of most industrial jobs are a function of the work environment. The work environment can be described in terms of three basic components. These are:

- The tools, machines, parts and materials required for the job.
- The workstation and the physical environment.
- The task, including its content and the organizational environment in which it is performed.

A generic definition of tools may include hand tools, powered tools, machines, computer terminals and keyboards, instruments and their component parts. Traditionally, ergonomic evaluations begin with an investigation of the tools and equipment used in the workplace. Tools that require awkward postures and repeated forceful exertions, or transmit vibration to the hand have been implicated in the development of upper extremity musculoskeletal disorders [Putz-Anderson 1988].

The workstation can include tables and benches, stools and chairs, controls and displays, vehicle cabs, checkout stands, and storage bins. The physical environment includes lighting, noise levels, air quality, temperature, and ventilation. Both factors can have significant effects on comfort and functional ability as well as health. Ergonomic deficiencies in the workstation and physical environment may not be as obvious as tool design deficiencies, and special measurements (e.g., sound, illumination) may be required to identify problematic aspects. Correcting these problems may require greater capital expense (e.g., major facility renovations) than changes in tool design [Snyder et al. 1991].

Finally, task and organizational factors are increasingly recognized as important to the health, safety, productivity and satisfaction of workers. Job content (i.e., simple, routine versus complex, varied duties), work scheduling, work pacing, management style and climate, worker autonomy, feedback, worker support, opportunity for advancement, and training, are variables that can contribute to a positive work environment or, alternatively, produce stress. These "psychosocial" factors have been associated with low back pain in industrial workers and neck-shoulder symptoms in office workers [Linton and Kamwendo 1989; NIOSH 1992a; NIOSH 1992b; Wilson and Grey 1984]. Unfortunately, these factors are often the most difficult part of the work environment to evaluate. Although work rate is usually easy to measure, other problems emanating from job/organization factors are usually less evident from a physical inspection of the workplace and are often far more difficult to correct.

Although some studies may be limited to an investigation of tool and workstation factors, a thorough ergonomic hazard evaluation should examine the interaction of the worker with all three

components of the work environment. Some hazards result from interactions between tool, workstation and job design characteristics. To accurately characterize the severity of the hazard, an investigation of all three components is necessary. For example, poor workplace design, involving poor chair design or visual display problems, may have only modest consequences for workers with moderate production demands or for professionals able to exercise control over the work regimen. The same design flaws may have far more important implications for workers with more stringent performance demands or little control over their work regimen.

There are no generic procedures for conducting an ergonomic evaluation of the workplace; the specifics of an investigation are dependent on a number of constraints, and procedures must be tailored to the individual workplace. However, the protocol for conducting an ergonomic evaluation usually follows one of two formats [Putz-Anderson 1988]. One approach, referred to as task analysis, involves adaptations of traditional work measurement methods for the purpose of documenting and measuring exposures to ergonomic stressors. A second approach involves use of an ergonomic checklist. A brief description of each approach is provided below.

Task Analysis. Task analysis refers to a broad spectrum of methods used to analyze observable and covert human behavior for the purpose of identifying the performance demands of jobs and job tasks [Drury et al. 1987]. Once task elements and job demands are determined, the analyst can decide whether these demands fall within the capabilities of workers and whether controls and task modifications are needed [Putz-Anderson 1988; Saito 1987]. Task analysis can lead to workplace redesign or tool developments that will eliminate or reduce the hazards of a task. For example, the task of stretching carpets involved the use of knee kicking tools that damaged the knees of carpet layers. A number of mechanical tools have been developed that can eliminate or substantially reduce the use of hazardous knee kickers [NIOSH 1990].

One method, time and motion analysis, determines what the worker is doing and how it is being done over a given time period. Motion analysis is now used by ergonomists to identify excessive manual repetitions and awkward and static postures of jobs that pose a risk of musculoskeletal disorders. Timed activity analysis can also be useful for analyzing complex tasks, with varying levels of detail including irregular activities, and describing simple tasks with very repetitive, short-cycle job elements [Barnes 1983; Drury 1983]. Putz-Anderson et al. [1992] developed an expanded version of a timed activity analysis for application to complex office tasks. Their goal was to develop an objective method to evaluate stressful job designs that posed a risk to clerical workers for developing musculoskeletal disorders.

Checklists. Ergonomic checklists can be used as an alternative or supplement to task analysis methods. Persons with limited formal training can often use checklists to identify common hazard sources in a fairly short period of time, while ensuring that systematic and standardized procedures are followed. Examples of items that might be found on an ergonomic checklist are described by Lifshitz and Armstrong [1986]. Examples of checklists have also been included in Exhibit 3. Users should be cautioned that most checklists are not comprehensive enough to cover the entire spectrum of risk factors that may be present at any specific worksite. Therefore, existing checklists should be customized and evaluated in a walk-through survey to ensure that the questions are appropriate to the worksite of interest [Putz-Anderson 1988].

Evaluation of Human Capacities

For most biomechanical factors, the limits of human capacity have not been defined. The interaction between normal human biomechanical variables and environmental variables may make it difficult to arrive at general principles that can be applied to specific tasks. Thus, in an ergonomic evaluation, it is difficult to determine if job demands exceed acceptable limits of human capacity. Anthropometric tables can help determine if workstation design is compatible with the user. Other studies provide guidance on normal human strength capacities in particular work situations [Kamon et al. 1982; Mathiowetz et al. 1985]. An epidemiological study across several industries and tasks suggests that workers who are subjected to highly repetitive jobs that also involve high manual force exertion are at greater risk for upper extremity musculoskeletal disorders [Armstrong et al. 1985]. The NIOSH Work Practices Guide for Manual Lifting [1981] is based on studies that indicate that a number of variables, including job factors and personal factors, influence the amount of weight a person can lift without back injury. Formulas for calculating load limits for lifting tasks based on analyses of biomechanical stresses on the lower back, data on the lifting strength capabilities of the working population, and psychophysical studies of acceptable exertion levels have been published [Putz-Anderson and Waters 1991].

Where existing data are insufficient to indicate the magnitude of hazards associated with a particular task, additional indicators of task difficulty are task performance, physiological response, and the worker's subjective assessment of the workload [Meister 1985].

Performance measures. Performance measures quantify the productivity and quality of output by the worker. Job demands that exceed workers' capacities may be manifested by decrements in performance measures [Barnes 1983]. Common performance measures include the following [Meister 1985]:

1. Time:
   - Reaction time
   - Activity duration time

2. Accuracy
   - Observation errors
   - Response errors

3. Frequency of Occurrence
   - Number of responses per unit or interval
   - Number of errors per unit or interval

4. Amount Achieved or Accomplished
   - Percent of activities accomplished
   - Degree of success

5. Consumption or Quantity Used
   - Units consumed to accomplish activity
   - Units consumed per unit time

Generally, the best performance measures are those that are objective, quantitative, unobtrusive and easy to collect without specialized instrumentation [Meister 1985].

Performance test batteries can also be used to evaluate worker performance and subjective fatigue. Decrements in performance over the course of a work shift may indicate decreased alertness and increased fatigue due to work place conditions. A successful performance test battery was developed by NIOSH researchers to evaluate fatigue effects from shift work and long workdays [Rosa et al. 1985].

Physiological measures. Physiological measures can be used to evaluate an individual's response to controlled working conditions. Non-invasive monitoring techniques that do not interfere significantly with job performance can be used at the worksite to assess the effects of work demands on individual muscle activity or whole body cardiovascular function. Physiological indicators of whole-body stress include heart rate, blood pressure, oxygen consumption, and body temperature. Indicators of localized stress include surface electromyography (EMG), tremor measurements and ratings of perceived exertion [Meister 1985].

Subjective assessment measures. Subjective ratings of perceived exertion or comfort can be used to measure human capacity. An advantage of perceived exertion ratings is that they integrate information from the peripheral muscles and joints, cardiovascular and respiratory functions, and the central nervous system into a

single measure. Perceived exertion scales have been found particularly valuable in studies of short-term static work for which valid physiological measures are difficult to obtain [Rosa et al. 1985].

Inherent deficiencies in the use of subjective measurements are: lack of fundamental units for measuring perceived exertion [Rosa et al. 1985]; the worker may be unaware of the extent to which he/she is stressed, he/she may confuse mental and physical effort, and his/her estimates may change over time [Meister 1985]. Nonetheless, psychophysical scales have been used successfully in a number of ergonomic investigations of work tasks, and high correlations have been demonstrated between subjective ratings and physiological variables [Gamberale 1972].

B. HAZARD CONTROL [TO BE SUBMITTED TO OSHA AT A LATER DATE]

C. HEALTH SURVEILLANCE

General Principles

This section outlines suggestions for development and use of a workplace health surveillance program to identify, record, track and ultimately prevent and reduce work-related musculoskeletal disorders.

Surveillance has been defined as:

> "The ongoing systematic collection, analysis and interpretation of health and exposure data in the process of describing and monitoring a health event. Surveillance data are used to determine the need for occupational safety and health action and to plan, implement and evaluate ergonomic interventions and programs" [CDC 1988].

Components of a Surveillance System

The health surveillance program for a workplace should incorporate both passive surveillance and active surveillance elements.

Passive surveillance is the collection and analysis of data obtained from existing record sources to identify patterns of disease within a workplace group. The record sources are usually readily available and may be used to determine if a work-related musculoskeletal disorder exists, and to detect disease trends in the group at risk.

Active surveillance involves the development of a system to obtain

data with which to determine the patterns or trends of work-related musculoskeletal disorders with greater sensitivity than a passive surveillance system. That is, active surveillance might identify symptoms that may be indicators of developing work-related musculoskeletal disorders not captured by classic case definitions, as in the ICD, or identifies factors that may put workers at greater risk for work-related musculoskeletal disorders.

1. **Passive Surveillance**

Information Sources: Record systems or information used for passive surveillance generally are collected for purposes other than surveillance. Types of records that have been successfully used in passive surveillance systems, include OSHA 200 logs, plant clinic records or nurses logs, workers' compensation records, insurance claims, and accident reports. Other records that might be used include absentee records, job transfer applications, and other documented problems about particular jobs.

Evaluation of information: Review of information should occur routinely, e.g., yearly, but the frequency of which may be dependent upon the extent of the problem of work-related musculoskeletal disorders. Specific diagnoses may be coded according to the current version of the International Classification of Diseases (ICD). Calculation of job-specific incidence rates (rate of work-related musculoskeletal disorders appearing for the first time during a specified period), and job-specific prevalence rates (rate of all work-related musculoskeletal disorders occurring during a specified period) will help to identify jobs in which workers have work-related musculoskeletal disorders or are suffering physical discomfort from the jobs. The severity of the problem may be determined by examining the number of disability days.

Incidence (new case) rates (per 100 worker-years per year) may be calculated as follows:

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

Prevalence rates (all cases during the period) (per 100 worker-years per year) may be calculated as follows:

$$\frac{\text{total \# cases in the past 12 months x 200,000 hours}}{\text{\# work hours during the past 12 months}}$$

Limitations: Passive surveillance is limited by a number of factors, most of which are specific to the types of information being used. Some information sources, such as the OSHA 200 logs and clinic logs provide varying data quality, particularly in completeness (capture of all appropriate events) and accuracy of entries. Medical logs may also be variable due to the availability of an onsite clinic, management's attitude about the use of the clinic, and training of the clinic staff about occupational safety and health.

Information obtained through workers' compensation records; insurance records and personal medical provider records may vary due to a number of factors. These factors include: a worker's likelihood or ability to seek and obtain medical care, the ability or likelihood of the medical care provider to diagnose work-related musculoskeletal disorders correctly, and variations in data recording in the various record sources.

Surveillance data will be limited by information biases of various types. For example, health outcomes can be misclassified as a result of non-uniformity in the methods used by different data sources to classify specific health conditions. In addition, there will be some degree of underreporting in comparison to questionnaire-defined symptoms that appear to be a more accurate measure of the rate of symptoms and disorders. In general, neither of these problems is a serious problem for a passive surveillance system in which an effort has been made to establish some simple uniform reporting criteria and in which there are no major disincentives for workers to report their health problems. Moreover, the problem of health outcome misclassification is also mitigated by the fact that analysis of this type of data is generally done by body region.

2. Active Surveillance

Data Sources: Data can be obtained through periodic worker health surveys. The surveys should collect information on current and past symptoms, anatomical location, and duration and frequency of the symptoms. An advantage of questionnaires is that they are usually easy to administer and provide a quick method for identifying worker's perceptions of hazards and sources of discomfort. One particularly common and easy-to-use format is the "body part discomfort survey". The worker is given a picture of the body and asked to rate the level of comfort/discomfort experienced in different parts [Corlett 1976]. Similarly, the chief advantage of questionnaires and interviews is that they are often successful at eliciting information about job-related

complaints and symptoms that would otherwise go undocumented. If large numbers of workers in a specific job or department report job-related discomfort, an investigation of tool, workstation layout, or job design may be indicated.

Symptoms have been the principal method to determine the prevalence and incidence of work-related musculoskeletal disorders in several scientific studies [Siverstein et al. 1986; Bongers 1992; Pope et al. 1991]. Symptoms have been one of the principal outcome measurements in studies of the effectiveness of therapeutic procedures including surgical procedures and exercise programs [Silverstein et al. 1988]. Not only have ergonomists traditionally used changes in the symptoms by body region to evaluate the effectiveness of intervention efforts that lead to redesigned work station layouts and processes, but in NIOSH studies it has been found that over seventy percent of workers with moderate or severe symptoms have at least one positive physical finding on a concurrent physical examination [Baron et al. 1992].

A simple questionnaire should be used that is based on the questionnaire in the OSHA Ergonomics Program Management Guidelines for Meatpacking Plants [OSHA 1990]. Alternatively, the standardized Nordic questionnaires are acceptable for the analysis of musculoskeletal symptoms or a simple postural discomfort scale [Kuorinka et al. 1987].

A questionnaire should identify the location of symptoms, whether they are present at the time the questionnaire is administered, and some measures of their severity. The advantage of the simpler questionnaires is that a smaller facility with limited resources could easily administer and analyze the data. The slightly longer surveys are still easy to administer, but would allow a more sophisticated analysis of the problem, particularly for companies with a large workforce or multiple facilities.

Written questionnaires are relatively inexpensive to administer—workers can complete them at their convenience, and responses can be kept anonymous. A limitation of questionnaires, however, is that they can yield limited information. Symptom surveys are usually sensitive to work-related musculoskeletal disorders, but are poor at discriminating specific disorders or indicating the cause of the complaint. Factors such as the length of the questionnaire, the wording of the instructions, and the time and method of administration have a significant impact on the rate of response and the reliability of the data.

Evaluation of Data: Job-specific incidence and prevalence rates can be calculated using a variety of case definitions,

e.g., symptoms only or symptoms and an abnormal physical examination, neither of which are found in passive surveillance data. Information on the severity and frequency of symptoms should be used in determining which problems should be given the highest priority. The definitions and formulas for calculation of incidence and prevalence are included in the section on Passive Surveillance.

Frequency of Surveys: Surveys should be initiated as follows:

a. When evidence from passive surveillance or job analysis suggests an increase in work-related musculoskeletal disorders or a preponderance of ergonomic stressors;

b. Before and after institution of new jobs/tasks/tools/and process changes;

c. When new workers are hired, they should complete a symptom questionnaire prior to beginning work.

Limitations and Issues on Active Surveillance:

a. Active surveillance programs are generally more costly to conduct than passive surveillance;

b. Active surveillance programs depend on the accuracy of worker responses;

c. Questions must be worded so that they are understood by the workers, e.g., pretest the questions to insure that the respondents understand the information that is needed and multi-lingual versions should be created if needed;

d. Workers must understand the purpose of the surveys;

e. The effect of repeatedly asking the same questions over an extended period, as in yearly or periodic health interviews, has not been determined.

D. MEDICAL MANAGEMENT

A medical management program should promote early detection and prompt recovery from work-related musculoskeletal disorders when these disorders are not prevented. The program should also prevent aggravation of musculoskeletal disorders that could occur in workers due to non-occupational activities. Not only can work cause these disorders but it can aggravate them. The specific goals of medical management are the elimination or reduction of symptoms and functional impairment, and a return to work in a manner consistent with protecting the health of the worker.

Effectiveness

There is evidence that early treatment of low back pain and work-related musculoskeletal disorders of the upper extremity reduces their severity, duration of treatment and ultimate disability [AAOS 1991; Flowerdew and Bode 1942; Thompson et al. 1951; Haig et al. 1990; Leavitt et al. 1971; Frymoyer et al. 1983; Lutz and Hansford 1987; Mayer et al. 1987]. Accordingly, medical management policies that encourage workers to report symptoms early and employers to send their symptomatic worker for prompt medical evaluation and treatment may reduce the long-term severity and disability from these work-related musculoskeletal disorders. In addition, these policies create the conditions for an effective health surveillance system.

Because the scientific studies suggest that early intervention may be more effective than late intervention, and since, in general, the cost of care generally increases as these disorders become severe and chronic, medical management protocols should be directed at both mild and severe disorders. The evaluation and treatment approaches for early, mild or intermittent disorders are generally simple and can be provided by many different types of health care providers.

Medical Management Protocol Requirements

1. General Principles of Medical Management

Several principles should underlie the development of either voluntary or mandated medical management protocols. These include:

a. definition of work-related musculoskeletal disorders,

b. promotion of early reporting of symptoms and the avoidance of disincentives (e.g., reprisal) that may discourage reporting,

c. prompt access to care by the symptomatic worker,

d. the emphasis of non-surgical, therapeutic measures (e.g., rest) over surgical procedures in most cases, and

e. medical monitoring following an injured worker's return to work to prevent the recurrence of the disorder; and

f. establishment of an appropriate recovery period.

The clinical course of most work-related musculoskeletal disorders can be divided into three phases: acute (less than one month from the onset), subacute (one to three months), and chronic (greater than 3 months). Chronic disorders that are

severe enough to prevent return to work are associated with a poor prognosis. In an attempt to alter this poor prognosis, a number of comprehensive rehabilitation programs have been developed. There is limited evidence that these programs may be partially successful in returning injured workers to employment [Feuerstein 1992].

2. **Health Care Provider**

Any health care provider with training in work-related musculoskeletal disorders who is licensed and/or registered and practicing within the scope of their license and/or registration could develop a medical management protocol. However, the concepts of primary and secondary prevention should be incorporated in the training of the health care providers. Training and education should be strongly encouraged that address the causes of work-related musculoskeletal disorders, appropriate methods of clinical evaluations, identification of job hazards by workplace inspection, review of written job description or videotape recording of work processes, and the benefits of early evaluation should be strongly encouraged.

3. **Job Evaluations**

Job evaluations are predictive to some extent of risk of developing work-related musculoskeletal disorders. As discussed earlier, the overall epidemiological, biomechanical, and psychophysical laboratory studies support the basic hypothesis that physical job factors such as force, repetition, and awkward posture are associated with elevated rates of symptoms and disorders. A reasonable extension of this body of scientific studies is that workers with work-related musculoskeletal disorders are at higher risk if they continue to be exposed once the condition develops.

4. **Periodic Walkthroughs**

These have been recommended in the OSHA Meatpacking Guidelines [OSHA 1990]. As stated earlier in this section, the health care provider should understand the specific job risk factors for each patient or worker who is being evaluated.

5. **Rehabilitative Medical Management**

As stated earlier, evidence exists to support early intervention and treatment of work-related musculoskeletal disorders in order to decrease the cost, severity, and days of

disability. The following recommendations are not meant to substitute for sound medical practice. Standards of medical care change over time; therefore, it is the responsibility of the treating health care provider to render care consistent with current clinical practice.

a. Early Reporting

All workers should receive training regarding the signs and symptoms of work-related musculoskeletal disorders and be encouraged to report such symptoms to their employer. Such reporting allows for prompt evaluation, and, if necessary, treatment of the symptoms. Early treatment of many medical conditions, including musculoskeletal disorders has been shown to reduce their severity, duration of treatment, and ultimate disability [Flowerdew and Bode 1942; Thompson et al. 1951; Haig et al 1990; Leavitt et al. 1971; Frymoyer et al. 1983; Lutz and Hansford 1987; Mayer et al. 1987]. Workers must not be subject to reprisal or discrimination based on such reporting. Employers should also address any financial or other disincentives that discourage workers from reporting their symptoms.

b. Access to Care

Workers reporting signs and/or symptoms suggestive of work-related musculoskeletal disorders should be evaluated by an appropriate health care provider before the worker's next workshift. This is consistent with the risk of continued exposure as discussed earlier.

c. Summary of Health Care Providers' Evaluation

The health care provider who recommends a specific treatment plan for a symptomatic worker should first conduct a medical history to obtain an appropriate characterization of the symptoms, description of work activities, and a past medical history including past trauma to the symptomatic area, prior treatment of musculoskeletal disorders, non-work activities such as hobbies, and other existing diseases.

In assessing the role of work in causing musculoskeletal symptoms and disorders and determining whether a symptomatic worker can continue to work safely, the health care provider will, in general, need to understand the worker's job tasks by visiting the workplace, viewing jobs tasks recorded on videotape, reviewing written description of job tasks, and results of job analysis.

d. Interventions

Resting the symptomatic area, and reduction of soft tissue inflammation are the mainstays of treatment [Howard 1937; Howard 1938; Thompson et al. 1951; Thorson and Szabo 1989; Chipman et al. 1991; Moore 1992; Rempel et al. 1992]. The symptomatic area can be rested by:

(1) Reducing or eliminating worker exposure to biomechanical stressors (forceful exertions, repetitive activities, extreme or prolonged static postures, vibration, direct trauma). This is best accomplished by engineering controls in the workplace.

(2) When engineering controls are not feasible, or until effective controls can be installed, worker exposure to ergonomic hazards can be reduced through restricted duty, rest breaks, job rotation, or temporary job transfer. The principles of restricted duty and temporary job transfer are to reduce or eliminate the total amount of time a worker is exposed to ergonomic stressors [Lederman and Calabrese 1986; McKenzie et al. 1985]. A list of jobs with the lowest ergonomic risk should be developed. The ergonomic risk factors and the muscle-tendon groups required to perform those jobs should be listed.

The precise amount of work reduction for workers on restricted duty cannot be determined; however, the following principle applies: the degree of restriction should be proportional to symptom severity and intensity of the job's biomechanical stressors. Likewise, caution must be used in deciding which jobs are suitable for job transfer because differing job titles may pose the same biomechanical demands on the same muscles and tendons [OSHA 1990].

(3) Complete removal from the work environment should be reserved for severe conditions, or in workplaces where the only available jobs contain biomechanical stressors that would aggravate the existing condition.

(4) Immobilization devices, such as splints or supports, can help rest the symptomatic area [Howard 1937; Howard 1938; Thompson et al. 1951; Thorson and Szabo 1989; Chipman et al. 1991; Moore 1992; Rempel et al. 1992]. These devices are especially effective off-the-job, particularly during sleep. Wrist splints, typically worn by patients with possible carpal tunnel syndrome, should not be worn at work unless the health care provider determines that the worker's job tasks do not require wrist deviation or bending [Putz-

Anderson 1988; Kessler 1986]. Immobilization should be prescribed judiciously and monitored carefully to prevent muscle atrophy [Rempel et al. 1992; Curwin and Stanish 1984]. These recommendations do not preclude use of immobilization devices for patients with special needs due to underlying medical conditions.

(5) The health care provider should evaluate an injured worker's hobbies, recreational activities, and other personal habits that result in exposure to biomechanical stressors and advise the worker about the effects of continued exposure [Thorson and Szabo 1989; Chipman et al. 1991; Moore 1992].

e. Treatment for Soft-Tissue Inflammation

(1) Cold Therapy

Although no clinical trials have been performed on the effectiveness of cold therapy on the affected area, most clinicians consider this useful to reduce the swelling and inflammation associated with tendon-related disorders [Thorson and Szabo 1989; Chipman et al. 1991; Rempel et al. 1992; Simon 1991]. Cold therapy has effects on the local circulatory system (vasoconstriction) [Olson and Stravino 1972; Thorsson et al. 1985], and local muscle-tendon tissue (decreased metabolism) [Yackzan et al. 1984]. This reduced supply and demand for blood results in reduced effusion, edema, and swelling. In addition to pain reduction from the reduced swelling, cold therapy reduces the nerve conduction from pain receptors [Kaplan and Tanner 1989].

(2) Oral Anti-Inflammatories

Most clinicians consider these agents (aspirin or other non-steroidal anti-inflammatory agents) useful to reduce the severity of symptoms either through their analgesic or anti-inflammatory properties [Howard 1937; Howard 1938; Thompson et al. 1951; Thorson and Szabo 1989; Chipman et al. 1991; Moore 1992; Rempel et al. 1992; Simon and Mills 1980].

(3) Steroid Injections

For some disorders resistant to conservative treatment, local injection of an anesthetic agent with a corticosteroid may be indicated [Howard 1937; Howard 1938; Thompson et al. 1951; Thorson and Szabo 1989; Chipman et al. 1991; Moore 1992; Rempel et al. 1992].

(4) Ancillary Treatment Modalities

There is little scientific information that either establishes or refutes the efficacy of other treatment modalities for diagnoses encompassed under the term, work-related musculoskeletal disorders. Most clinicians consider physical and occupational therapy a valuable adjunct for treatment through its use of stretching and strengthening programs [Thorson and Szabo 1989; Chipman et al. 1991; Rempel et al. 1992; Curwin and Stanish 1984; Lane 1991].

(5) Referral to Specialists

Many, if not most, work-related musculoskeletal disorders improve with the above conservative measures. If the symptoms do not improve within the expected time frames, referral to an appropriate specialist is indicated. The expected time frame for resolution of symptoms depends on the type, duration, and severity of the condition, in addition to the underlying health of the worker.

Precise time intervals for follow-up evaluation, referral, improvement, and recovery cannot be stated in this submission. Algorithms to assist occupational health nurses through the process of evaluating, treating, and follow-up of workers with work-related musculoskeletal disorders have been developed [OSHA 1990; Hales and Bertsche 1992]. These algorithms are not meant to dictate medical practice, but to provide guidance to practicing occupational health nurses.

E. TRAINING AND EDUCATION [TO BE SUBMITTED TO OSHA AT A LATER DATE]

IV. LIST OF REFERENCES ON ERGONOMICS

Exhibit 4 is a list of references generated by NIOSH that are relevant to ergonomic hazards or work-related musculoskeletal disorders.

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15. Supplementary Notes

16. Abstract (Limit: 200 words) This testimony summarized information and comments from NIOSH regarding the proposed rule on ergonomics as set forth by OSHA. Recommendations were made to revise the definitions of ergonomic hazards and ergonomic disorders. Information was included regarding document problems using injury/morbidity databases, occupational injuries and illnesses in the United States by industry, workers' compensation and other data systems, social security disability data, and SENSOR programs. Other topics discussed included: scope and application of the ergonomics standard, elements of an ergonomics management program, worksite analysis, evaluation of job demands, task analysis, checklists, evaluation of human capacities, performance measures, physiological measures, subjective assessment measures, general principles of health surveillance, components of a surveillance system, passive and active surveillance, medical management, periodic walk through studies, rehabilitative medical management, access to care, interventions, and treatment of soft tissue inflammation.

17. Document Analysis a. Descriptors

b. Identifiers/Open-Ended Terms NIOSH-Publication, NIOSH-Author, NIOSH-Testimony, Niemeier-R-W, Repetitive-work, Musculoskeletal-system-disorders, Work-capability, Task-performance, Physical-stress, Risk-analysis, Human-factors-engineering

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