CURRENT CONCEPTS IN OCCUPATIONAL HEALTH: WORK-RELATED INJURY/ILLNESS PREVENTION AND ERGONOMICS GUIDELINES

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Introduction

The purpose of an injury/illness prevention and ergonomics program in the workplace is to maintain the health and productivity of workers. Well designed and appropriately implemented injury/illness prevention and ergonomics programs decrease injuries and related costs. In addition, they can successfully balance the needs of individual employees and the needs of a company for competitive performance.[1]

Physical therapist participation in injury/illness prevention and ergonomics programs continues to evolve, at least partially in response to the fluctuating incidence and cost of work-related injury/illness. A physical therapist's ability to remediate occupational health problems related to neuro-musculoskeletal conditions, and to enhance human performance contributes significantly to the effectiveness of these programs.[2,3,4]

The physical therapist is a vital member of the team performing workplace analysis and problem solving for injury/illness prevention and ergonomics. With expertise in identification of work-related risks to the neuro-musculoskeletal system, the physical therapist can design, implement, and monitor health, wellness, fitness and productivity solutions for an individual, group, or work population.

Purpose

The purpose of this document is to provide guidelines for the interventions and parameters related to occupational injury/illness prevention and ergonomic services as provided by physical therapists, and to promote consistency of language among physical therapists. Implementation and use of these guidelines is intended for:

1. Physical therapists, physical therapist assistants, and physical therapy students interested in injury/illness prevention and ergonomics services.

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[1] Occupational Safety and Health Administration: Injury and Illness Prevention Programs White Paper. https://www.osha.gov/dsg/InjuryIllnessPreventionProgramsWhitePaper.html#. Published January 2012. Accessed September 9, 2017.

[2] DeWeese and Curt. Workers and the Worksite: Research and Practice. *Work*. 2006; 26(3): 251-253. https://www.ncbi.nlm.nih.gov/pubmed/16720964. Accessed September 10, 2017.

[3] Landers and Maguire. Effects of a Work Injury Prevention Program for Housekeeping in the Hotel Industry. *Work.* 2004; 22(3): 239-46. https://www.ncbi.nlm.nih.gov/pubmed/15156089. Accessed September 10, 2017.

[4] Ryden et al. Benefits of a Back Care and Light Duty Health Promotion Program in a Hospital Setting. *J Community Health*. 1988; 13(4): 222-30. https://www.ncbi.nlm.nih.gov/pubmed/15156089. Accessed September 10, 2017.

2. Occupational health providers and team members to facilitate successfully integrated delivery of injury/illness prevention and ergonomics services in which physical therapists participate or provide management of such programs.

Key Stakeholders

Those impacted by the provision of such illness/injury prevention and ergonomic services include:

1. Employers who manage injury/illness prevention and ergonomics programs through utilization of physical therapists in the provision or management, of such programs;
2. Employees and labor organizations seeking to improve health and safety through the utilization of physical therapists providing and managing injury/illness prevention and ergonomics programs;
3. Federal and state regulatory agencies as definitional and guideline resources for patients/clients involved in, or considering injury/illness prevention and ergonomics programs in which physical therapists participate or provide management of such programs;
4. Insurers, insurance brokers, and third-party administrators utilizing physical therapists to implement injury/illness prevention and ergonomics programs to facilitate reduction of costs for their employer clients;
5. Business groups and trade associations utilizing physical therapists to implement injury/illness prevention and ergonomics programs to facilitate reduction of costs for their employer clients;
6. Educators, students, researchers, and others involved in the development and presentation of instructional injury/illness prevention and ergonomics programs that may be provided or managed by physical therapists.

Definitions

Several definitions are used in this document and are commonly used terms in the provision of workplace services.

Administrative controls refer to work processes or procedures implemented to reduce the magnitude, frequency, or duration of exposure to ergonomic risk factors and/or improve efficiency of work[5].

Behavioral Controls include strategies under an individual employee's control, such as personal protective equipment, habits, and other procedures implemented to reduce ergonomic hazards[5].

Engineering Controls include physical changes implemented in a workplace, such as equipment, implemented to reduce or eliminate ergonomic hazards[5].

Ergonomics is the study of work. It refers to the relationships among the worker, the work that is done, the tasks and activities inherent in that work, and the environment in which the work is performed. Ergonomics uses scientific and engineering principles to improve the safety, efficiency, and quality of movement involved in work[6].

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[5] Occupational Safety and Health Administration: Safety and Health/Ergonomics/Solutions to Control Hazards. https://www.osha.gov/SLTC/ergonomics/controlhazards.html. Accessed 9/20/2017.

[6] Occupational Safety and Health Administration: Ergonomics: The Study of Work. https://www.osha.gov/Publications/osha3125.pdf. Revised 2000. Accessed 9/20/2017.

Evaluation (Ergonomic) refers to a dynamic process in which the physical therapist evaluates a workplace, its furnishings, tools, and tasks in relation to the physical abilities and attributes of the worker. It is synonymous with Ergonomic Assessment[7].

Evaluation of worker capacity refers to a detailed examination that measures objectively an applicant's/worker's current level of ability to perform the physical demands of a specifically identified job. A physical therapist makes clinical judgments based on this data when providing a report.

Examination refers to a comprehensive screening and specific testing process leading to diagnostic classification or, as appropriate, to a referral to another practitioner. The examination has three components: the patient/client history, the systems reviews, and tests and measures[8].

Injury/Illness refers to the occurrence of work-related pathology/pathophysiology, pain, impairment, activity limitation, or participation restriction. The categorization of an incident to injury or illness may be different depending upon the regulations or regulatory agency involved[9].

Occupational health providers are health-care professionals who participate in the delivery of work-related injury/illness prevention, treatment, and ergonomics services[10].

Occupational health team members are all participants in a specialized team effort for injury/illness prevention, treatment, and ergonomics in a work environment. This group may include claims personnel, vocational rehabilitation providers, and others[11].

Prevention refers to activities that are directed toward the avoidance, minimization or delay of the onset of impairment, activity limitations, and/or participation restrictions and includes three phases, as follows[10].

Primary prevention refers to prevention of disease in a susceptible or potentially susceptible (work-place) population before it ever occurs through specific measures such as general health promotion efforts[10].

Secondary prevention refers to efforts to decrease the duration of illness, severity of diseases, or sequelae that have already occurred through early diagnosis and prompt intervention[10].

Tertiary prevention refers to limiting the degree of disability and promoting rehabilitation and restoration of function in patients with chronic and irreversible diseases[10].

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[7] Gale Encyclopedia of Nursing and Allied Health. 2006. The Gale Group. http://www.encyclopedia.com/medicine/encyclopedias-almanacs-transcripts-and-maps/ergonomic-assessment. Accessed 9/20/2017.

[8] *Guide to Physical Therapist Practice 3.0*. Alexandria, VA: American Physical Therapy Association; 2014. Available at: http://guidetoptpractice.apta.org/. Accessed 9/22/2017.

[9] Occupational Safety and Health Administration: OSHA Injury and Illness Recordkeeping and Reporting Requirements. https://www.osha.gov/recordkeeping/index.html. Accessed 9/22/2017.

[10] Dictionary of American History. 2003. The Gale Group. http://www.encyclopedia.com/history/dictionaries-thesauruses-pictures-and-press-releases/medicine-occupational. Accessed 9/22/2017.

[11] Dictionary of American History. 2003. The Gale Group. http://www.encyclopedia.com/history/dictionaries-thesauruses-pictures-and-press-releases/medicine-occupational. Accessed 9/22/2017.

Prognosis refers to the determination of the predicted optimal improvement in functioning that might reasonably be expected, taking into account any stated fiscal or organizational constraints, for a given work station or work site, and the amount of time needed to reach that level.[10]

Screening refers to determining the need for further intervention, such as examination or consultation by a physical therapist, referral to another health professional, or referral to other resources. Screening, such as musculoskeletal screening, may be for the purposes of injury prevention without a referral from another party.

Surveillance (Ergonomic Surveillance) refers to active and passive methods to assess risk and prioritize ergonomic issues for the purpose of illness/injury prevention. Active methods may include on-going observation and review of worker, work environment, and work activities. Passive surveillance may include analysis of surveys, injury data, and risk analysis[12]. Surveillance carries other meanings in the broader context of safety, including medical surveillance as OSHA defines it, and surveillance of risks and hazards as pertains to prevention of exposures such as chemicals and bloodborne pathogens.[13]

Work culture refers to the organizational and interpersonal environment that influences attitudes and behaviors of individuals toward safety and injury/illness prevention, injury/illness management, productivity demands, communication, and work relationships.

Conceptual Model

There is an interaction of the elements of work demands, worker capacity, worker behaviors, and administrative controls in the conceptual model of injury/illness prevention (Figure 1). Work demands vary with changing processes and tools, variable production levels and changing work schedules. Worker capacity changes with aging workers, employment turnover and changes in worker health. Worker behaviors are affected by experience, individual characteristics, morale, policy, training, and incentives. The work environment may be affected by such variables as regulations, productivity demands, weather, and administrative controls established by management.

Injury prevention in the arena of occupational health occurs in a complex and dynamic environment that is in constant flux. A challenge associated with injury prevention and ergonomics programs is in maintaining a dynamic balance of the aforementioned elements in the midst of changing and competing forces. Changing one or any combination of these elements may alter this balance and impede success of the programs. Therefore, injury prevention initiatives must attempt to consider and manage these elements as they are implemented.

Multiple strategies exist that can be used by physical therapists to restore a desired balance in the workplace, as presented in the model below (Figure 1). The model presents the reality that worker behaviors attempt to balance the demands of work with the worker's capacity.

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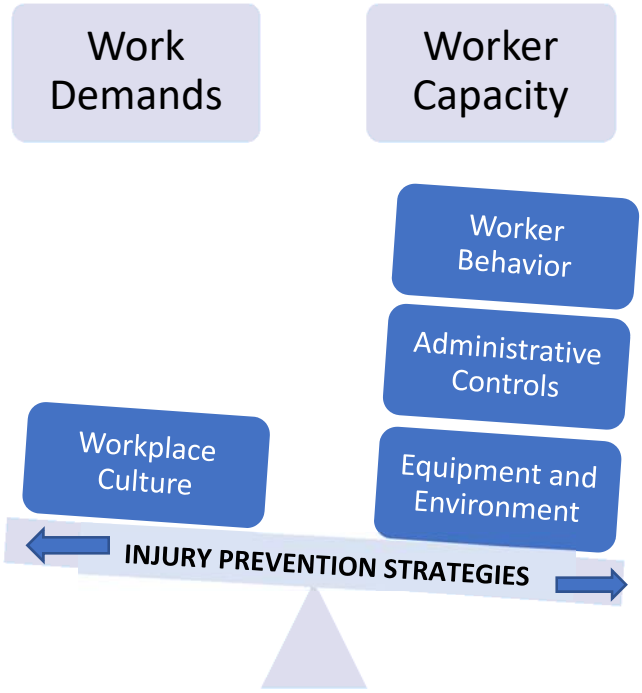
[12] Waldemar Karwowski, ed. *International Encylopedia of Ergonomics and Human Factors, 2nd ed*. CRC Press; 2006: 1561-2.

[13] Occupational Safety and Health Administration. https://www.osha.gov/SLTC/medicalsurveillance/surveillance.html. Accessed 9/30/2017.

Each workplace possesses unique physical demands, environmental exposures, work pacing, etc. In order to understand the physical requirements of each job, the physical therapist may perform a job analyses. The physical therapist may recommend ergonomic changes to match worker demands to the worker's capacity, or vice versa. Worker capacity may be addressed by job-specific exercise programs developed by physical therapists. Worker behavior may be modified by management and employee education developed and presented by a physical therapist.

Figure 1

A Balance Model for Injury/Illness Prevention Management



In-depth understanding of a workplace by physical therapists, including work demands, worker capabilities, safety rules, governmental rules and regulations, production constraints, and economic factors of business necessity are of utmost importance when developing injury/illness prevention strategies. Thorough dialogue with workplace stakeholders including human resources, labor unions, managers, and employees is essential. A full appreciation of the unique set of administrative controls and constraints and the availability of resources is necessary before a specific injury/illness prevention and ergonomics plan is constructed by a physical therapist.

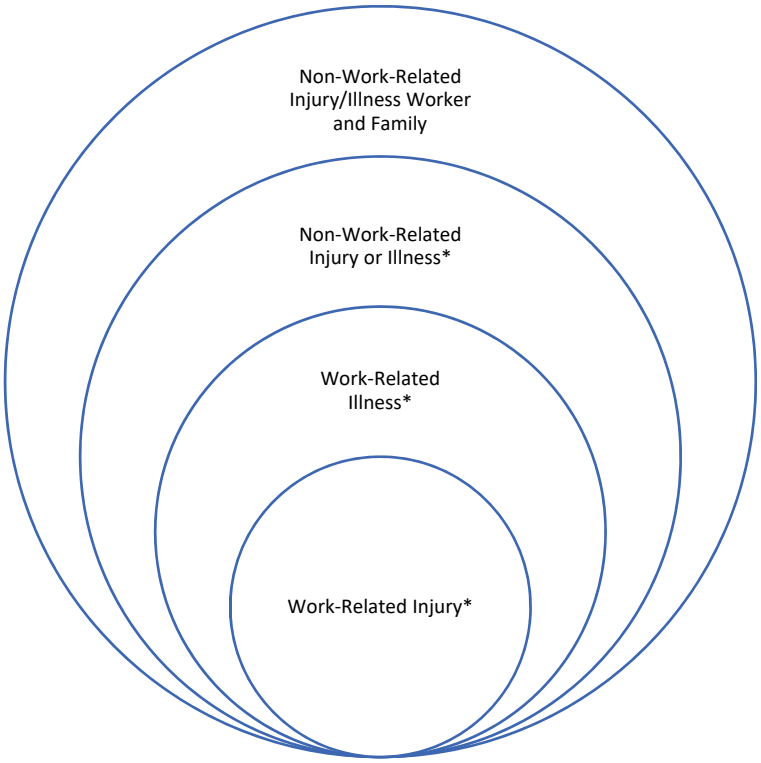
Injury/illness prevention and ergonomics programs may focus on different populations (Figure 2). The first populations include workers only. These populations may be workers who have an injury or illness that is directly caused by work, workers whose injury or illness develops over time as a result of work, or workers whose injury or illness, either work-related or non-work-related, is exacerbated by work. The second population may extend beyond workers, to include families of workers.

Business and industry are increasingly perceiving that broader health promotion programs have a positive impact on total healthcare costs. As such, they are addressing issues like health risk behavior modifications, health promotion, ergonomics, and injury/illness prevention for workers and their families. Depending upon the employer-sponsored health plan, workplace and non-workplace-related injury/illness prevention and ergonomics services can be provided by physical therapists. Such services can encompass the cardiovascular/pulmonary, integumentary, musculoskeletal, and neuromuscular systems. All such injury/illness prevention and ergonomics services are integral to the practice of physical therapists.

Figure 2

Populations Included in Injury/Illness Prevention Programs

*As Defined by OSHA



Knowledge Base

Physical therapists participate in injury/illness prevention and ergonomics programs by assuming a variety of roles. Physical therapists have mastered the appropriate knowledge base(s) necessary to fulfill these roles. Physical therapists participating in injury/illness prevention and ergonomics programs must have an appropriate background in anatomy, biomechanics and mechanics, kinesiology, patho-kinesiology, motor control, statistics, epidemiology, and ergonomic processes.

Within the realm of ergonomic processes, knowledge of data review, work analysis, worker and workforce analysis, surveillance, ergonomic risk identification and analysis is required.

- Data review requires knowledge of the types of records relating to injury reporting, the requirements and limitations involved in reporting and recording occupational injuries, and statistical methods of evaluating injury data.
- Work analysis requires knowledge of industrial processes, availability and functionality of industrial equipment and tools, how workers may be assisted/constrained in performing occupational tasks, and how industrial processes, equipment, tools, and tasks may be modified within appropriate economic constraints.
- Analysis of workers and the workforce requires knowledge of how individual workers perform occupational tasks, and the composition of the general workforce participating in similar industrial processes.
- Surveillance is a workplace safety strategy defined and described by OSHA in conjunction with the Centers for Disease Control (CDC) and NIOSH in preventing injuries. It is a process by which physical therapists may follow the flow of work and resultant injury/illness to detect and eliminate underlying causes which introduce hazards or exposures, and provide information concerning work practices and injury/illness[14].
- Evaluation and analysis of identified ergonomic risks provides opportunities for intervention to modify risks and prevent potential injuries.

Examination and evaluation of the interaction of each of these components of the ergonomic process by physical therapists permits identification of stressors imposed upon workers and the workforce.

Opportunities for intervention by physical therapists to alleviate stressors may include education and training, health promotion, ergonomics, and work re-entry management. Education and training provides an opportunity for physical therapists to demonstrate the best use of available equipment, tools, and methods of task performance. Education and training is necessary for both management and workers, so both share the responsibility of appropriate supervision and use. Health promotion encourages employees to engage in wellness and fitness behaviors that may contribute to primary injury/illness prevention. Ergonomics addresses the physical demands placed on workers as part of their job, and work re-entry management provides for a smooth, safe, and cost-effective means of returning injured workers to the job.

There are several regulatory bodies, agencies, and laws that govern, have an impact on, or provide guidance relevant to workplace practices. Some of these are involved in oversight of industry standards and injury prevention programs and may affect the provision of such services. Many of these also provide resources for program design and implementation.

Among these are:

1. United States Department of Labor (DOL)
2. United States Bureau of Labor Statistics (BLS)
3. Occupational Safety and Health Administration (OSHA)
4. Occupational Safety and Health Ergonomic Standards
5. National Safety Council
6. National Institutes of Health (NIH)
7. National Institute for Occupational Safety and Health (NIOSH)

[14] Centers for Disease Control and Prevention: NIOSH. https://www.cdc.gov/niosh/topics/surveillance/. Accessed 9/22/2017.

8. Americans with Disabilities Act (ADA)
9. Equal Employment Opportunity Commission (EEOC)
10. Uniform Hiring Guidelines
11. State Department(s) of Labor
12. State workers' compensation statutes
13. State ergonomics guidelines and standards
14. Insurance industry statistics and modification rates for each insurance carrier
15. Insurance carriers and third-party administrators for group health and workers' compensation

Each of these entities and laws may affect various aspects of employment practice in different ways. Physical therapists combine these areas of knowledge to provide services to client companies and integrate the perspectives and needs of all those involved in workplace practices. As such, physical therapists are uniquely qualified to develop, implement, manage and evaluate effective injury/illness prevention and ergonomics programs. Physical therapists practicing in the occupational health realm, especially those providing or managing injury/illness prevention and ergonomics programs, recognize the value of expanding their knowledge base in areas applicable to the dynamics of the workplace, and workplace organization. Physical therapists recognize that general knowledge of organizational structure is necessary when consulting for a specific client company. This includes knowledge of the: 1) policies and procedures specific to a client company; 2) latitude permitted in developing, implementing, and enforcing policies and procedures under state and federal law; and 3) ability to work within different labor environments, such as union versus non-union. Physical therapists also recognize that the ability to develop and implement such programs may be limited or enhanced by client company organization, policies and procedures, state and federal law, and management and employee participation, support, and work rules.

The ability to provide successful intervention is most often defined by economic benefit. Economic benefit may be limited within a given workplace by internal factors, such as product characteristics, and production processes. External factors that may affect economic benefit are insurance carrier programs, the availability of occupational health provider resources, and history of occupational health cost.

Two major issues relating to the relationship of individual workers and employers and their impact on acceptance of injury/illness prevention and ergonomics programs are recognized and understood by physical therapists. The first issue is compensation and benefits paid to workers. Specifically, this issue encompasses, salary, incentives and bonuses, leave policies, and medical and disability benefits. The second concerns labor relations. The union/non-union status of a company, the method by which labor contracts are negotiated, and the methods by which labor contracts are implemented and enforced, including administrative and legal processes for grievances and appeals, will have a major effect on the acceptance of these programs.

There are several aspects of a client company's activities and processes concerning the work environment that impact workers' performance that are understood by physical therapists. Appropriate work assignment may involve job matching, job accommodation, or job rotation. How these facets are managed will have an impact on who is hired and how well the workers may be able to avoid or prevent occupational injury/illness. The current environment of human resources management must be understood, whether relating to existing employees or potential new hires. Human resources issues affecting workers include the current status of hiring

efforts, potential or actual lay-offs, disciplinary action for safety or productivity infractions, return to work management, and company downsizing.

All aspects of worker - management relationships have an impact on corporate values and work culture. Physical therapists participating in occupational health have a clear understanding of the issues and relationships. Therefore, these issues must be examined and understood to anticipate how workers and management will respond to, and implement, injury/illness prevention and ergonomics programs.

Finally, in developing injury/illness prevention and ergonomics programs physical therapists may need to take into consideration issues relating to product design, production and quality standards, as these will affect how works and management interact. As a company makes changes to these features, the work environment evolves and may alter the workers' risk exposure.

Management Model

Physical therapists, in their management of individual patients/clients, integrate five elements in case management: examination, evaluation, diagnosis, prognosis, and intervention(s). These elements are incorporated in a manner designed to provide the best functional outcome in the shortest possible case duration. This approach is also successfully employed by physical therapists in the development, implementation, and management of workplace injury/illness prevention programs.

Examination

When investigating the potential for injury/illness prevention and ergonomics programs, the first step is to take a complete history of the client company's injury/illness experience. Investigation starts with a review of epidemiological and worker demographic information. This information can be extracted from OSHA reportable injuries/illnesses (OSHA 200 logs), an analysis of loss time records, productivity records, medical records, near-miss and at-risk behavior logs, industry-wide incidence rates (noted by OSHA Standard Industrial Classification *https://www.bls.gov/iif/oshsum.htm*), and insurance reports. Access to these records, and others listed previously, should be granted by a client company if the client company wishes to design and implement an effective injury/illness prevention and ergonomics program.

Some companies may not have an analysis of loss time records, near-miss/at-risk behavior logs, or incidence rates. These data may have to be constructed after the incident. Insurance carriers often share data generously for consultants who are working to decrease costs associated with occupational injury and illness. Information available from insurance carriers will include loss run, experience modification rate, and insurance reserves data. Loss run data demonstrate the effects of injury/illness on time lost from work. Experience modification rate data demonstrate how insurance costs are modified based on a client company's injury/illness experience. Insurance reserves data indicate the financial implications of funds allocated for injury/illness, and how injury/illness prevention programs can decrease the amount of funds encumbered for insurance coverage.

The first tests and measures to be performed relate to individual work sites and work stations. Ergonomic tests and measures examine the environment, site, tools, equipment, materials,

machinery, workflow, production processes and requirements, physical demands, physical stressors, and task rotation. Environmental factors of noise, ambient temperature, humidity, light, and air quality all may contribute to potential injury/illness during performance of occupational tasks. Physical characteristics of the work site and workstation, including surfaces, work station area size and configuration, and seating also may contribute to potential injury/illness during performance of occupational tasks. Individual aspects of occupational tasks that may contribute to potential injury/illness include tools, equipment, materials, machinery, individual work sequencing and pacing, general production processes rate, quality and production demands. Specific physical demands placed on individuals during occupational tasks may include force, repetition, postures and motions, vibration, and surface temperature of materials. Examining work sites and workstations requires an appropriate surveillance system for identification of at-risk employment situations/work processes within which accurate tests and measures can be performed and recorded.

The second tests and measures to be performed relate to individuals who will perform occupational tasks. Examination of each worker and the work force includes anthropometrics, including age and gender, examination of the individual worker, evaluation of the physical capacities of the worker, and assessment of work and health habits, risk behaviors, and worker/workforce characteristics. Health habits should include nutrition, exercise, and smoking history. These aspects of individuals should be examined for workers who are new hires, transferring jobs within the same client company, or returning to work following injury/illness, leave, or lay-off.

Evaluation, Diagnosis and Prognosis

Reports relating to the evaluation and diagnosis of work sites or work stations, with respect to preventing injury or illness, should include data analysis, work analysis, evaluation of worker/workforce, safety, behavior, and compliance, identification of at-risk employees, identification of at-risk work processes/work stations, and identification of solutions. Reports relating to prognosis of work sites or work stations, with respect to preventing injury/illness, should include an estimate of goals and outcomes for all interventions.

Interventions

Successful injury/illness prevention and ergonomics programs address the needs of both individual workers and employers. The dynamic nature of these programs mandates careful analysis and balancing of relevant components of intervention.
There are two major areas of intervention. The first area of intervention includes those aspects of prevention programs where physical therapists take primary leadership roles. Procedural intervention components include monitoring at-risk employees and work processes, ergonomics, education and training, health promotion, return-to-work case management, and occupational health committee/team development.

The second area of intervention includes those aspects of injury/illness prevention and ergonomics programs in which physical therapists most often participate as team members. Participatory intervention components include involvement as a team member in work assignment, human resources management, compensation and benefits, labor relations, corporate values and work culture, and design and production standards.

Outcomes

Physical therapists participate in, and direct, the development of evidence that injury/illness prevention and ergonomics programs are efficacious and effective. In doing so, physical therapists generate, analyze, and interpret data related to incidence rates, severity rates, restricted duty rates, modification rates, direct and indirect health-care costs, direct and indirect worker compensation costs, cost per case, aggregate annual costs, insurance reserve pool, quality control, productivity, employee morale/turnover, and return on investment for injury/illness prevention and ergonomics programs. Generating, analyzing, and interpreting data related to injury/illness prevention and ergonomics is performed by physical therapists using of the full range of statistical and epidemiological methods, and appropriate application of such methods.

Conclusion

Physical therapists are uniquely positioned to provide comprehensive workplace services to prevent as well as manage neuro-musculoskeletal injury. Many resources exist to support the development of such services and include resources available through the entities listed in the previous section entitled "Knowledge Base". To name only a few examples, OSHA produces information on assessing and providing solutions related to musculoskeletal hazards[15], the CDC and NIOSH produce numerous resources related to guidelines for manual materials handling, upper extremity injury prevention, program design such as the Total Worker Health program, and others[16]. Additionally, Clinical Practice Guidelines are published that provide current evidence-based direction for such programs, including guidance for prevention, intervention, and management of injuries in work populations. Among these is the Work-Rehab Clinical Practice Guideline [submitted for publishing 5-2018].

An occupational health injury/illness prevention and ergonomics system developed, implemented, and managed by a physical therapist should provide explicit definition of what services a physical therapist will perform, and what a physical therapist anticipates as outcomes. A comprehensive occupational health injury/illness prevention and ergonomics program developed, implemented, and managed by a physical therapist will explicitly define the; 1) scope of the program, program plan, relevant policies and procedures, 2) authorities, responsibilities, accountabilities of those participating in the program, 3) surveillance strategy, benchmark, baseline, and triggering indicators, and intervention protocols, 4) content and process of report generation, report distribution, 5) maintenance of the program, and 6) methods of program evaluation and improvement through measures that determine actual outcomes.

Comprehensive injury and illness approaches in occupational health, such as described in this guideline, can have a substantial positive impact on employees and organizations. When physical therapists contribute to the development, implementation and management of injury/illness prevention and ergonomics programs, significant and lasting workforce health improvement and workplace health-related cost reductions can be expected.

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[15] Occupational Safety and Health Administration: Safety and Health/Ergonomics/Solutions to Control Hazards. https://www.osha.gov/SLTC/ergonomics/controlhazards.html. Accessed 9/20/2017.

[16] Centers for Disease Control and Prevention: NIOSH/Ergonomics and Musculoskeletal Disorders. https://www.cdc.gov/niosh/topics/ergonomics/default.html. Accessed 9/20/2017.