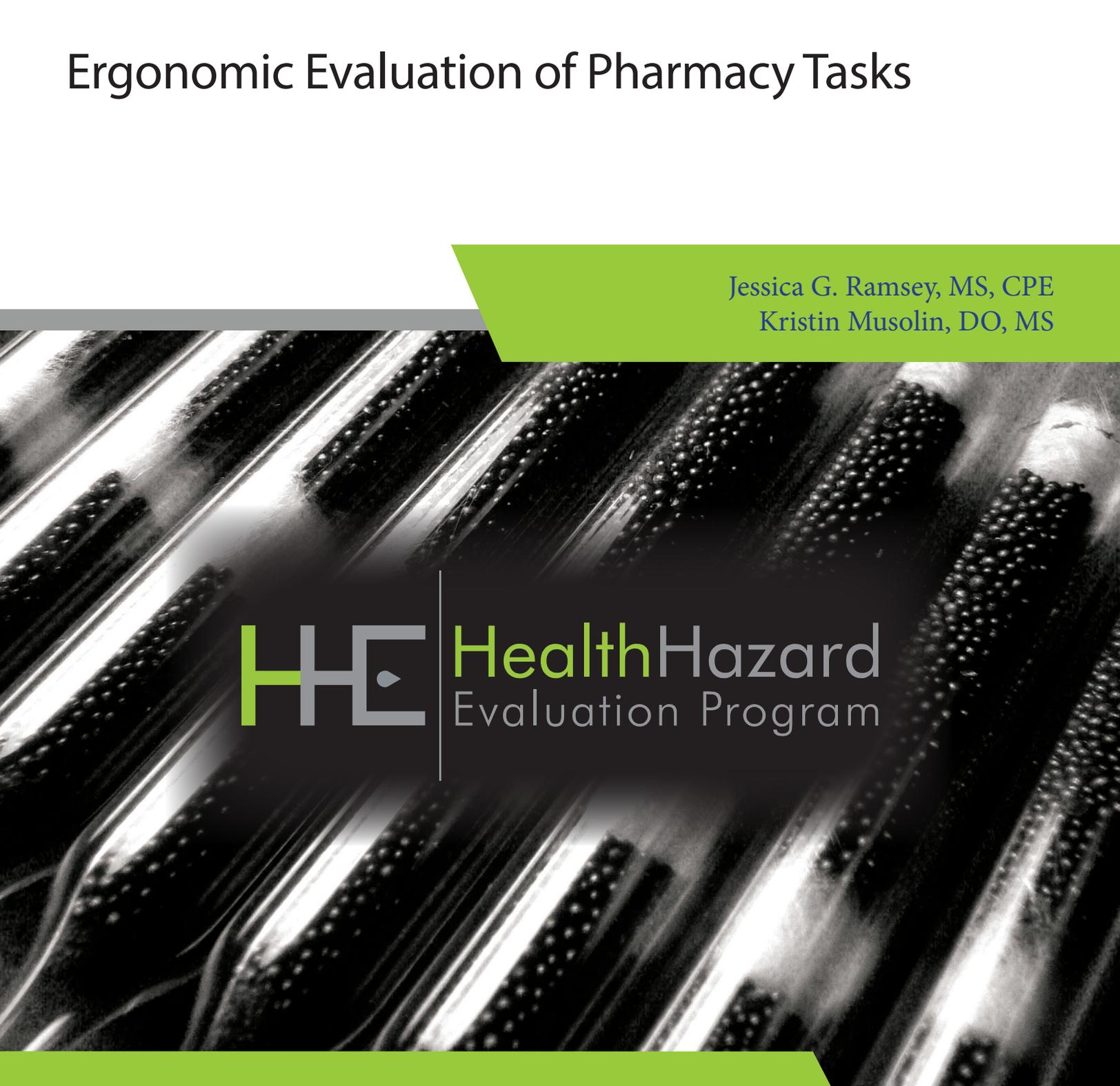


Ergonomic Evaluation of Pharmacy Tasks

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HE Health Hazard
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The employer is required to post a copy of this report for 30 days at or near the workplace(s) of affected employees. The employer must take steps to ensure that the posted report is not altered, defaced, or covered by other material.

The cover photo is a close-up image of sorbent tubes, which are used by the HHE Program to measure airborne exposures. This photo is an artistic representation that may not be related to this Health Hazard Evaluation. Photo by NIOSH.

Highlights of this Evaluation

The Health Hazard Evaluation Program received a request from an employer representative at a health service clinic. The request concerned musculoskeletal disorders associated with pharmacy employees who repeatedly opened and closed child-resistant medication bottles. We visited the clinic in April 2016.

What We Did

- We observed employees while they opened and closed child-resistant medication bottles and performed other pharmacy tasks.
- We measured workstation heights and took pictures and videos of pharmacy tasks.
- We asked employees about their work history, training, tool use, health information related to exposures, and health and safety concerns.
- We reviewed logs of work-related injuries and illnesses for the years 2011–2015.
- We reviewed medical records concerning two employees' exposure to repetitive and forceful movements and awkward postures.

What We Found

- Pharmacy staff did not use the adjustability features that were available for some equipment.
- Capping and uncapping medicine bottles required repetitive and forceful movements and awkward wrist postures.
- We observed repetition, force, awkward wrist and shoulder postures, and reaching above shoulders while employees did some pharmacy tasks. These factors increased employees' risk for musculoskeletal disorders of the shoulders, arms, and hands.
- Employees reported hand and neck symptoms and conditions that were consistent with work-related musculoskeletal disorders.
- Repetitive motion injuries were the most common recordable injury among pharmacy department employees.

We evaluated the potential for musculoskeletal disorders among pharmacy employees at a health service clinic. We found that employees used repetition, forceful movements, and awkward postures during their work. Many employees reported symptoms consistent with work-related musculoskeletal disorders. We recommended evaluating a way to reduce the number of return-to-stock bottles that need to be opened, removing child-resistant caps from larger quantity medication bottles, and educating employees on musculoskeletal disorders and ergonomics.

What the Employer Can Do

- Evaluate a way to reduce the number of return-to-stock medication bottles that need to be opened each day. If this is not an option, then spread out the task of opening these bottles throughout the day and use multiple employees for the task.
- Provide adjustable workstations to accommodate all employees.
- Educate employees on how to prevent musculoskeletal injuries and disorders during pharmacy tasks and operations.
- Improve communication with employees concerning submission of electronic health and safety incident reports.
- Encourage all employees to promptly report work-related health and safety concerns.

What Employees Can Do

- Adjust each workstation before you begin work.
- Remove child-resistant caps from the larger quantity bottles that are used to fill prescription medications manually.
- Use hands-free phone headsets when answering calls.
- Alternate between computer work and pharmacy tasks that require capping and uncapping medication bottles.
- Tell your supervisor about symptoms that you believe are work related. If symptoms continue, see a healthcare provider who is knowledgeable in occupational medicine.
- Report injuries that happen at work to your supervisor.

Abbreviations

CFR	Code of Federal Regulations
NIOSH	National Institute for Occupational Safety and Health
OSHA	Occupational Safety and Health Administration

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Introduction

The Health Hazard Evaluation Program received a request from an employer representative at an Indian Health Service pharmacy. The request concerned the potential for musculoskeletal disorders among pharmacy employees. The primary concern was a large number (up to 200 per week) of undistributed prescriptions returned to stock because patients did not pick them up in the designated time frame. We visited the pharmacy in April 2016 and observed job tasks, measured workstation heights, and spoke with managers and employees. We sent a letter summarizing our preliminary findings and recommendations to employer and employee representatives in May 2016.

The pharmacy was a large room located within the health center building. The room contained several computer workstations, some standing and others seated; a robotic prescription dispensing system; storage shelving areas; and a caged narcotics area. The dispensing system filled and labeled uncapped medication bottles for inspection and verification. The system contained cells (containers filled with prescription medication) of up to 200 different medications and two prescription bottle sizes. During our visit, pharmacy staff included four pharmacists and one pharmacy technician. One pharmacist position was vacant. The employees reported filling an average of 380 total prescriptions per day. The robotic prescription dispensing system filled approximately 80% of the prescriptions. The health service clinic had an occupational safety and health program.

The pharmacy technician and pharmacists were responsible for administrative duties such as billing insurance companies, ordering medications, answering phone calls, scheduling patients, and receiving and managing prescription medication requests. Additional prescription-related duties included scanning bags and opening and closing a large number of return-to-stock medication bottles, and placing and removing labels on medication bottles. The pharmacy technician also maintained, cleaned, and filled the cells of the robotic prescription dispensing system and stocked workstation drawers and shelves. The pharmacy technician had a designated seated workstation to perform paperwork but also worked at the dispensing system standing workstation. Pharmacists also developed protocols for medication treatment guidelines, performed clinical duties such as counseling on prescriptions, and staffed a variety of pharmacy-managed clinics (anticoagulant, immunization, spirometry, asthma, tobacco, and/or retinal imaging). After the lunch break, pharmacists who were working at the standing workstations rotated to the seated workstations and vice versa.

Methods

Our objectives included the following:

- Evaluating the ergonomic characteristics of the current work practices
- Determining if current work practices may increase the risk of musculoskeletal injuries
- Determining whether employees had workplace health and safety concerns

Ergonomic Evaluation

We observed workplace conditions and work practices to identify ergonomic risk factors. We measured workstation heights and reach distances and noted the availability of antifatigue mats and other personal protective equipment. A description of risk factors for work-related musculoskeletal disorders is provided in Appendix A.

Employee Medical Interviews and Medical Records Review

We held confidential interviews with all pharmacy employees. We asked about employees' work, training, and tool use. In addition, we asked about exposures and health and safety concerns. We reviewed the Occupational Safety and Health Administration (OSHA) Form 300 Logs of Work-Related Injuries and Illnesses for years 2011–2015, and incident reports. We reviewed medical records for two employees who had seen a healthcare provider because of musculoskeletal symptoms.

Results and Discussion

Ergonomic Evaluation

The primary concern listed in the health hazard evaluation request was the potential for musculoskeletal disorders from opening and closing medication bottles, particularly from opening return-to-stock medications. Most returns required employees to open the prescription bottle and pour the contents back into the robotic prescription dispensing system. Additionally, pharmacy employees removed and shredded the label on the bottle to maintain patient privacy. In the past, the pharmacy technician processed all the returns on one specific day of the week. This resulted in the pharmacy technician having to open up to 200 prescription containers that day. Shortly before the visit, the pharmacy had changed procedures to processing returned prescriptions daily rather than once a week, and the pharmacists helped the technician with the returns. On the day of our visit, the pharmacy had approximately 24 returned prescriptions to process.

Opening and closing medication bottles with child-resistant packaging/caps caused the most repetitive and awkward postures. The Poison Prevention Packaging Act, 16 CFR 1700, established the requirements for child-resistant packaging. In general, the packaging should be difficult for children under 5 years old to open, but not difficult for adults to use. Pharmacy employees are not covered under the Act.

We noted that most medication bottles at this pharmacy had one of two types of child-resistant caps. One type used a squeeze/pinch and turn mechanism, and another type used a push down and turn mechanism. Figure 1 shows the squeeze and turn child-resistant bottle in the center and a non-child-resistant bottle on the right. The pharmacy technician explained that, when possible, the pharmacy purchased large quantity bottles of stock medications that did not have child-resistant caps. However, not all stock medications were available for purchase with non-child-resistant caps. We took several empty bottles back to the National Institute for Occupational Safety and Health (NIOSH) laboratory and attempted to measure the

force required to remove the child-resistant caps. However, the equipment we had available could not accurately measure the force of the dual mechanism required to open the caps. It is beyond the scope of the Health Hazard Evaluation Program to redesign medication bottles and caps. However, the pharmacy could partner with a university to evaluate new designs.



Figure 1. Different types of medication bottles in stock at the pharmacy. Photo by NIOSH.

Bottles of stock medication were either used to fill the robotic prescription dispensing system, labeled directly for the patient, or opened to remove the appropriate amount for the prescription and placed back on the stock shelf. The employees opened stock bottles multiple times when a medication was not dispensed from the robotic prescription dispensing system. In those instances, when possible, the employees removed the child-resistant cap and replaced it with a regular screw top cap to eliminate the repetitive and awkward postures.

The pharmacy employees had tried two commercially available tools to help with cap removal. However, the tools seemed to be designed with the patient in mind, not for pharmacy employees to use multiple times per day. The cap-shaped tool in Figure 2 was meant to help remove caps that required a push and turn motion. However, the pharmacy employees felt that this tool made cap removal harder in some instances because the bottle cap slipped during use, leading to greater hand forces. The tool shown in the bottom of Figure 3 was a long slender hand tool with a hook, meant to aid in the removal of the outer plastic child-resistant portion of the cap. The motion required to use the tool resulted in awkward wrist postures, and the pharmacy employees described a high hand force. Neither tool was used regularly by the employees at this pharmacy.



Figure 2. Hand tool used for removing medication bottle caps that required a push and turn motion. Photo by NIOSH.



Figure 3. Hand tool used to remove plastic child-resistant portion of the cap on the medication bottle. The bottle on the right has an intact child-resistant cap. The child-resistant cap on the bottle on the left has been removed. Photo by NIOSH.

Stock bottles and boxes of medications were stored 5"–76" above the floor surface. Reaching for items stored too high can cause awkward shoulder postures. Bending for items stored too low can cause awkward back and shoulder postures.

The pharmacy had three seated and three standing workstations. Although the employees reported a previous ergonomic evaluation of the workstations in 2013, few were set correctly for the employee using them. For example, the adjustable standing monitor heights were within the recommended range of 61"–65"; however, they were not adjusted so that the top of the monitor was at the line of sight for the employee at the workstation. Additionally, some of the standing fixed-height monitors with touch screen capability were above the recommended fixed height of 59". Only the monitors were adjustable at some of the standing workstations. Therefore, the height of the keyboards, mice, and scanners were limited by the counter or tray height. The standing workstation counters were 35"–41" above the floor,

which was below the recommended fixed height of 42". Working surfaces and keyboards that are placed too low may cause employees to type with their wrists bent upwards at an extreme angle, which then may compress the tendons and median nerve and, along with other risk factors, increase the risk for tendinitis and carpal tunnel syndrome. When keyboards are too high, employees may raise their shoulders to elevate their arms creating awkward postures that may also increase the risk of musculoskeletal disorders. All of the standing workstations had antifatigue mats to reduce stress on the feet and knees.

The workstations also had either hand-held phones or hands-free phone headsets. Because employees need to use both hands during work activities, those using hand-held phones tended to pinch the phone receiver between their shoulder and head when using the phone. This posture increases static, awkward postures in the neck and muscles, and increases the risk of musculoskeletal disorders of the neck. In contrast, the use of hands-free headsets may help to reduce these static neck postures and reduce neck muscle strain. It is also important to place phones so that employees have easy access to them, and no one has to reach too far or to stretch into extreme positions to use them. Because the employees regularly rotate between workstations, having access to adjustability features and having reminders to use them consistently (starting with daily) are important and can help reduce musculoskeletal-related complaints.

Using an ergonomics program to guide modification of pharmacy tasks and providing ergonomically comfortable workstations may help to decrease incidence of work-related musculoskeletal disorders [OSHA 2009].

Employee Medical Interviews

During our visit, we held confidential medical interviews with all five employees (one pharmacy technician and four pharmacists) who worked in the pharmacy department. Employees reported working at the facility an average of 8.4 years (range: 1.5–15.5 years) and working in a pharmacy an average of 14 years. Average age was 38 years (range: 29–50), and all interviewed employees were female. Employees usually worked 40 hours a week with occasional overtime.

Employees were asked about hand use at work. Most reported they used both hands. Employees were also asked about what types of hand-held tools were being used. No one reported using any tool to open the bottle caps. Most reported the tools did not work as described, and that they required more gripping strength, or they placed too much pressure on the palm. Employees reported that they had not received any in-depth inservice ergonomic training or other educational sessions since being hired, except for some basic information during their annual online training. All employees reported activities while opening medication bottles that were consistent with the risk factors of musculoskeletal disorders. These activities included excessive forceful exertion of hand or arm, twisting/rotating of hand or arm, repetitive movements of hand or arm, pinch grip, and/or awkward wrist postures including ulnar deviation and/or radial deviation and flexion or extension.

We assessed the employees' perception of exertion while opening medication bottles using the modified Borg Rating of Perceived Exertion. It is a way of measuring physical activity

intensity level that combines all sensations and feelings of physical stress, effort, and fatigue. Employees reported an exertion rating of 3 (moderate exertion level) on a 0 to 11 modified Borg CR-10 scale while opening medication bottles [Borg 1982]. All employees reported that certain pharmacy tasks required reaching above shoulders. Employees reported an average of 4 hours of standing, 3.5 hours of sitting, and 7.75 hours of computer use during a work shift. Most employees said they had help from the safety officer during a previous ergonomic evaluation setting up an ergonomic desk/computer workstation.

When asked specific questions regarding musculoskeletal disorders, one employee reported being told by a doctor of having a specific thumb tendon musculoskeletal disorder, de Quervain tenosynovitis, one employee reported having hand or wrist tendinitis, and two employees reported having other musculoskeletal disorders (radial tunnel syndrome or shoulder impingement syndrome). See Appendix A for information about these musculoskeletal disorders. In addition, all employees reported having at least one musculoskeletal symptom (many reported more than one) in the past 12 months mainly affecting their hands (with opening and closing medication bottles) and neck (using hand-held phones). Other musculoskeletal symptoms some employees reported included a variety of symptoms in the shoulders, elbows or forearms, hips, knees, and ankles or feet. Three employees reported that they saw a healthcare provider for a number of these symptoms in the past 12 months.

We asked employees an open-ended question regarding what, if any, health or safety concerns they had about their work. All employees reported at least one safety and/or health concern. Safety and health concerns included issues with stocking low shelves and bending over, not receiving feedback from the electronic incident reporting system in a timely manner, and issues being addressed appropriately. Additional concerns included uncomfortable chairs, pain with heavy lifting, repetition and musculoskeletal symptoms, and short staffing. Musculoskeletal symptoms have improved for some employees after changing to a roller mouse, ergonomic adjustable keyboard risers, and hands-free phone headsets.

Medical Records Review

We reviewed the medical records for two pharmacy employees who had seen a healthcare provider because of a musculoskeletal complaint. We agreed with the physicians' (family practice and orthopedic) diagnoses for both employees of work-related thumb carpometacarpal joint osteoarthritis and mild tenosynovitis involving the muscle in the forearm and radial tunnel syndrome (mostly a clinical syndrome). All of these conditions likely developed after exposure to repetitive and forceful movements, awkward wrist postures, and contact stress from opening and closing medication bottle caps. Their records documented work exposures as possible causes or contributors to musculoskeletal disorders. Both employees were given instructions to avoid using certain arm, elbow, and/or hand activities such as forceful pinch grip with thumb and index finger.

Logs of Injuries and Illnesses

The OSHA Form 300 Logs of Work-Related Injuries and Illnesses for years 2011–2015 and incident reports included 18 injuries in all departments; 5 of those injuries were in the pharmacy department. Repetitive motion injury (or overuse syndrome) was the most common type of injury or illness among pharmacy department employees, accounting for four of five reports; the other report was musculoskeletal pain. Arm, forearm, and thumb were the most commonly reported body part affected by repetitive motion injury. The most common cause of injury was associated with opening multiple medication stock bottles that required a pinch grip or downward, twisting force. The other injury reported by a pharmacy department employee was arm pain.

Conclusions

Pharmacists and the pharmacy technician were exposed to work-related factors such as repetitive and forceful movements, awkward wrist and shoulder postures and contact stress such as opening or closing bottle caps that put them at risk for musculoskeletal disorders including de Quervain tenosynovitis, carpal or radial tunnel syndrome, and/or upper extremity tendinitis [OSHA 2009]. To reduce musculoskeletal injury risk we recommended providing and using adjustable workstations, educating employees on injury prevention during pharmacy tasks, and communicating and reporting work-related health and safety concerns.

Recommendations

On the basis of our findings, we recommend the actions listed below. We encourage the pharmacy to use a labor-management health and safety committee or working group to discuss our recommendations and develop an action plan. Those involved in the work can best set priorities and assess the feasibility of our recommendations for the specific situation at the pharmacy.

Our recommendations are based on an approach known as the hierarchy of controls. This approach groups actions by their likely effectiveness in reducing or removing hazards. In most cases, the preferred approach is to eliminate hazardous materials or processes and install engineering controls to reduce exposure or shield employees. Until such controls are in place, or if they are not effective or feasible, administrative measures and personal protective equipment may be needed.

Elimination and Substitution

Eliminating or substituting hazardous processes or materials reduces hazards and protects employees more effectively than other approaches. Prevention through design, considering elimination or substitution when designing or developing a project, reduces the need for additional controls in the future.

1. Evaluate a way to reduce the number of return-to-stock medication bottles that need to be opened each day. Pharmacists could review data looking for patients who are

routinely late picking up their prescriptions. If this is not an option, then spread out the task of opening these bottles throughout the day and use multiple employees for the task.

2. Discuss with existing vendors or identify additional vendors that can provide prescription medicines in larger quantities and in packaging that does not use the child-resistant caps currently in use.
3. Identify vendors that provide prescription medicines in exact quantities (monthly or 90-day supplies) so that medications do not need to be repackaged before distribution to patients.

Engineering Controls

Engineering controls reduce employees' exposures by removing the hazard from the process or by placing a barrier between the hazard and the employee. Engineering controls protect employees effectively without placing primary responsibility of implementation on the employee. Many of the recommendations listed below were obtained from The Handbook of Ergonomic Design Guidelines [Humantech 2009].

1. Consult with a university that has a human factors, ergonomics, or engineering design program and can assist with the evaluation and design of medication bottles and caps or of devices to assist with removal of bottle caps.
2. Provide adjustable workstations to accommodate all employees.
3. Position adjustable touchscreens with the top of the screen adjustable 47"–71" above the standing surface. If a fixed height is used, the top of the touch screen should be placed at 59" above standing surfaces. Maintain a touch distance of less than 22" for touch screens.
4. Position adjustable visual displays that are not touchscreen with the top of the display adjustable 58"–71" above the standing surface. If a fixed height is used, the top of the visual display should be placed at 66" above the standing surface. The top of the display should be in the employee's line of vision. Maintain the viewing distance for adjustable displays at 18"–30" or 23" for fixed displays.
5. Provide adjustability for hand working height. The optimal adjustable height is 38"–47" above the standing surface. The acceptable zone is 30"–57" with a fixed height of 42" above the standing surface.
6. Store items 24"–70" above the standing surface. The most frequently used items (e.g., medication bottles) should be located in the middle of this range to reduce bending at the back and reaching above the shoulder.

Administrative Controls

The term administrative controls refers to employer-dictated work practices and policies to reduce or prevent hazardous exposures. Their effectiveness depends on employer

commitment and employee acceptance. Regular monitoring and reinforcement are necessary to ensure that policies and procedures are followed consistently.

1. Remove child-resistant caps from larger quantity bottles that are used to fill prescription medications manually.
2. Use an ergonomics program to guide modification of pharmacy tasks, choosing assistive devices designed to open medication bottle caps and provide ergonomic workstations.
3. Educate employees on musculoskeletal disorders and ergonomics, covering specific operations that may cause or are likely to cause musculoskeletal disorders, and how they can avoid musculoskeletal disorders (e.g., wrists should be kept in neutral posture as much as possible to reduce the risk of musculoskeletal disorders).
4. Improve and ensure good communication with employees concerning submission of electronic health and safety incident reports. Provide prompt feedback regarding their health and safety concerns. Employees should be informed what actions have been or will be taken and the rationale for decisions, and their concerns should be addressed in a timely manner.
5. Encourage all employees to report potential work-related health concerns early. Employees with persistent symptoms should promptly seek medical attention from a healthcare provider who is knowledgeable in occupational medicine.
6. Incorporate variation into pharmacy tasks by alternating tasks that use different postures or muscle groups to reduce work-related musculoskeletal disorders.

Appendix A: Risk Factors for Work-Related Musculoskeletal Disorders

Musculoskeletal disorders are conditions that involve the nerves, tendons, muscles, and supporting structures of the body. They can be characterized by chronic pain and limited mobility. Work-related musculoskeletal disorder refers to (1) musculoskeletal disorders to which the work environment and the performance of work contribute significantly, or (2) musculoskeletal disorders that are made worse or longer lasting by work conditions. A substantial body of data provides strong evidence of an association between musculoskeletal disorders and certain work-related factors (physical, work organizational, psychosocial, individual, and sociocultural). The multifactorial nature of musculoskeletal disorders requires a discussion of individual factors and how they are associated with work-related musculoskeletal disorders. Strong evidence shows that employees whose work tasks involve high levels of static contraction, prolonged static loads, or extreme working postures involving the neck/shoulder muscles are at increased risk for neck/shoulder musculoskeletal disorders [NIOSH 1997]. Further strong evidence shows job tasks that require a combination of risk factors (highly repetitive, forceful hand/wrist exertions) increase risk for hand/wrist tendinitis [NIOSH 1997]. Finally, evidence shows that low-back disorders are associated with work-related lifting and forceful movements, awkward postures such as bending and twisting, and whole body vibration [NIOSH 1997]. A number of personal factors can also influence the response to risk factors for musculoskeletal disorders: age, sex, smoking, physical activity, strength, and body measurements. Although personal factors may affect an individual's susceptibility to overexertion injuries/disorders, studies conducted in high-risk industries show that the risk associated with personal factors is small compared to that associated with occupational exposures [NIOSH 1997].

De Quervain tenosynovitis is a common cause of wrist pain in adults and most frequently in women and adults greater than 40 years old [Wolf et al. 2009]. De Quervain disease is the entrapment of the extensor and abductor tendons in the hand [NIOSH 1997]. There is not sufficient scientific evidence to determine a causal relationship between de Quervain tenosynovitis and occupational risk factors such as repetitive and forceful work [Stahl et al. 2013, 2015]. However, implementation of ergonomic programs could reduce incidence of musculoskeletal disorders such as de Quervain tenosynovitis [Calvo-Cerrada et al. 2012]. In addition, movements of the forearm requiring intense effort performed by workers using forceful and repetitive movements with the elbow in extension and the forearm in pronation and supination increase the risk of radial tunnel syndrome [Roquelaure et al. 2000]. Ineffective ergonomic controls play a role in the development of many upper extremity (e.g., elbow tendinitis) tendinopathies [Werner et al. 2005]. On the basis of epidemiologic data, there is strong evidence for a positive association between highly repetitive work, in combination with other job risk factors, and hand/wrist tendinitis [NIOSH 1997].

In all cases, the preferred method for preventing and controlling work-related musculoskeletal disorders is to design jobs, workstations, tools, and other equipment to match the physiological, anatomical, and psychological characteristics and capabilities of the employee. Under these conditions, exposures to risk factors considered potentially hazardous are reduced or eliminated.

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