Help protect workers from hazards caused by manual material handling.

According to the Bureau of Labor Statistics (BLS), manual material handling contributes to a large percentage of the over 500,000 cases of musculoskeletal disorders reported annually in the United States. The BLS has reported that more than one of every three injuries involving missed workdays were the result of shoulder and back injuries, many of which are caused by overexertion and repetitive trauma associated with the manual movement of materials.

This document provides guidance on common workplace material handling tasks, the risk factors associated with those tasks, and how jobs can be improved for those involved—often at little or no cost.

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is on your side

See the following pages for practical steps your business can take.

Defining manual material handling.

According to the U.S. Department of Labor, manual material handling (MMH) is defined as: seizing, holding, grasping, turning, or otherwise working with the hand or hands. Fingers are involved only to the extent that they are an extension of the hand. In this document, handling means that the worker's hands are involved in the job task, whether that involves using the hands to grasp an object to be lifted, pushing a cart with handles, or some other hand-involved task.

Benefits of improving manual material handling.

MMH causes a significant number of injuries in U.S. workplaces each year that lead to substantial treatment and recovery costs; however, considering only the direct costs of those injuries — many of which may appear to be passed along to the workers' compensation insurer — fails to consider other costs that MMH creates for your business. To illustrate, consider the example of Jim, a production worker who routinely lifts parts from floor level, twists at the waist, and reaches out from his body to place the item on a conveyor. Depending on the weight of the object, how long the task is performed, physical condition, and other factors, Jim may go years without experiencing an injury — or he may be injured within the first few weeks of his employment. But even if no injuries occur, benefits can still be realized by improving material handling tasks like those in Jim's job. How? Consider these additional benefits of improving MMH in your organization:

- **Reducing workers' efforts (and improving morale) by decreasing forces in lifting, handling, pushing, and pulling materials.** In many organizations, one of the most significant costs is related to employee turnover. Many employees move on from jobs that cause physical pain, often before the pain is significant enough to be labeled as a work injury. By reducing the amount of effort employees expend on the job, turnover can be positively impacted. In doing so, advertising, hiring, training and associated onboarding costs can also be decreased.
- **Increasing productivity.** Material handling is typically thought of as a non-valued-added task, as no work is being directly completed on the product. Although often a necessary part of production, construction, or other business activities, every bend, carry, reach, or other MMH task that can be improved frees up time for workers to complete other value-added tasks and improves production efficiency.

Improving MMH provides benefits beyond just worker safety.

- **Improving product and service quality.** When the hands and body are exposed to challenging tasks, the body becomes fatigued more quickly. Tired employees are known to make more errors, resulting in risk of damage to raw materials, tools or finished goods that subsequently leads to customer complaints, additional rework, increased warranty costs, etc.
- **Other indirect benefits.** Improving MMH can also help to lower costs by reducing or eliminating production bottlenecks and reducing absenteeism associated with general aches and pains.

Manual material handling risk factors.

A single MMH task may expose workers to several physical risk factors, which are elements of the job or task that increase the likelihood (or risk) of injury. Some organizations refer to risk factors as contributing factors, which is also accurate and acceptable. Repeated or continual exposure to one or more of these factors initially may lead to fatigue and discomfort. Over time, injury to the back, shoulders, hands, wrists, or other parts of the body may occur. Injuries may include damage to muscles, tendons, ligaments, nerves, and blood vessels. Injuries of this type are known as musculoskeletal disorders, or MSDs. The main risk factors associated with the development of MSD injuries in MMH tasks include:

- **High force requirements.** Workers lift, lower and move items every day. The heavier the weight to be lifted, lowered and/or moved, the more force the worker will have to exert. In most situations involving lifting, lowering, and moving heavy items, the predominant risk factor is force. So, just how much force is too much? Various studies aim to answer that question, but the prevailing advice is that less force is always better. High force can be segmented into the following tasks:
  - **Lifting and Lowering.** Although it may seem that lifting is more difficult than lowering, they both require the worker to exert forces consistent with the weight of the object. It should be obvious that lifting objects weighing 25 pounds is considerably easier than those weighing 50 pounds and that more people can safely lift the smaller amount. The distance of the object from the spine also plays a major role in the force required when moving an object. If that object can be held or lifted closer to the body, the weight that the back "feels" is less.

The more risk factors present, the riskier the material handling task.

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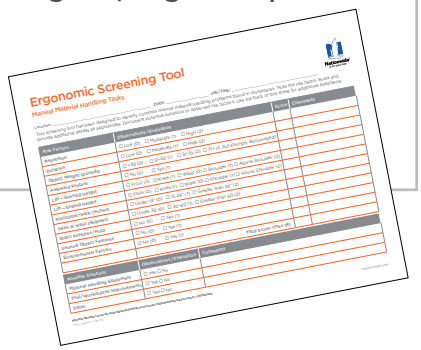
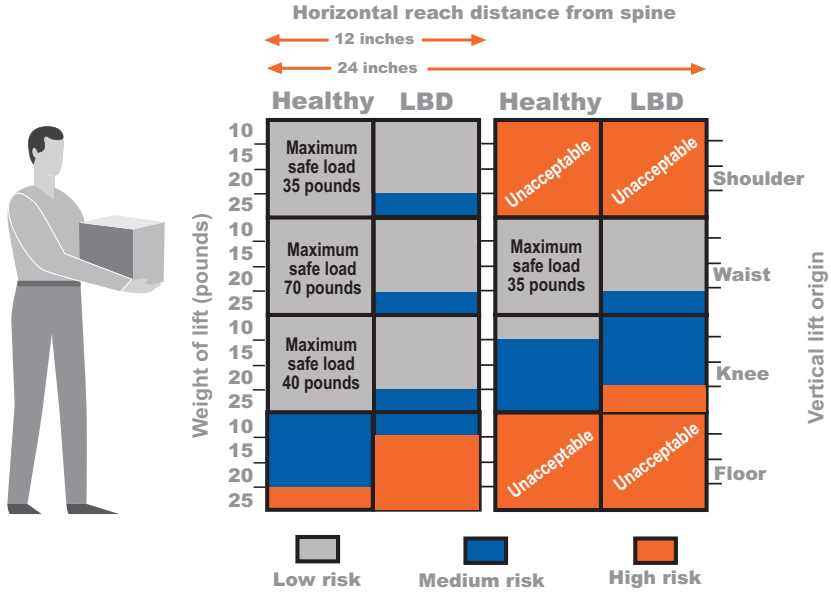
To further evaluate lifting tasks in the workplace, use our self-evaluation tool at: **https://www.mylosscontrolservices.com/documents/loss-control-library/ergonomics-screening-tool** or try the Ohio BWC Interactive Tool at: **https://www.bwc.ohio.gov/employer/programs/safety/liftguide/liftguide.aspx**



One quick assessment tool organizations can use to assess lifting and lowering tasks is from the Ohio Bureau of Workers' Compensation (Ohio BWC) and Ohio State University. As shown in the diagram below, which is one of three such diagrams on this topic (this one being associated with lifts with limited twisting at the waist), a combination of several factors — weight of the object, distance from the ground, horizontal distance from the spine, and previous back injuries (shown as LBD, or Lower Back Disorder) — combine to produce an overall risk for the lift. The following insights can be taken from this diagram:



- Lifts between the knees and the shoulder (also known as the "power zone") have the lowest risk. Lifts near the floor and above the shoulders have the highest risk.
- As the weight of the object increases, so too does the lifting risk. Under ideal conditions, the maximum safe load advised by the Ohio BWC is 70 pounds.
- Horizontal reach, or how far away the object is held from the spine, increases the risk of the lift and should always be minimized.
- Workers with previous injuries to the back are more likely to develop future injuries. A lift that is safe for one worker may be unsafe for another.

- **Carrying.** If lifting is a significant MMH risk factor, carrying may be even more concerning. After all, carrying typically includes both lifting the object and walking it to its destination. In carrying, the weight, distance traveled, and object characteristics affect the forces required. For example, carrying a 50-pound bag of loose-fill sand is more difficult than carrying a 50-pound box with handholds. In general, carrying should be avoided whenever possible by using carts, conveyors, and other material handling devices. The significant forces placed on the body while carrying can cause problems almost immediately, and fixes that reduce or eliminate carrying are often quick and inexpensive to implement.
- **Pushing and Pulling.** One of the ways many organizations avoid carrying is to use carts and other devices which can be pushed or pulled. While this is almost always a better option, pushing and pulling can also introduce high force requirements and should be evaluated for risk factors. The weight of the object or conveyance, including its contents, affects the force required of the worker. For very heavy carts, stopping and controlling the cart can sometimes be as difficult and important a risk factor as pushing or pulling it to the desired location. In other cases, employees push and pull objects without the use of carts—such as sliding boxes into or out of a truck. In these cases, the weight of the object and amount of friction between the object and the surface determine how much force is required. Poorly designed pushing and pulling tasks often lead to shoulder, neck and upper back MSDs.

To further evaluate pushing and pulling tasks in the workplace, use our self-evaluation tool or try the Ohio BWC Interactive Tool at: https://www.bwc.ohio.gov/employer/programs/safety/PushPullGuide/PushPullGuide.aspx.

- **Awkward postures.** Bending or twisting while handling creates an awkward posture and changes the way forces are distributed in the back. When the spine is in its natural position (when the employee is standing comfortably in an upright position with his/her arms at the sides), forces are directed more evenly along the spine in an up-and-down (compression) manner. Bending and twisting, however, redirects the forces into a more lateral or side-to-side (shear) manner, which creates more wear on the discs of the spine. This is further complicated in an awkward posture where loads and forces are not only side-to-side, but are also unevenly distributed or more one-sided (asymmetrical).

To avoid awkward postures, the hands should be at (or slightly below) waist level when manual handling begins. Manual handling tasks that require the hands to be lower than the knees or higher than mid-torso put the worker at a disadvantage, which requires the muscles to exert more force than if the starting point is near waist height. Low starting points require bending or squatting, which adds stress to the back and knees.

Reduce lifting and carrying with pallet jacks, carts, and other devices.

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- **Repetitive motions.** Repetitive motion can be thought of as the risk factor that makes other risk factors even worse. For example, an employee who lifts a heavy box once a day from floor level is at risk for an injury, but an employee who lifts the same box every 5 minutes for an 8-hour work shift is much more likely to be injured.

  Jobs that do not provide short pauses or breaks between tasks are often a problem because there may not be adequate time for muscles to recover from the effects of the task before the task must be repeated. If there are no pauses between motions or the pauses are too short, the muscles cannot recover.

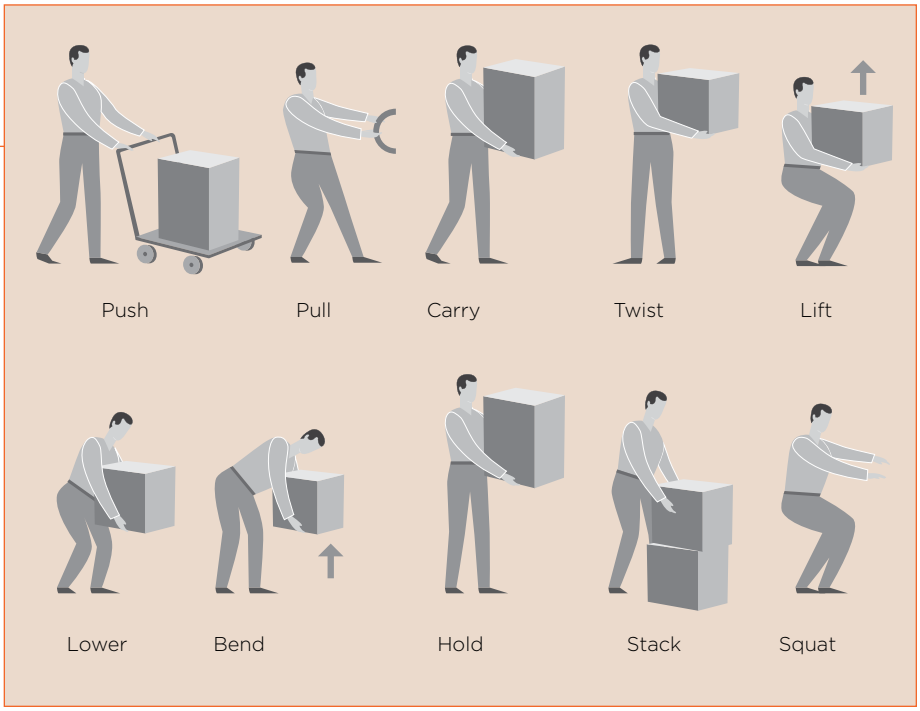
  Repetitive motion often becomes a "hidden" risk factor. Repetitive bending and lifting is often overlooked if the object being lifted is light in weight; however, every bend (especially if it is a bend at the waist) requires the muscles to lift the upper half of the body, and fatigue will set in quickly even if no object is being lifted. Repetitive motion can also be missed unless the task is observed for multiple cycles. For example, consider the simple task of holding a bottle of water with a fully-extended arm. If you saw a person doing this task, you may not immediately think of it as being difficult. However, if you were to ask that same person to hold the bottle of water in this fashion for one hour, they likely would not be able to do it. Over time, the force required to hold up the bottle and the arm would be so high that the muscles could not perform any longer.

- **Pressure points.** Repeated or continuous contact with hard or sharp edges and objects can create pressure over an area of the body that leads to reduced nerve function and blood flow. As an example, consider the small plastic piece added over the top of the wire handle on large buckets. Without the plastic piece, the entire weight of the bucket is spread over a very small area, causing significant pain.

  Pressure points often occur in manual material handling in situations where the hands are forced to grasp small objects like crates with sharp handholds, carts with squared handles (creating sharp corners), and similar situations. Pressure points can also occur in the knees and elbows if handling requires repeated contact with hard surfaces, such as kneeling to pick up a heavy object from the floor.

- **Static postures.** The chief complaint people usually make when they have worked for a long time in the same position is that they feel stiff, sore and tired. These are some of the effects that result when tasks involve static postures. The effects of maintaining the same work positions can occur in almost any joint of the body and vary depending on body location. For example, the effect on the knees and back from squatting or kneeling for two hours during a MMH task is likely to be greater than the effect on the neck and shoulders from looking up at a monitor for the same period.

This image provides a good reference regarding the risk factors that are most likely to cause workplace injuries during manual material handling tasks. When the risk factors are identified, they can be corrected using a variety of methods discussed later in this document.



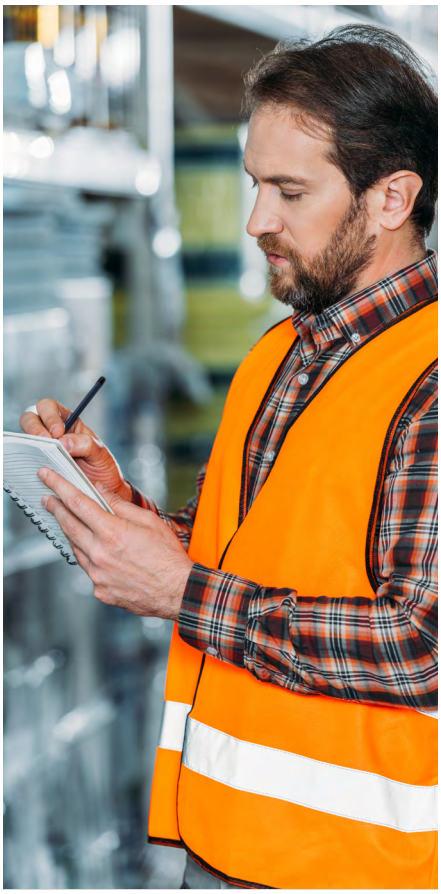
Identifying manual material handling risk factors and prioritizing for improvements.

Now that we know a little about MMH risk factors, how can they be identified and corrected in the workplace? Here are a few ideas:

- **Review written records.** A trusted statement in risk management is that "the past is often a great predictor of the future." That in mind, use written records like OSHA logs, past worker reports or complaints, and workers' compensation loss reports to identify previous problem areas. Look for injuries associated with the risk factors discussed above, which may appear as injuries such as "back strain" or "shoulder soreness."
- **Observe work activities**. Probably the best way to identify MMH risk factors in the workplace is to obtain a camera and notepad and watch employees involved in MMH tasks. Talk to workers and supervisors about where problems exist related to manual handling, paying attention to warning signs like:
  - Risk factors previously discussed (high force, awkward postures, repetitive motions, pressure points, and static postures).
  - Worker fatigue, discomfort, or reports of general aches and pains associated with MMH tasks.
  - Workers exhibiting "pain behaviors" like not moving certain body parts, restricting their movements, or massaging their hands or other body parts.
  - Other related issues such as increased absenteeism/turnover, increased error rates, decreased product quality, or other outcomes that can be explained by fatigue associated with MMH.
- **Use outside sources.** Having a second set of eyes—especially eyes trained in MMH risk factors—can go a long way to identifying and correcting risky MMH tasks. Consult with your Nationwide representative, insurance agent, or another risk management professional to assist you in this activity.
- **Use checklists and other tools.** An internet search of MMH assessment tools will yield many resources. In addition, Nationwide offers those listed below:
  - Lifting assessment: https://www.mylosscontrolservices.com/documents/loss-control-library/ergonomics-screening-tool
  - Push/pull assessment: https://www.mylosscontrolservices.com/documents/loss-control-library/ergonomics-screening-tool-pushing-and-pulling-tasks

After identifying MMH risk factors, you may find that there are more areas to correct than time or money available. In these cases, you'll need to prioritize. Although there is no one-size-fits-all method of prioritization, consider the following when deciding where to start:

- The frequency and severity of the risk factors you have identified that may lead to injuries. The more risk factors that are involved, or the degree of each individual risk factor, the more priority should be placed on finding a solution.
- The frequency and severity of complaints, symptoms, and/or injuries. If



Use checklists to ensure all risk factors are considered in each job.

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Focus on difficult and frequently completed MMH tasks if you need a place to start.

injuries continue to occur in a certain task, it should be a high priority.

- Technical and financial resources available. In many organizations, an open checkbook is not available for improvements. You may need to pick those that require limited (or no) money to complete. Making low-cost fixes and showing benefits is also a great way to demonstrate the value of the improvements, which can lead to money being available for more expensive solutions in the future.
- Ideas of workers for making improvements. In many cases, workers performing the job have great ideas regarding how to make it better. You'll often hear ideas starting with "all we need to do to make it better is...". Involve as many workers as possible so you don't miss these opportunities.
- Difficulty and timeframe in implementing various improvements. As discussed, some improvements are easier to make than others. Often, picking "low hanging fruit" creates momentum for larger, more complex improvements in the future.

If prioritizing using the tips above still leaves questions as to where to start, a final method can be to jointly consider the difficulty of the task and how often it is completed. Talking to employees who perform the work can often provide valuable information about why tasks are difficult and how they may be improved. Also, remember it is important to carefully observe all tasks in a given job because each of them may contain contributing factors.

How difficult is the task?	Score	How often is the task done?	Score
Very easy	1	Rarely (a few times a year)	1
Easy	2	Occasionally (a few times a shift or week)	2
Somewhat hard	3	Frequently (up to 4 hours per shift)	3
Hard	4	Constantly (more than 4 hours per shift)	4
Very hard	5	Extended (more than 8 hours per shift)	5

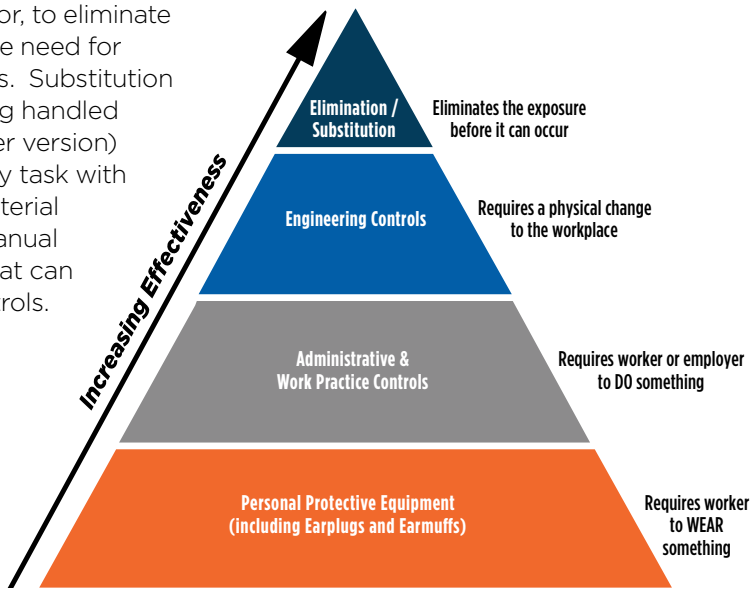
Give each task a score from each column and multiply the two scores to get a total task score. Using this method you can decide, for example, to improve a hard (4) task completed frequently (3) — a total score of 12 — before a very hard (5) task completed only once per year (1).

Task	Score for "how hard"	Score for "how often"	Total Task Score
Loading hopper	4	3	12
Cleaning scales	5	1	5

Making manual material handling improvements.

To obtain the benefits that improved manual material handling offers, positive changes must be made in the workplace. There are usually several ways to improve a given situation, and it can be tempting to pick a reasonable solution like "safe lifting training" and believe that the task has been improved. Before jumping to a training solution keep in mind the OSHA/NIOSH hierarchy of hazard control, at right.

- **Elimination/substitution** aims to remove the hazard entirely or replace it with safer alternatives. Related to manual material handling, elimination can be achieved by taking away the need for a manual task by using a mechanized solution, such as a conveyor, to eliminate carrying or an automated hopper, removing the need for employees to manually dump bags of materials. Substitution can be achieved with the object/material being handled (typically by replacing it with a smaller or lighter version) or with the process, such as substituting a carry task with a pushing task. Organizations should study material flow through the facility to identify as many manual lift/push/pull/carry/other MMH situations that can be eliminated or benefit from substitution controls.



- **Engineering** controls implement physical changes to the workplace or process that reduce the hazard. These often fall into the category of "ergonomic" improvements, which are changes made to improve the fit between the demands of the work (the risk factors) and the capabilities of the workforce. Engineering controls often involve changes to the process, materials, equipment, etc., and are limited only by the creativity of the workforce. For example, returning to the case of production worker Jim from earlier, a simple engineering control to prevent Jim from bending to floor level would be to use a tool like an adjustable height work platform. This doesn't eliminate the lifting task or substitute the material weight, but it does improve the process by allowing Jim to keep it in his "strike zone" between the knees and shoulders. Often, changes can be made very quickly and cost effectively. In this case, something as easy as placing the parts on a fixed height table or even a stack of pallets can also do the trick. Every lift Jim avoids from floor level improves the work situation. Below are key MMH design goals and how engineering controls can be effectively applied in many situations.

  - **Minimize force** — Reduce the size/weight of the load. Incorporate mechanical lifting devices such as hoists, cranes, vacuum lifts and manipulators to reduce the forces on the back. Proper caster size, design and material can significantly reduce push/pull forces for carts.

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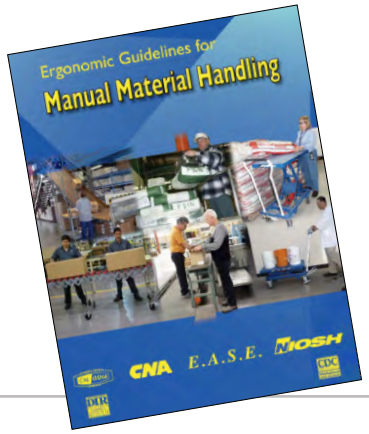
Looking for more ideas on how to improve manual material handling situations in your facility?

A great place to start is the Ergonomic Guidelines for Manual Material Handling, which includes many ideas and photos with improvements you can make in your workplace.

http://www.dir.ca.gov/dosh/dosh_publications/mmh.pdf



- **Minimize horizontal reach** — Allow for lifting loads as close to the body as possible. Modify the sides of bins for easy access or use a tilt table to allow for better access. Use a turn table for loads on pallets.
- **Minimize vertical range** — Place the load as close to waist height as possible. Keeping the lift in the "strike zone" between the knees and the shoulders reduces the risk significantly.
- **Minimize twist** — Reduce the need to twist the trunk by reorienting the starting and ending positions of the lift. If the starting and ending points go beyond the range of 90 degrees and cannot be designed differently, move the two points a step apart to encourage workers to turn their entire body, not just twist at the waist. Remind employees to always "align their toes with their nose" and point both in the same direction to avoid twisting.
- **Maximize grip** — Make loads as easy to grab and move as possible. Avoid slippery or shifting loads by using a well-designed tote or cart. Provide handholds or use lifting attachments to improve grip and keep the load close.

Administrative and work practice controls establish procedures that require employees to do something differently to reduce the hazard. With administrative controls, the task itself hasn't changed, but the amount of time any one employee performs the task is often reduced. The "how hard?" response remains the same, but the "how often?" score changes, resulting in a lower total score for the task. For this reason, administrative controls should be used only after engineering controls have been determined to be infeasible or until engineering controls can be implemented. Examples of administrative controls for MMH include:

- Alternate heavy tasks with light tasks. Adjust work schedules, work pace, or work practices.
- Provide variety in jobs to eliminate or reduce repetition (i.e., overuse of the same joint and/or muscle groups). Keep in mind with job rotation that unless different joint and muscle groups are involved, the benefits will be reduced. Simply moving an employee from a lifting situation in one department to a similar lifting task in another department may seem like "job rotation," but it is not affording the employee the necessary recovery period that job rotation is designed to provide.
- Provide recovery time (e.g., short rest breaks.) Break up work with frequent, short recovery periods. Even recovery periods as short as a few seconds on a regular basis are helpful.
- Use multi-person lifts for the heavy objects.

- Provide employee training programs on MMH risk factors. Training alone is not an ergonomic improvement. Instead, it should be used together with any workplace changes made. Workers need training and hands-on practice with new tools, equipment, or work practices to make sure they have the skills necessary to work safely. Training is most effective when it is interactive and fully involves workers.

  One of the most effective training programs for MMH is the case study. Pick a task in your workplace that has known risk factors and talk through with workers how to complete the task safely. Brainstorm the different risk factors present and what changes might be possible to reduce or eliminate the risk factors. If similar improvements have been made in other areas, show the workers these areas and discuss how they might be incorporated into other operations. Provide ample opportunities for questions and open discussion.

  While training is never a bad thing, it just can't be the only thing. Providing employees with training on safe lifting practices is good for those times when lifting is the only option. However, before deciding that lifting is the only option, be sure to investigate one of the many engineering controls that are available to reduce risk factors or even eliminate the lift from needing to be completed.

- **Personal protective equipment (PPE)** such as hard hats, vests, safety glasses, and other items are most effective when combined with other controls that first minimize the exposure; however, there are instances where some workplace hazards cannot be effectively controlled by other means. Although PPE is less appropriate for many MMH tasks as compared to other workplace hazards, there are cases when PPE can reduce risk factors, such as:

  - Knee and elbow pads can be used to protect the body from pressure points that occur when material handling requires contact with hard surfaces.
  - Proper footwear can prevent workers from slipping and prevent fatigue from extended standing on hard surfaces.
  - Gloves can protect hands from sharp or abrasive objects, chemicals, hot/cold temperatures, and other risks associated with MMH, and they can be used to improve grip.

Newer technologies, such as exoskeletons, are also designed to be worn to reduce or eliminate risk factors. Whether these tools are ultimately beneficial in reducing risks associated with MMH is still open to question, and more studies will be required before they are recommended.

While training is never a bad thing, it just can't be the only thing.

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Following-up on MMH improvements.

An important and often overlooked step in any improvement process is to follow up and determine if the improvements worked to control the observed risk factors. After a reasonable adjustment period, set a date to follow up on the changes made. The following questions may be helpful to ask during this process. If you determine that your improvements have not worked, modify them or try something different until the risk factors have been reduced or eliminated.

Has each improvement:

- Reduced or eliminated most or all the risk factors?
- Reduced or eliminated fatigue, discomfort, symptoms, and/or injuries?
- Been accepted by workers? If not, why not?
- Caused any new risk factors, hazards, or other problems that should be evaluated?
- Improved productivity and efficiency?
- Improved product and service quality?
- Been supported with the training needed to make it effective?

If you find that your improvements have brought the changes desired, be sure to make them known to workers. Show before-and-after photos on company bulletin boards (remember the camera you brought during the observation phase?), discuss the improvements made during employee safety meetings, and get the word out as much as possible. When workers see changes being made, morale improves and workers may provide even more suggestions for similar improvements to their work areas. What starts as a small effort in one department can grow into a valuable movement throughout the entire facility and/or organization. Good ideas related to MMH spread quickly and can provide many benefits.

Check for success and celebrate the improvements you've made.

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