



Ergonomic Evaluation of Radiopharmaceutical Tasks

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Author: **Jessica G. Ramsey, MS, CPE**

Desktop Publisher: Shawna Watts

Editor: Cheryl Hamilton

Logistics: Donnie Booher, Kevin Moore

Industrial Hygiene Field Assistance: Weston Dubose

Medical Assistance: Shawn Armes

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Introduction

Request

Management at a nuclear pharmacy requested a health hazard evaluation regarding potential musculoskeletal disorders among pharmacists. Their concerns focused on employees who manually moved shipping containers and used hot cell manipulators to pull individual drug doses.

Workplace

The facility is part of a large pharmaceutical distribution group. At the time of our evaluation, the company employed about seven people at this location. We evaluated employees with various job titles at the facility.

To learn more about the workplace, go to [Section A in the Supporting Technical Information](#)

Our Approach

We visited the facility in March 2020 to evaluate ergonomic hazards and musculoskeletal health symptoms of employees. During the visit, we completed the following activities:

- Observed work processes, practices, and conditions.
- Measured workstation heights and took pictures of workstations.
- Interviewed four employees about their work and health. Interview topics included job tenure, job tasks, and musculoskeletal health symptoms and concerns.

To learn more about our methods, go to [Section B in the Supporting Technical Information](#)

Our Key Findings

Workstations and tools were not ergonomically designed to reduce work-related musculoskeletal disorders

- Computer workstations were static and did not adjust.
- Conveyors were not set up properly for the size of the containers. The conveyors were too low, placing the container handles lower than recommended.
- Remote handling tools were not ergonomically designed. For example, the handle grip did not meet specifications for length, diameter, or grip span.

The most common potentially work-related pain reported was in the hand, wrist, and back

- Employees who reported back pain listed job tasks involving lifting heavy shipping containers.
- Employees who reported hand and wrist pain listed tasks including the hot cell manipulator.

To learn more about our results, go to [Section B in the Supporting Technical Information](#)

Our Recommendations

The Occupational Safety and Health Act requires employers to provide a safe workplace.

Potential Benefits of Improving Workplace Health and Safety:

- | | |
|--|--|
| ↑ Improved worker health and well-being | ↑ Enhanced image and reputation |
| ↑ Better workplace morale | ↑ Superior products, processes, and services |
| ↑ Easier employee recruiting and retention | ↑ Increased overall cost savings |

The recommendations below are based on the findings of our evaluation. For each recommendation, we list a series of actions you can take to address the issue at your workplace. The actions at the beginning of each list are preferable to the ones listed later. The list order is based on a well-accepted approach called the “hierarchy of controls.” The hierarchy of controls is a way of determining which actions will best control exposures. In most cases, the preferred approach is to eliminate hazards or to replace the hazard with something less hazardous (i.e., substitution). Installing engineering controls to isolate people from the hazard is the next step in the hierarchy. Until such controls are in place, or if they are not effective or practical, administrative controls and personal protective equipment might be needed. Read more about the hierarchy of controls at <https://www.cdc.gov/niosh/hierarchy-of-controls/about/index.html>. Most of the recommendations provided in this report were adapted from principles outlined in *The Handbook of Ergonomic Design Guidelines* [Humantech 2009].

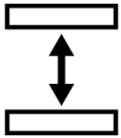


We encourage the company to use a health and safety committee to discuss our recommendations and develop an action plan. Both employee representatives and management representatives should be included on the committee. Helpful guidance can be found in *Recommended Practices for Safety and Health Programs* at <https://www.osha.gov/safety-management>.

Recommendation 1: Reduce risks for musculoskeletal disorders

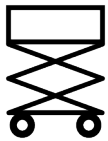
Why? Evidence associates low-back and shoulder disorders with work-related lifting, forceful movements, and awkward postures such as bending, reaching, and twisting. The best way to prevent and control work-related musculoskeletal disorders is through design. Job tasks, workstations, and tools and other equipment should be designed to match the physical capabilities of the employee.

How? At your workplace, we recommend these specific actions:



Make sure that hand working heights on conveyors range 38"–49". Also consider where the employee handles the load, that is, at the top, bottom, or center of the item.

- Reach distances should range 11"–22". For example, move the container of zip ties to the adjacent wall to reduce reach distances.
- Provide tools, such as hooks, to bring items closer to the employee without reaching.

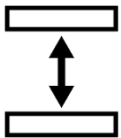


Do not place heavy items, such as shipping containers, directly on the floor. Incorporate load leveling tables or carts where space is available.



Design a remote handling device with the following characteristics.

- Handle grip span should be less than or equal to 2" when fully closed and less than or equal to 3.5" when fully open.
- Acceptable handle grip diameter is 1.2"–2".
- Acceptable handle grip length is 4"–6".
- The surface should be non-slip, slightly soft composite, or rubber.



Provide workstations that adjust for sitting and standing based on employees' job demands.

- Standing workstations are recommended if the job includes heavy lifting, long reaches, or frequent walking. Adjust these as follows:
 - Standing hand working heights should have an adjustability range between 38"–47" or fixed at 42".
 - The display viewing height (top of screen) should have an adjustability range between 58"–71" or fixed at 66". Viewing distance should have an adjustability range between 18"–30" or fixed at 23".

- Parts bins used during standing work should be placed in front of the employee. The reaching distance to the bins should be less than 16". The vertical height of the bins from the floor should range 24"–70".
- Touch screens, such as the keypad on the hot box, should have an optimal height (top of screen) that is adjustable between 47"–71" or fixed at 59" above the standing surface.
- Seated workstations are recommended if the job is visually demanding. Adjust these as follows:
 - Seated hand working heights should have an adjustability range between 27"–36" or fixed at 36".
 - The display viewing height (top of screen) should have an adjustability range between 35"–46" or fixed at 46". Viewing distance should range between 18"–30" or fixed at 23".
 - Seated workstation clearance should be greater than 18" for knee depth and greater than 30" for knee width.
 - Parts bins used during work should be placed in front of the employee. Reaching distance to the bins should be less than 16". The vertical height of the bins from the floor should be less than 46".
 - A height adjustable chair with footrest can be provided, if needed.



Provide antifatigue mats for employees who usually stand as part of their job.

- Mats should be at least 0.5" thick. They should have an optimal compressibility (firmness) of 3%–4% and beveled edges so they are not tripping hazards. They should be at least 8" under a workstation to keep standing surfaces even.
- Mats should cover the entire area that employees move while performing their job tasks. They should be replaced when they appear worn out or are damaged.

Recommendation 2: Encourage employees to report health concerns they think are work-related to their supervisors

Why? Recognizing symptoms early can reduce severity. Management can regularly review this information to look for common processes that might be related to reported musculoskeletal health symptoms and safety concerns. Management can use this information to identify opportunities for improvement.

How? At your workplace, we recommend these specific actions:



If needed, employees should seek care for work-related medical concerns from a healthcare provider knowledgeable in occupational medicine.

- The American College of Occupational and Environmental Medicine (<https://acoem.org/Find-a-Provider>) and the Association of Occupational and Environmental Clinics (<http://www.aoec.org/index/htm>) maintain databases of providers to help locate someone in your geographic area.

Supporting Technical Information

Ergonomic Evaluation of Radiopharmaceutical Tasks

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Section A: Workplace Information

Employee Information

Number of employees at time of evaluation: 7 (3 pharmacists and 4 production employees)

Standard work shift: 8-hour days, 5 days per week

Median age: 42 years

Median tenure at job: 11 years

History of Issue at Workplace

Request basis: In 2019, the year prior to the health hazard evaluation request, the facility had two injuries and one OSHA recordable related to musculoskeletal disorders (MSDs).

Process Description

Radiopharmaceutical Tasks

Nuclear pharmacies handle radiopharmaceuticals, which are drugs that contain radioactive isotopes. These drugs can be used to image or kill cancer cells. At this facility, pharmacists used manipulators attached to a hot cell to remotely draw and dispense doses of radiologic isotopes into syringes. Hot cells are shielded enclosures that allow for remote handling of radioactive materials. They placed the doses into a lead-shielded container (called a PIG) that weighed approximately 10 pounds. PIGs got their name from the industry term for a lead ingot that resembled the shape of a piglet. The containers have changed shapes throughout the years, but the name is still commonly used in industry. Employees prepared between 40 to 100 doses per workday. The pharmacists transferred the PIG from the hot cell to shipping containers using a remote carrying device. This device was about 30" long and was used to reduce potential radiation exposure by placing the radiation farther from the pharmacist. The PIGs were transferred into shipping containers that weighed approximately 60 to 100 pounds due to lead shielding that prevented radiation exposure. Pharmacists also processed prescriptions and performed other paperwork on computers.

Shipping Tasks

Pharmacists or production technicians placed the shipping containers (cases) onto a conveyor to be prepared for shipping. They performed this task 40 to 100 times per day. Sites typically had carts or dollies to help manually move the cases. Depending on the facility's layout, some overflow cases might remain on the floor. These had to be lifted to the conveyor. Employees placed paperwork and shipping items in the case, and then wiped them clean and surveyed them for radiation activity documentation.

Employees broke down cases as they were returned from the customer, which occurred 40 to 100 times per day. They removed the PIGs from the shipping cases, and then cleaned and inspected them before moving them to the central accumulation area. Employees then placed prescription labels on the PIGs to be ready for the next day.

Section B: Methods, Results, and Discussion

Our objectives were as follows:

- Observe work practices and procedures that may cause MSDs among employees.
- Determine the prevalence of employee symptoms related to work-related ergonomic risk factors.
- Provide recommendations to reduce work-related ergonomic risk factors and MSDs.

Methods: Ergonomics Evaluation

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

Results: Ergonomics Evaluation

Radiopharmaceutical Tasks

Figure B1 shows a pharmacist standing in front of the hot cell holding manipulators. The manipulators measured 53.5" from floor to handle, and the handles were 21" from the window. The employee in



Figure B1. A pharmacist standing on a platform using manipulators on a hot cell to prepare a syringe of radiological isotopes. Photo by NIOSH.

Figure B1 required a platform to be able to see the syringe inside the window. We observed awkward wrist postures as pharmacists used the manipulators. The remote carrying device used to transport the dose in the PIG to the shipping container was a specially designed “grabber” (Figure B2). The carrying device’s design could have been more ergonomic because the handle grip did not meet required specifications for length, diameter, or grip span.



Figure B2. One of the newer remote carrying devices (grabber) used to transport the dose. Photo by NIOSH.

Shipping Tasks

Two rows of conveyors held the packed shipping containers in the shipping area (Figure B3). Empty containers were stored on the floor under the conveyors. Conveyors measured 22" high, and the handle height of a container was 33" high. This handle height is below recommended values. The conveyors were 18" wide; consequently, the reach distance to a container on the back conveyor was at the upper limit of recommended values. For such large items, higher reach distances can cause more back strain.



Figure B3. Conveyors of containers in the shipping area. Photo by NIOSH.

Methods: Employee Health

Confidential Interviews

We held voluntary confidential interviews with all employees working at the facility the day of our visit. During these interviews, we discussed job tenure and job tasks, musculoskeletal health concerns, and relevant medical history. Employees were asked open-ended questions about specific exposures, health concerns, or health and safety issues. We also asked if they had pain, and if so, the location and severity of pain and if it interfered with their normal work, home, or nonwork activities.

Record Review

We reviewed Occupational Safety and Health Administration (OSHA) Form 300 Logs of Work-Related Injuries and Illnesses for years 2015 through 2019.

Results: Employee Health

Confidential Interviews

Four employees participated in the voluntary confidential interviews. Their median age was 42 years and median time working at the facility was 11 years. Interviewed employees represented pharmacists and production technicians. A majority of interviewed employees reported potentially work-related pain. The most common sites were the low back, wrist, and hand. Common tasks associated with potentially work-related pain were using the hot cell manipulators and lifting cases. All interviewed employees noted receiving onboarding and annual ergonomics training.

Record Review

During 2015–2019, only one OSHA Log entry was recorded in 2019. The injury was described as strain and soreness in both wrists from the hot cell manipulators.

Discussion

Work activities such as bending at the back, lifting items from various levels, standing for extended periods, and using awkward wrist postures could explain the symptoms and injuries that affected employees at the facility. Well-accepted measures that should reduce employees' risk for MSDs include redesigning job tasks and workstations. For example, employers could decrease the duration of continuous repetitive movements by rotating jobs that use different muscle groups. Additionally, some studies have shown that small increases in break times have decreased symptoms with no significant effect on productivity [Dababneh et al. 2001; Faucett et al. 2007; Galinsky et al. 2007].

Limitations

This evaluation was subject to limitations. The observations of job tasks were limited to the days when the evaluation occurred. Additionally, we were only able to document concerns and symptoms that were reported to us during the evaluation by current employees who chose to participate.

Section C: Occupational Exposure Limits

Risk Factors for Work-related Musculoskeletal Disorders

MSDs 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 disorders refer to (1) MSDs to which the work environment and the performance of work contribute significantly, or (2) MSDs that are made worse or longer lasting by work conditions. A substantial body of data provides strong evidence of an association between MSDs and certain work-related factors (physical, work organizational, psychosocial, individual, and sociocultural). The multifactorial nature of MSDs requires a discussion of individual factors and how they are associated with work-related MSDs.

Strong evidence shows that employees whose job 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 MSDs [NIOSH 1997]. Further strong evidence shows job tasks that require a combination of risk factors (highly repetitious, forceful hand/wrist exertions) increased risk for hand/wrist tendonitis [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 MSDs: 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 with that associated with occupational exposures [NIOSH 1997].

In all cases, the preferred method for preventing and controlling work-related MSDs is to design jobs, workstations, tools, and other equipment to match the physiological, anatomical, and psychological characteristics and capabilities of the employee. Most of the recommendations provided in this report were adapted from principles outlined in *The Handbook of Ergonomic Design Guidelines* [Humantech 2009]. Under these conditions, exposures to risk factors considered potentially hazardous are reduced or eliminated.

Section D: References

Discussion

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Faucett J, Meyers J, Miles J, Janowitz I, Fathallah F [2007]. Rest break interventions in stoop labor tasks. *Appl Ergon* 38(2):219–226, <https://doi.org/10.1016/j.apergo.2006.02.003>.

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Occupational Exposure Criteria

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