

Work Related Musculoskeletal Disorders In Sonography



SOCIETY OF DIAGNOSTIC MEDICAL SONOGRAPHY

Susan Murphey, BS, RDMS, RDCS, CECD

WHITE PAPER SERIES

Disclaimer: This informational resource is provided by the Society of Diagnostic Medical Sonography (SDMS) to facilitate discussion of complex issues affecting the diagnostic medical sonography profession. It is meant to help readers understand an issue, solve a problem, or make a decision. The information presented does not represent SDMS policy and should not be considered medical or legal advice. The reader should always consult a physician (for medical advice) or an attorney (for legal advice) licensed in their state to discuss their specific facts and circumstances before relying on the information provided in this document.

Comments/Suggestions: The SDMS is committed to providing informational resources like this white paper to its members. If you have comments or suggestions for this or other informational white papers, please contact the SDMS at: executivestaff@sdms.org

Discussions: SDMS Members are encouraged to utilize the SDMS Collaborate Community, <https://collaborate.sdms.org>, to discuss the issues addressed in this and other SDMS white papers.

WORK RELATED MUSCULOSKELETAL DISORDERS (WRMSDs) IN SONOGRAPHY

The terms “work related musculoskeletal disorders (WRMSDs)”, “musculoskeletal strain injuries”, and “cumulative trauma disorders” are used to describe conditions that are caused or aggravated by workplace activities. These painful disorders affect the muscles, nerves, ligaments, and tendons and occur in a number of professions, including sonography. Unlike acute injuries that happen in the workplace, such as slips, trips, and falls, WRMSDs develop gradually over a period of time from repeated exposure to a variety of risk factors and may be painful during work or at rest. Musculoskeletal disorders resulting from work activities are among the most frequently reported causes of restricted or lost work time.¹ They cost employers up to \$20 billion yearly in direct costs such as Worker’s Compensation and medical expenses, and up to five times that in indirect costs such as lost revenue, absenteeism, and costs related to hiring and training new employees.² WRMSDs also often impose a substantial personal toll on those affected since they may no longer be able to work or perform simple personal tasks and activities of daily living.² In sonography, workforce shortages can affect worker morale and patient access to care in addition to the physical health and well-being of staff.

The first published account of ergonomic concerns in sonography was termed “sonographer’s shoulder” by Marveen Craig in 1985.³ A subsequent study in 1997 by the Health Care Benefit Trust utilized data collected from almost 1,000 sonographers practicing in the United States. Results showed 84% experienced musculoskeletal pain related to scanning, with neck, shoulder, wrist,

90% of clinical sonographers
experienced symptoms of WRMSDs⁶

Costing employers over
\$120 billion yearly
in direct and indirect costs²

Figure 1. Musculoskeletal disorders resulting from work activities are among the most frequently reported causes of restricted or lost work time.¹

hands/fingers, and back as the most commonly affected sites.⁴ *The Industry Standards for the Prevention of Work-Related Musculoskeletal Disorders in Sonography* were first published in 2003, and since then, there have been significant ergonomic improvements in the design of sonographic workstation equipment.⁵ Today, almost all ultrasound systems have some degree of adjustability and sonography exam tables are now designed specifically for various ultrasound applications. Despite these improvements, a 2009 study indicated 90% of clinical sonographers experienced symptoms of WRMSDs, an increase of 6% from the 1997 study.⁶

UNDERSTANDING THE RISKS

The reason for an increase in symptoms of work related musculoskeletal discomfort among sonographers is multi-factorial. While there have been significant improvements in the design of ultrasound systems and workstation equipment for sonographers, not all sites have a full complement of state-of-the-art equipment. Additionally, exams are increasingly completed at the patient’s bedside or in other departments, where the sonographer does not have access to ergonomically designed workstation equipment and has the added burden of transporting equipment. Moreover, technological changes in workflow have resulted in increased interaction with computers, which increases the sonographer’s exposure to ergonomic hazards that have mechanical risk factors similar to scanning. Staff shortages due to injuries and increasing referrals for sonography have resulted in insufficient rest periods, further increasing the duration of the sonographer’s exposure to risk.

Although there are a growing number of workplace factors contributing to symptoms in sonographers, a primary driver of WRMSDs is due to an accumulation of repeated exposure



WORK RELATED MUSCULOSKELETAL DISORDERS (WRMSDs) IN SONOGRAPHY

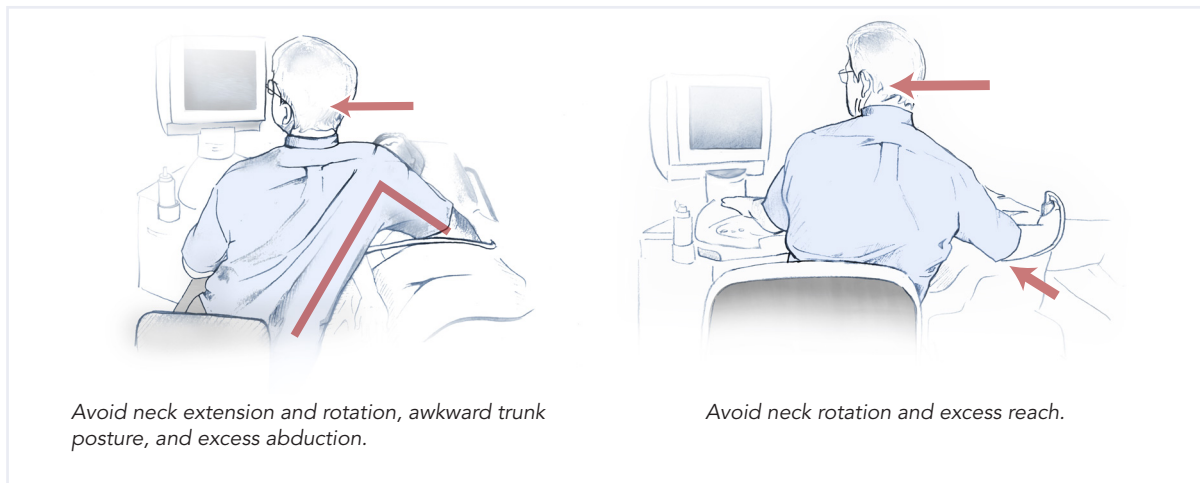


Figure 2: A primary driver of WRMSDs is due to an accumulation of repeated exposure to physical risk factors, many of which are related to sonographer scanning techniques.

to physical risk factors, many of which are related to sonographer scanning techniques. Many sonographers are utilizing the same scanning techniques from 30 years ago, despite the improved design and technological advances of workstation equipment. Individual movements and activities associated with musculoskeletal disorders are not necessarily harmful in and of themselves, but frequent repetition or prolonged duration of exposure, along with a pace that lacks sufficient time for recovery can be risk producing. In sonography, the primary physical risks include:

- **Force** is the exertion of physical effort applied by a body part to perform a task. Higher forces and/or longer durations of force can increase risk. Examples of force include: pushing/pulling, lifting, gripping, and pinching.⁷ In sonography, force is often associated with downward pressure applied with the transducer to obtain an image and grip force used to hold the transducer.
- **Repetition** is performing the same or similar tasks, either continually or frequently for an extended period of time without adequate recovery time. The severity of the risk increases with higher repetition of motions, particularly with other ergonomic risk factors such as force and/or awkward posture.⁷ Sonographers who perform the same type(s) of exams repeatedly, or exams using similar muscle activity have an increased exposure to risk factors associated with repetition.
- **Awkward** or sustained postures occur when body parts are positioned away from their neutral position. These postures can put stress on the joint and its associated muscles. The potential for risk increases the further from neutral and the longer the awkward posture is sustained. Examples include: flexion/extension of the wrist, excess abduction of the shoulders, forward flexion of the shoulders (reaching), bending/twisting at the waist, and bending or rotating the neck.⁷ Sonographers often exhibit awkward postures during scanning in an effort to access the region of interest or as a result of insufficient adjustability of equipment.
- **Contact pressure** is sustained contact between a body part and an external object.⁷ In sonography, examples include resting the hip or forearm against the exam table while scanning.

WORK RELATED MUSCULOSKELETAL DISORDERS (WRMSDS) IN SONOGRAPHY

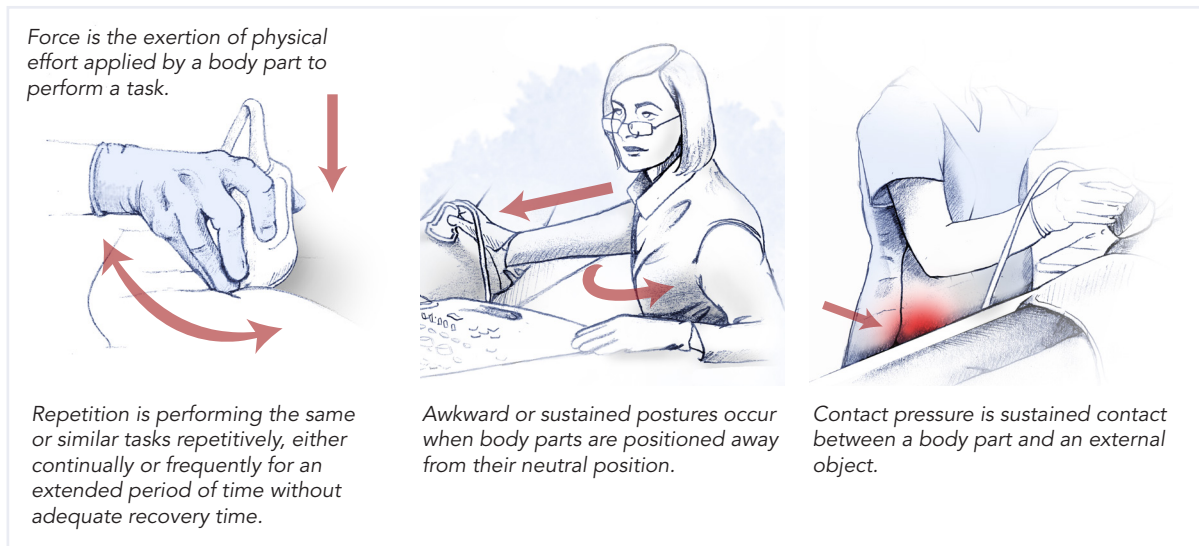


Figure 3. In sonography, the primary physical risks include: force, repetition, awkward or sustained postures, and contact pressure.

A simplified explanation of how injuries occur is when the load placed on a tissue exceeds the capacity of that tissue. Muscular activity increases in proportion to the load exerted upon it. When a muscle is unable to meet the demands of a task, there is additional strain placed on the tendons associated with that particular muscle resulting in tendonitis, tenosynovitis or bursitis.⁷ Inflammation of muscles, tendons, or ligaments surrounding nerves can cause pressure against the nerves and result in muscle weakness, numbness, and tingling.⁷

Repeated exposure to these loads, or risk factors, interferes with the ability of the body to recover and results in the accumulation of trauma to the muscles and tendons, which often ends in chronic conditions identified as musculoskeletal disorders. Awkward postures of the trunk, neck, and upper extremities, as well as excess gripping and downward force applied with the transducer, contribute to sonographers' symptoms of discomfort and risk for injury. For sonographers, the mechanism of injury to the shoulder is felt to correspond to frequent abduction of the scanning arm combined with static loading of the muscles related to pressure applied with the transducer. This results in mechanical compression of portions of the rotator cuff against the bony structures the shoulder girdle, decreased perfusion of blood to the muscles and tendons, and micro trauma to the muscle fibers.⁸ Back and neck pain have been found to be associated with repeated episodes of twisting of the neck and trunk, particularly when combined with abduction of the arm. Risk factors for the hand/wrist and elbow have been associated with awkward postures, repetition, and sustained or forceful gripping.^{8,10}

IMPACT OF WRMSDS

The impact of WRMSDs range from minor discomfort to career-ending injuries. In the study by Pike et al, 20% of sonographers who were symptomatic suffered career-ending injuries.⁴ The onset of WRMSD symptoms occurs as early as six months from the start of employment (15% incidence), increasing to 45% after three years, and as high as 72% after ten years of employment.¹¹ There are also a number of emotional and financial implications for the worker, as well as an impact on co-

WORK RELATED MUSCULOSKELETAL DISORDERS (WRMSDs) IN SONOGRAPHY

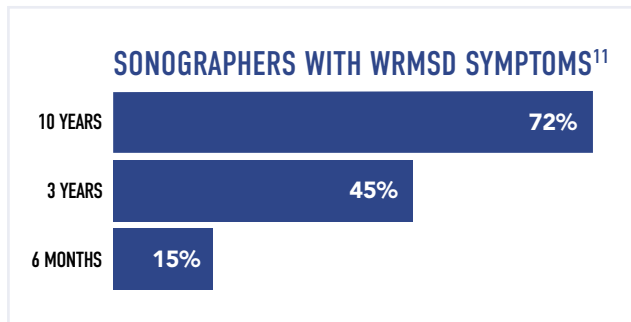


Figure 4. The impact of WRMSDs range from minor discomfort to career-ending injuries.

of sonographers reported shoulder pain, with 69% reporting low back pain and more than half (54%) reporting work related symptoms of the hand and wrist.⁶

It is difficult to successfully treat WRMSDs if reporting is delayed or the worker is sent back to the same work environment that produced the initial injury. Therefore, early reporting of symptoms and efforts to prevent injuries is critically important. The first onset of pain is a signal that the muscles and tendons need to rest and recover. Otherwise, an injury can become longstanding, and sometimes, irreversible.

STAGING OF WORK RELATED MUSCULOSKELETAL DISORDER SYMPTOMS	
STAGES	SYMPTOMS
Early stage	Aching and tiredness of the affected limb occurs during the work shift but disappears at night and during days off work. No reduction of work performance.
Intermediate stage	Aching and tiredness occur early in the work shift and persist at night. Reduced capacity for repetitive work.
Late stage	Aching, fatigue, and weakness persist at rest. Inability to sleep and to perform light duties.

Figure 5. Staging of work related musculoskeletal disorder symptoms⁹

ADDRESSING THE PROBLEM

Everyone has a role in maintaining a culture of safety and reducing the incidence of WRMSDs in sonographers. Originally published in 2003 and updated in 2017, the *Industry Standards for the Prevention of Work Related Musculoskeletal Disorders in Sonography* provides a comprehensive guide on the role of manufacturers, employers, educators and sonographers/users in the reduction of risk for WRMSDs.⁵ Beyond ergonomic equipment design, the development of a strong safety culture has the potential for the single greatest impact on injury reduction of any process and should be a top priority for all imaging departments. In a strong safety culture, everyone feels responsible for safety and pursues it on a daily basis. There is open communication between staff and management about safety and ergonomics. Managers motivate personnel through active participation in and

workers and the employer.

Pain is the most common symptom and may be accompanied by joint stiffness, redness or swelling, and/or muscle tightness. Numbness and tingling may also occur. The progression of symptoms is defined according to stages in Figure 5. The most common injuries among sonographers are carpal and cubital tunnel syndrome, epicondylitis of the elbow, shoulder capsulitis and tendonitis, and neck and back strains. In a 2009 sample by Evans et al, 90%

WORK RELATED MUSCULOSKELETAL DISORDERS (WRMSDS) IN SONOGRAPHY

support of safety-related activities, and provide necessary resources including equipment, time, money, and staffing for successful safety efforts.

Sonographers

For those who are actively scanning, personal accountability for maintaining safe work practices and the ongoing pursuit of risk-reducing modifications to scanning techniques are a necessity. Sonographers should know what work postures cause pain and make the necessary changes in their work behaviors, such as avoiding scanning positions that require extreme wrist flexion, trunk bending or twisting, shoulder abduction greater than 30 degrees, and excess force to acquire an image, particularly when scanning patients with a Body Mass Index (BMI) greater than 30. Familiarization with the proper use of adjustable chairs and adjustable exam tables is also crucial to optimizing scanning position. Sonographers should take the time to adjust the patient close to the edge of the exam table and properly adjust the height of the exam table and chair used during the exam to reduce abduction and reach of the upper extremities.

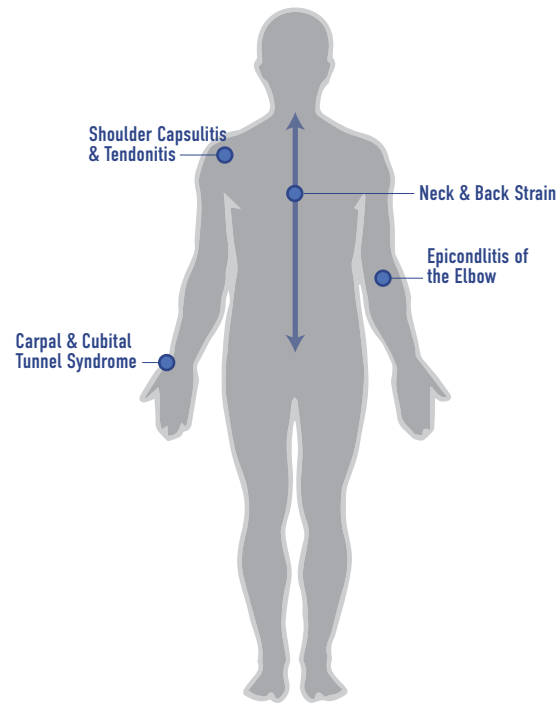


Figure 6. The most common injuries among sonographers are carpal and cubital tunnel, epicondylitis of the elbow, shoulder capsulitis and tendonitis, and neck and back strains.⁶

Employers

To ensure worker safety, management and employees must share a commitment to a culture of safety. In a true culture of safety, mutual respect is present. Employees proactively identify unsafe conditions and behaviors and are empowered by management to intervene and correct them. Employees perceive the presence of a culture of safety based on multiple factors, including:

- Actions taken by management to improve safety
- Availability of written safety guidelines and policies
- Worker involvement in the writing of safety-related policies
- Management attitudes regarding safety practices
- Availability of relevant safety and protective equipment

All of these factors serve to communicate the organization's attitude and commitment to safety. In a positive culture, safety is a core value of the organization, even at the expense of production or efficiency. A successful culture of safety depends on the active engagement of leadership. To protect sonographers, management must:

- Be aware of schedules and allow for adequate breaks. Scheduling templates should comply with local, state, and federal labor standards as well as facility policies for rest breaks and meal periods.

WORK RELATED MUSCULOSKELETAL DISORDERS (WRMSDS) IN SONOGRAPHY

- Vary exam types whenever possible. A variety of exams throughout the day allows the sonographer to use different sets of muscles during different exams, thus allowing muscle groups to rest periodically. This is particularly important for physically demanding exams.
- Limit portable/bedside exams to critical patients, with task rotation implemented to reduce exposure rate.
- Provide adequate space in scanning rooms for proper patient positioning, workstation and ultrasound equipment optimization.
- Maintain reasonable expectations regarding the limitations of body habitus on the ability to obtain diagnostic imaging data.
- Provide equipment with exam specific features and adjustability for optimizing scanning posture. This includes not only the ultrasound system, but also the exam tables, scanning chairs, external monitors, and adaptive support devices.

Shared Sonographer-Employer Responsibility

Even in areas where the Occupational Safety and Health Administration (OSHA) has not set forth a standard addressing a specific hazard, there is employer and employee responsibility for complying with the *Occupational Safety and Health Act of 1970 (OSH Act)*.¹² The general duty clause (Section 5) of the OSH Act provides that:

Each employer

- Shall furnish to each employee a place of employment that is free from recognized hazards that are causing or are likely to cause death or serious physical harm to their employees;
- Shall comply with occupational safety and health standards promulgated under this Act.

Each employee

- Shall comply with occupational safety and health standards and all rules, regulations, and orders issued pursuant to this Act which are applicable to their own actions and conduct.



Figure 7. In a true culture of safety, . . . employees proactively identify unsafe conditions and behaviors and are empowered by management to intervene and correct them.

Furthermore, the Occupational Safety and Health Act of 1970 gives employees and their representatives the right to confidentially file a complaint and request an OSHA inspection of their workplace if they believe there is a serious hazard or their employer is not following OSHA standards. Workers can file a complaint **without fear of retaliation** by calling 1-800-321-OSHA (6742), online via [eComplaint Form](#), or by printing the complaint form and mailing or faxing it to the local OSHA area office.¹³

WORK RELATED MUSCULOSKELETAL DISORDERS (WRMSDs) IN SONOGRAPHY

MANUFACTURERS

With compelling evidence for work related risk factors for musculoskeletal disorders in sonography, ergonomics must be a primary consideration in the design of apparatus and equipment used in the practice of sonography. Cutting edge design addressing the ergonomics of workstation equipment for sonographers can improve postural positioning and image acquisition and ultimately, reduce the exposure to risks associated with WRMSDs.

RESEARCHERS

To date, research on WRMSDs in sonographers has primarily been limited to symptom surveys and small-scale observational studies; additional research is needed to determine occupational exposure limits and the effectiveness of abatement methods. Evidence from these initial studies demonstrates a relationship between high levels of exposure to certain physical risk factors and the development of musculoskeletal disorders in sonographers. It would be of value for subsequent studies within the sonography profession to include observational trials for determining permissible exposure limits such as transducer time, number of exams per day, and threshold limit values for known risk factors. In addition, research has shown that a successful integrated ergonomic approach can be achieved through Industry Standards and initiatives aimed at developing specific tools for the prevention of WRMSDs.¹⁴ Thus, it is important that there be increased interventional trials to investigate preventive solutions for sonographers that go beyond equipment design.

THE FUTURE OF SONOGRAPHY

The use of sonographic imaging is likely to continue increasing. As technology evolves, medical facilities will replace more invasive, costly imaging procedures with sonography, and the number of sonography users will exponentially increase. The Bureau of Labor Statistics predicts that 27,600 additional sonographers will be needed by 2024, an increase that exceeds average growth of all occupations.¹⁵ With injury rates as high as 90%, it will be difficult to maintain a skilled workforce. One significant advancement in technology is the development of lightweight, compact, portable, point-of-care (POC) ultrasound systems. This new market generated over \$1 billion in annual sales in 2013, with systems intended for use primarily by non-sonographers.^{16,17} According to a 2011 report published by Klein Biomedical Consultants, the radiology/vascular medicine, emergency medicine, cardiology, anesthesiology, and musculoskeletal physician specialties use the majority of systems weighing less than 14 pounds.¹⁸ Ergonomic challenges such as forward head posture, repetitive movements of the thumbs, visual disturbances from close working distances and small text size, and the lack of separation between the controls and monitor may overlap with other compact technologies such as hand held communication and entertainment devices.

27,600 additional sonographers
will be needed by **2024**
AN INCREASE OF 24%¹⁴

Figure 8. As technology evolves, medical facilities will replace more invasive, costly imaging procedures with sonography, and the number of sonography users will exponentially increase.



ESTABLISHING BEST PRACTICES

Whether through a regulatory approach or voluntary best practices, it is imperative to protect and preserve the health and well-being of workers in this vital diagnostic modality. Risk factors and symptoms are frequently known, but ignored because of a reluctance to report concerns or a lack of understanding on how to address the issues. Understanding the need for proactive, preventative work safety programs requires both the vigilance and reporting by sonographers, and vision and action on the part of management. The precedence must be to develop best practices for establishing an on-going preventative maintenance program to protect sonographers and keep them pain free. Proper ergonomic programs that include a multi-faceted approach to equipment, positioning, and workflow organization can provide the foundation for effective prevention and allow well-trained workers to perform at their best level, thus increasing productivity, profits, and patient access to care. The experience and expertise sonographers bring to their work must be protected so that they can continue to provide the best patient care possible. Devoting resources to the welfare of sonographers is an investment in quality patient care, employee well-being, and the bottom line for any facility. For industry specific control measures for the prevention of WRMSDs, see the *Industry Standards for the Prevention of Work Related Musculoskeletal Disorders in Sonography*.⁵

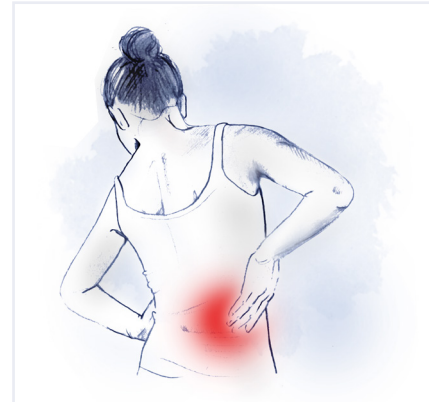


Figure 9. Sonographers should know what work postures cause pain.

WORK RELATED MUSCULOSKELETAL DISORDERS (WRMSDS) IN SONOGRAPHY

REFERENCES

1. Prevention of Musculoskeletal Disorders in the Workplace. Occupational Safety and Health Administration 2016. Available at: <https://www.osha.gov/SLTC/ergonomics/>. Accessed July 17, 2016.
2. Prevention of Work-Related Musculoskeletal Disorders. Occupational Safety and Health Administration 2016. Available at: https://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=UNIFIED_AGENDA&p_id=4481. Accessed July 8, 2016.
3. Craig M. Sonography: An Occupational Hazard. *Journal of Diagnostic Medical Sonography* 1985;1(3):121-126.
4. Pike I, Russo A, Berkowitz J, Baker J, Lessoway V. The Prevalence of Musculoskeletal Disorders Among Diagnostic Medical Sonographers. *Journal of Diagnostic Medical Sonography* 1997;13(5):219-227.
5. Industry Standards for the Prevention of Work Related Musculoskeletal Disorders in Sonography. Society of Diagnostic Medical Sonography. Available at: <http://www.sdms.org/?ID=19>. Accessed August 1, 2017.
6. Evans K, Roll S, Baker J. Work-Related Musculoskeletal Disorders (WRMSD) Among Registered Diagnostic Medical Sonographers and Vascular Technologists: A Representative Sample. *Journal of Diagnostic Medical Sonography* 2009;25(6):287-299.
7. CCOHS(WRMSD): Canadian Centre for Occupational Health and Safety; Work-related Musculoskeletal Disorders <https://www.ccohs.ca/oshanswers/diseases/rmirsi.html>. Accessed August 8, 2016.
8. Village J & Trask C. Ergonomic analysis of postural and muscular loads to diagnostic sonographers. *International Journal of Industrial Ergonomics*. 2007;37:781-789.
9. Work-Related Musculoskeletal Disorders. Canadian Centre for Occupational Health and Safety 2016. Available at: <https://www.ccohs.ca/oshanswers/diseases/rmirsi.html>. Accessed July 17, 2016.
10. Bertoloni E, Fenaroli M, Marciano F. Sonographers' workplace improvement: ergonomics evaluation using modelling and simulation software. Proceedings of the 2012 International Conference on Industrial Engineering and Operations Management, Istanbul, Turkey, July 3–6, 2012.
11. Muir M, Hrynkow P, Chase R, Boyce D, Mclean D. The Nature, Cause, and Extent of Occupational Musculoskeletal Injuries among Sonographers: Recommendations for Treatment and Prevention. *Journal of Diagnostic Medical Sonography* 2004;20(5):317-325.
12. OSHA Act of 1970. Occupational Safety and Health Administration 2016. Available at: https://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=OSHACT&p_id=3359. Accessed July 15, 2016.
13. How to File a Safety and Health Complaint. Occupational Safety and Health Administration 2016. Available at: https://www.osha.gov/workers/file_complaint.html. Accessed July 15, 2016.



WORK RELATED MUSCULOSKELETAL DISORDERS (WRMSDS) IN SONOGRAPHY

14. Fallentin N. Occupational Exposure Limits or Ergonomics Programs – Developmental Trends in EU and the US. National Institute of Occupational Health, Copenhagen, Denmark; 2003. Available at: <http://www.qec.freeiz.com/references/expoLimits-EU-US-IEA03.pdf>. Accessed August 18, 2016.
15. Diagnostic Medical Sonographers and Cardiovascular Technologists and Technicians, including Vascular Technologists: Occupational Outlook Handbook: U.S. Bureau of Labor Statistics. United States Department of Labor 2015. Available at: <http://www.bls.gov/ooh/healthcare/diagnostic-medical-sonographers.htm>. Accessed July 21, 2016.
16. Hope B. What's next for portable ultrasound? Imaging Technology News 2012. Available at: <http://www.itnonline.com/article/what%E2%80%99s-next-portable-ultrasound>. Accessed August 3, 2016.
17. Holloway S. Size Matters in the Future Evolution of Compact Ultrasound. Aunt Minnie 2014. Available at: <http://www.auntminnie.com/index.aspx?sec=ser&sub=def&pag=dis&ItemID=106618>. Accessed August 3, 2016.
18. Kaplan D. Portable Ultrasound Market Grows as Machines Become Smaller, Better. Diagnostic Imaging 2011. Available at: <http://www.diagnosticimaging.com/ultrasound/portable-ultrasound-market-grows-machines-become-smaller-better>. Accessed July 15, 2016.

