Industry Standards

for the

Prevention of Work-Related Musculoskeletal Disorders in Sonography

Developed through a consensus conference hosted by

Society of Diagnostic Medical Sonography

May 2003

Consensus Conference
on
Work-Related Musculoskeletal Disorders
in Sonography

SUMMARY

The Society of Diagnostic Medical Sonography (SDMS) hosted a consensus conference on Work-Related Musculoskeletal Disorders* (WRMSD) in Sonography on May 13-14, 2003 in Dallas, Texas. The conference was chaired by Joan P. Baker, MSR, RDMS, RDCS, FSDMS, founder of the SDMS, and internationally recognized advocate for prevention of WRMSD in sonography. Joan has been a sonographer for 43 years and serves on the faculty of Bellevue Community College. She is also a consultant for occupational health with Sound Ergonomics LLC, and lectures worldwide.

The goal of the conference was to develop risk-reducing industry standards that serve to address the multifaceted problem of WRMSD in sonography.

These industry standards address the role of employees, employers, educators, medical facilities, and equipment manufacturers in reducing the incidence and impact of these injuries on the workforce. These industry standards are intended to assist all stakeholders in making informed decisions. Adoption of these industry standards will improve the well-being of sonographers and sonologists and hopefully assist in addressing the workforce shortage in the profession.

This document reflects the consensus achieved by the conference participants.

* Musculoskeletal Disorders: a range of conditions caused by repetitive, forceful or awkward movements that cause injury to muscles, tendons, and ligaments.

PARTICIPANTS

Representatives of the following organizations / corporations participated in the Consensus Conference:

American Healthcare Radiology Administrators
American Institute of Ultrasound in Medicine
American Society of Echocardiography
Amersham Health
American Registry of Diagnostic Medical Sonographers

Australian Sonographers Association
Biodex Medical Systems
Biosound Esaote
Bristol-Myers Squibb, Medical Imaging
Canadian Society of Diagnostic Medical Sonographers
Joint Review Committee on Education in Cardiovascular Technology
Joint Review Committee on Education in Diagnostic Medical Sonography
GE Medical Systems-Ultrasound
Heritage Medical Products
Hitachi Medical Systems America
Medical Positioning
MediVision
Philips Medical Systems-Ultrasound
Precision Interconnect
Siemens Medical Solutions
Society of Diagnostic Medical Sonography
Society of Radiographers (United Kingdom)
Society for Vascular Ultrasound
SonoSite
Sound Ergonomics
Sound Technology
W.L. Gore and Associates

CONSENSUS CONFERENCE PROCESS

Participants at the Consensus Conference were invited stakeholder groups, professional organizations, and credentialing, accreditation, and governmental agencies. It was recognized that participants presented their personal views on the issues and not necessarily those of the organizations, agencies, or companies they represented. These standards are not a policy statement of any of the participating organizations, companies, or agencies.

Consensus Conference participants reviewed an extensive collection of literature related to WRMSD in sonography. They also heard presentations by international experts in the field including:

Grahame Brown, BSc, MRCGP, DipSportsMed, AFOM, FHGI, FFSEM
Consultant in Musculoskeletal, Sports, and Exercise Medicine
Specialist in Occupational and Psychological Medicine
The Royal Orthopaedic Hospital
Birmingham, United Kingdom

Val Gregory, MIR, AMS, M Mgt
Royal Prince Alfred Hospital
Sydney, Australia

Daniel J. Habes, MSE, CPE
Industrial Engineer
Industrial Hygiene Section
Hazard Evaluations and Technical Assistance Branch
Division of Surveillance, Hazard Evaluations, and Field Studies
National Institute for Occupational Safety and Health (NIOSH)
Cincinnati, Ohio

Susan Murphey, BS, RDMS, RDCS
Consultant for Sonographer Health
Sound Ergonomics, LLC
Kenmore, Washington

For this conference, consensus was broadly defined as agreement that the recommendations under discussion were acceptable to participants. Consensus was further clarified as being more than a simple majority. Although unanimity was not required, it was achieved. In the final consensus-achieving session of the conference, the chair declared consensus when participants demonstrated that they supported the recommendations under discussion and no participant expressed unyielding disagreement with the recommendations.

The recommendations reflect current knowledge presented at the conference and held by participants, corroborated by a systematic review of the literature (1985 to 2002). The recommendations are subject to change in the light of future developments. They provide detailed industry standards advocating best practices and control measures to prevent WRMSDs.

BACKGROUND

More than 80% of sonographers are scanning in pain and 20% of these professionals eventually experience a career-ending injury. On average, within 5 years of entering the profession, sonographers experience pain while scanning. [1]

The increasing loss of sonographers due to WRMSDs exacerbates the existing shortage of sonographers in the workplace and decreases patient access to this important healthcare service.

The economics of ergonomics is also an important consideration. A workstation including the cost of an ergonomically designed state-of-the-art ultrasound system, a table, chair, and accessories can be purchased for $188,200. In contrast, failure to address ergonomics in the workplace setting can result in $580,000 in revenue loss, medical bills, average cost of a Worker's Compensation claim, and new staff recruitment. Temporary staffing from an agency can cost an additional $80,000. [2]

REFERENCES

1. Society of Diagnostic Medical Sonography. *Sonography Benchmark Survey*. Dallas, Texas; 2000.

2. Sound Ergonomics. *Manpower Shortages are Costly*. Available at: http://www.soundergonomics.com/Pages/Admin_Risk/ergoeconomics.htm Accessibility verified May 29, 2003.

CORRECTION: This document incorrectly references the Society of Diagnostic Medical Sonography, Sonography Benchmark Survey (footnote #1 above). For information on the incidence of musculoskeletal disorders among sonographers, please see the following articles:

Pike I, Russo A, Berkowitz J, Baker J, Lessoway V: The Prevalence of Musculoskeletal Disorders Among Diagnostic Medical Sonographers. *J of Diagnostic Medical Sonography*; 1997:13:219. [see http://jdm.sagepub.com/content/13/5/219.abstract]

Gregory, V: *Musculoskeletal Injuries: An Occupational Health and Safety issue in Sonography*. Australian Sonographers Association. *Sound Effects*; 1998. [See http://mail.soundergonomics.com/pdf/mskarticle.pdf]

Murphy C, Russo A: *An Update on Ergonomic Issues in Sonography*. Employee Health and Safety Services, Healthcare Benefit Trust, 2000. [see http://www.sdms.org/pdf/sonoergonomics.pdf]

Baker, J: *Sonographer Symptom Survey Highlights*, Sound Ergonomics, 2008. [See http://www.soundergonomics.com/pdf/2008_Survey_results.pdf]

Industry Standards for the Prevention of Work-Related Musculoskeletal Disorders in Sonography

Work-related musculoskeletal disorders (WRMSDs) affect a large number of sonographers and sonologists, particularly those with heavy workloads and those who have been in the profession for a long time. Good ergonomic design must be an integral part of equipment design, and significantly influence purchasing decisions. The employer, manufacturer, user, and educational programs have the responsibility to prevent health and safety problems that cause WRMSDs.

I. EQUIPMENT CONTROL MEASURES

A. ULTRASOUND SYSTEM

State-of-the-art equipment allows for optimal visualization which increases diagnostic accuracy and reduces sonographer/sonologist fatigue. These industry standards are specific to floor-standing models. Therefore, some recommendations may not apply to non-floor-standing models.

1. Fully adjustable equipment that suits the anthropometrics of the 5th to 95th percentile of the population and is specific to the demographic area of the users.[1]
2. Easily accessible controls for achieving two-wheel, four-wheel, and braked positions. Central locking is preferable.
3. Recording devices positioned to minimize the user's reach to external devices; external devices should not interfere with adjustability of the system.
4. Footrest on the equipment designed to encourage neutral position of the ankle.
5. Transducer holder incorporates ease of access (unobstructed); should not be detrimental to the distance required to access controls; low force, minimal effort required for single-handed use.
6. Cables should not interfere with access to equipment or system interaction.
7. Port Connector permits ease of use, single-handed use, minimizing the user's reach, force, and necessity of a pinch grip; does not interfere with access to equipment or system interaction.

8. System design such that transporting the equipment does not exceed 50 pounds of force for pushing or pulling by a single user on usual flooring surfaces. Otherwise, it is required that additional personnel are available to assist in moving the equipment.[2]
9. Height-adjustable handles suitable for transporting the equipment.

B. CONTROL PANEL

1. Height-adjustable, separate from the monitor with appropriate degree of tilt to allow for standing or seated user to achieve neutral posture of wrist and forearm. Independent movement of control panel allows users to work while maintaining their elbow at their side.
2. Optimized control layout to allow use by both right and left-handed users.
3. Size, shape, and spacing of controls designed according to occupational ergonomic guidelines.[1] Font size and control layout are visually discernable, according to occupational ergonomic guidelines.[1] The range of illumination permits clear identification of control functions at applicable user positions.
4. Entire system designed to be used in seated position without obstruction of legs / knees.

C. MONITORS

1. Incorporate features to minimize eye strain, such as:
   a. Reduced flicker
   b. Appropriate brightness and contrast levels
   c. Resolution
   d. Visual contrast
2. Height-adjustable, separate from the control panel with appropriate degree of tilt to enable standing or seated users to achieve neutral posture of their necks.
3. Single-handed movement of the monitor allows users to work while maintaining their neck in a forward, neutral position at a range of 18 - 30 inches.
4. System must support the ability to use an external monitor. See page 4: G. Accessories.

D. TRANSDUCERS

1. Lightweight and balanced to minimize torque on the wrist, facilitate a palmar grip without an expanded stretch of the hand, and encourage a neutral wrist position.

2. Sized to support appropriate anthropometric data for the majority of users, encourage a palmar grip, and slip resistant.
3. Cables and cable management systems must be suitable in length to permit unrestricted use; and be of suitable length for intended applications.

E. TABLE

Industry standards #1-5 are considered essential when new or replacement tables are being purchased.

1. Height-adjustable, capable of being adjusted low enough to allow patients to get on and off easily unassisted, and to allow user to scan in a sitting or standing position while maintaining arm abduction of less than 30 degrees.[3]
2. Maneuverable, full wheel mobility, and wheel locks that are easily operated.
3. Open access from all sides to allow the users to place their knees and feet underneath, if needed. Table support structure and/or table mechanisms should not extend beyond the table top such that it prevents the user from minimizing reach and arm abduction.
4. For endovaginal scanning, suitable patient access and support such as adjustable footboard and stirrups.
5. For cardiac imaging, an easily operated, drop away or cut out section to allow unhindered access to the apical region while allowing the user's wrist to remain supported and in a neutral position.
6. Ideally, electronic controls that are accessible and easy to use.
7. The following options may assist in reducing scan time by improved patient positioning depending on the procedure:
   a. Trendelenberg and reverse Trendelenberg
   b. Fowler back (upright table back)
   c. Arm extension
   d. Central locks
   e. Patient restraints

F. CHAIR

1. Height-adjustable with sufficient range to suit the majority of the users. Range of height adjustability optimizes positioning of less than 30 degrees abduction of the scanning arm and allows the forearm of the non-scanning arm to be approximately parallel to the floor.[3]
2. Adjustable lumbar support, adjustable seat for thigh support, and an adjustable footrest. Seat design must encourage an upright posture.

3. Swivels to allow the user to rotate from the patient to the ultrasound system while maintaining an aligned posture.
4. Casters suitable to the type of flooring.

G. ACCESSORIES

1. Gel bottles should have large openings to reduce the strength needed to squeeze the bottle and of suitable diameter to avoid extended grip position.
2. Support devices available to all users for arm support in abduction.
3. When required, the patient chair (and/or table converted to sitting position) used for seated procedures (eg, shoulder ultrasound) should be fully adjustable, easy to rotate, lockable and armless, or with removable arms to achieve unobstructed access for proper ergonomics.
4. A transducer cable support device to allow users to reduce their grip by reducing the amount of torque on the wrist/forearm.
5. Properly fitting, textured exam gloves to reduce the force required to grip the transducer.

II. ADMINISTRATIVE CONTROL MEASURES

A. EMPLOYER

1. Provide annual education to all users on the risk and prevention of musculoskeletal disorders.
2. Perform risk assessments in consultation with the users on a regular basis to identify musculoskeletal disorders and formulate and implement controls for the prevention and/or reduction of these disorders.
3. Provide a system to report and document acute or chronic musculoskeletal disorders per applicable regulations.
4. Conduct risk assessments prior to the purchase of equipment.
5. Maintain all equipment in good working order.

B. WORKLOAD AND SCHEDULING

1. Solicit user input on establishing protocols on examination scheduling.
2. Provide adequate rest breaks between examinations particularly for procedures comprised of similar postural and muscular force attributes.
3. Encourage task rotation in the workplace as much as possible.

4. Establish maximum transducer time per hour. (Research to determine maximum safe transducer time is encouraged.)
5. Minimize portable/bedside examinations.

C. EXAMINATION AREA

1. Dedicated examination area provides adequate space for the maneuverability of equipment around the exam table and allows easy access from all sides.
2. Examination room doorway allows easy access for all wheelchairs, beds, and ultrasound equipment.
3. Suitable flooring to allow easy movement of equipment.
4. Adequate ventilation and temperature control to ensure the comfort of user and patient while enabling the equipment to operate at a functional temperature.
5. Adjustable room lighting with easily accessible dimmer controls; shaded windows to eliminate light.
6. Accessories that improve posture and reduce muscular force should be available and easily accessible to the user.
7. All imaging supplies stored in the examination area and easily accessible.

III. PROFESSIONAL CONTROL MEASURES

A. BEST PRACTICES

It is recommended that sonographers, sonologists, and students follow current best practices to reduce the risk of developing musculoskeletal disorders. These best practices include:

1. Minimize sustained bending, twisting, reaching, lifting, pressure, and awkward postures; alternate sitting and standing and vary scanning techniques and transducer grips.
2. Adjust all equipment to suit user's size and have accessories on hand before beginning to scan.
3. Use measures to reduce arm abduction and forward and backward reach to include: instructing the patient to move as close to the user as possible; adjust the table and chair; and use arm supports.
4. Relax muscles periodically throughout the day:
   a. Stretch hand, wrist, shoulder muscles, and spine
   b. Take mini breaks during the procedure
   c. Take meal breaks separate from work-related tasks
   d. Re-focus eyes onto distant objects
   e. Vary procedures, tasks, and skills as much as reasonably possible

5. Use correct body mechanics when moving patients, wheelchairs, beds, stretchers, and ultrasound equipment.
    a. Correct body mechanic guidelines are available from employers or regulatory bodies.
6. Report and document any persistent pain to employer and seek competent medical advice.
7. Maintain a good level of physical fitness in order to perform the demanding work tasks required.
8. Collaborate with employers on staffing solutions that allow sufficient time away from work.

B. EDUCATION AND TRAINING

1. Participate in education and training to reduce the risk of developing musculoskeletal disorders:
    a. Attend employer sponsored in-services
    b. Attend seminars, lectures, workshops, or conferences offered by professional organizations or manufacturers
    c. Access journals, textbooks, online resources, etc.
    d. Attend a formal sonography program that includes WRMSD prevention in the curriculum

REFERENCES

1. Kroemer K, Grandjean E. *Fitting the Task to the Human. A Textbook of Occupational Ergonomics*. 5th ed. Philadelphia: Taylor & Francis, Inc; 1997.

2. Eastman Kodak Co, Rodgers SH (ed). *Ergonomic design for people at work. Volume 2*. New York: Van Nostrand Reinhold; 1986.

3. Salvendy G. *Handbook of Human Factors and Ergonomics*. New York: John Wiley & Sons, Inc; 1997.

GLOSSARY

Anthropometrics: measured data of body dimensions for various populations.

Demographic area: the characteristics of human populations and population segments, especially when used to identify consumer markets.

Equipment: the ultrasound system without accessories.

Mini breaks: breaks lasting a minute or two taken throughout the examination study to relax muscles that are put into spasm while scanning. These muscles include, but are not limited, to the neck, shoulder, wrist, and fingers.

Pressure: force applied uniformly over a surface, measured as force per unit of area. The application of continuous force by one body on another that it is touching; compression.

Sonographer: a professional who uses an ultrasound system to create images of structures inside the human body that are used by physicians to make a medical diagnosis.

Sonologist: a physician who makes a medical diagnosis using ultrasound and who may also perform ultrasound procedures.

Suitable Flooring: tile, linoleum or other hard surface (not carpeting).

System: all the components of an ultrasound unit with accessories such as a printing device or VCR, or the entire workstation.

Unit: a component of an ultrasound system.

User: a professional who uses ultrasound to make diagnostic images in a medical setting.