

CORPORATE SCIENCE, ENGINEERING AND
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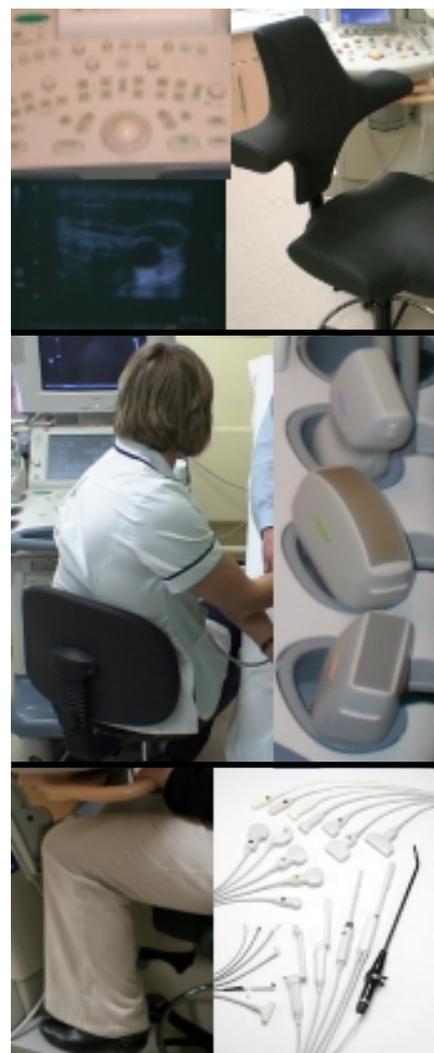
**Project
Report**

Human Factors, Ergonomics and Psychology

RISK MANAGEMENT OF MUSCULOSKELETAL DISORDERS IN SONOGRAPHY WORK

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EXECUTIVE SUMMARY

INTRODUCTION

Healthcare professionals undertaking diagnostic imaging work using ultrasound equipment have a high prevalence of musculoskeletal disorders (MSD). There is a substantial amount of published information on MSD risk management specific to sonography. However, it is not clear how this information translates into practice in the UK. This report describes a project to examine MSD risk management performance across a range of sonography operations at UK NHS Trusts. This report is aimed at healthcare professionals involved with sonography work, their professional bodies and trusts that employ sonographers and operate services. It is also aimed at manufacturers of sonography equipment and training providers. This report will also be of use to regulators and other health and safety professionals involved with the health service.

MAIN FINDINGS

Inspections of 14 NHS trusts in the UK were undertaken in 2007 to examine how effectively MSD risks were managed in sonography work. Overall, performance was found to be much less effective than it should be. This is cause for concern because of the high levels of MSD associated with sonography professionals and the large amount of industry specific guidance in existence. The main issues were:

- Risk assessments generally weren't suitable and sufficient
- Despite widespread awareness of the MSD risks to sonographers, action to tackle the problems tended to be superficial
- Risk reduction and controls were generally not comprehensive enough to reach the 'so far as is reasonably practicable' standard
- Workload was generally high in sonography. Work organisational / psychosocial factors were seldom sufficiently assessed and controlled, despite their apparent influence in reducing risk
- In most cases training did not adequately address MSD risks, and how to conduct best practice scanning
- Occupational Health provision, whilst generally good, tended not to be used proactively for sonographers
- Health monitoring was rare, even for individuals with established MSD problems
- Manufacturers and education providers have a key role in developing improved systems in sonography work. Both should take account of and facilitate fundamental changes to current scanning practice
- Generally, the arrangements for sonography work could be improved which would improve efficiency as well as the health of sonographers.

To deliver a sustainable, efficient and safe sonography service the human factors issues in sonography need to be tackled in a thorough and fundamental way.

Improving standards

Trusts should adopt the HSG60 seven stage approach for managing MSDs in sonography and across other specialist departments. The evidence strongly suggests that action is needed most in risk assessment and control. NHS trusts should provide the necessary resources to help all departments tackle their MSD risks effectively.

Efforts should be coordinated across all sonography modalities at a trust. Work organisation should be a central target. Increased sonographer control of their work should be considered as well as efforts to balance workload to enable rest breaks to be taken. Suitable changes to the physical environment like the introduction of slave

monitors can be effective. The potential of introducing fundamental changes in sonography practice such as scanning with both hands and making effective use of voice activated systems should be a priority. There is a clear role for equipment manufacturers and education providers in developing / facilitating improvements to sonography systems of work supported by feedback of users.

Further detailed actions concerning sonography work are contained in this report.

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1 INTRODUCTION

Diagnostic imaging using ultrasound equipment is an effective and useful tool for a range of clinicians in the National Health Service (NHS). Ultrasound uses high frequency sound waves to produce a real time image of the internal body. These images are used to check function, look for abnormalities and take measurements and stills for the most part non-invasively. Three main professions do ultrasound work: Radiographers work in obstetrics, gynaecology and general ultrasound; Cardiac Technicians undertake echocardiography (the heart); and Vascular Technicians investigate blood vessels using ultrasound. Midwives can undertake aspects of the obstetric work (e.g. dating scans etc). Ultrasound equipment is also deployed in musculoskeletal investigations. Medical practitioners can also use ultrasound machines. Sonography work involves an operator guiding a handheld transducer against the patient's body while simultaneously monitoring a screen and using a keyboard to control / record the image.

1.1 Musculoskeletal disorders (MSD) in sonographers

Several studies have identified aspects of sonography work that were associated with MSD. These included (fig 1.1): one-sided static working position; prolonged pinch gripping of the ultrasound transducer; abduction at the shoulder during transducer placement; and insufficient recovery time (Vanderpool et al, 1993; Magnavita et al, 1999; Schoenfeld et al, 1999; and Village and Trask, 2007). Most recently, Dodd-Hughes (2008) found evidence that work organization (psychosocial) factors (such as demand, control, support and role) as well as physical factors were associated with musculoskeletal problems in a sample of UK sonographers (see appendix 1 for a summary of this research). Musculoskeletal disorder prevalence rates in excess of 80% have been reported for sonographers in the literature (Smith et al. 1997; Magnavita et al, 1999 and Dodd-Hughes, 2008). Worryingly, Brown and Baker (2004) found that around 20% of sonographers reportedly left the profession due to persistent discomfort. The Society of Radiographers recently publicised a civil case where an ex-sonographer was awarded almost £230k for her career ending MSD.

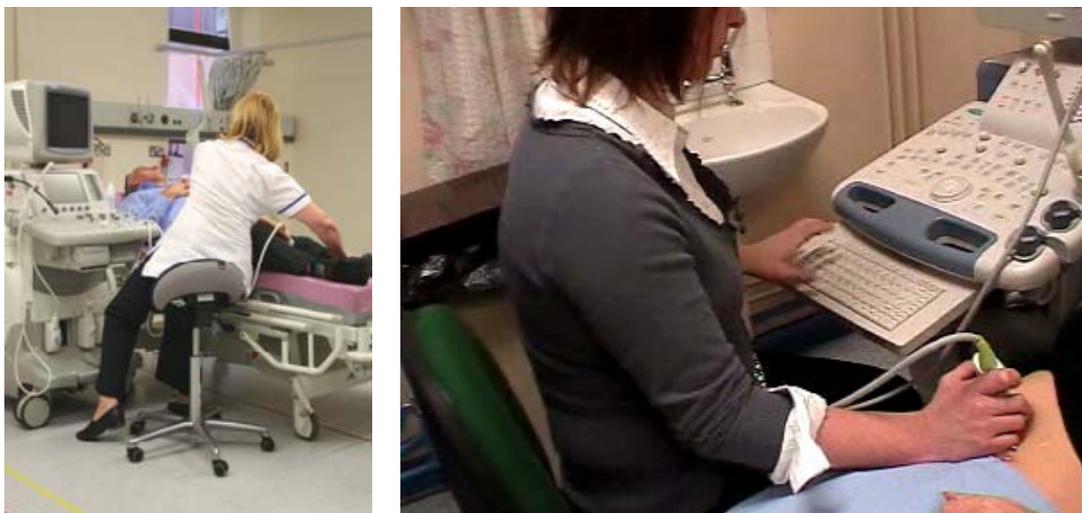


Figure 1.1. Examples of sonography procedures and the range of awkward postures involved. Left, a vascular examination of the lower limbs giving rise to reaching, and twisting of the trunk as the sonographer applies the transducer with one hand and squeezes the muscle with the other. Right, an early pregnancy scan giving rise to extension and deviation of the wrist as the transducer is applied and finely moved to give an appropriate image on the screen.

1.2 Key information on managing MSD risks in sonographers

The Society of Diagnostic Medical Sonography (SDMS, 2003) developed consensus guidance on industry standards for the prevention of work related MSDs in sonographers. This process involved a number of key stakeholders including equipment manufacturers. The guidance described a range of useful ergonomics measures concerning:

- Equipment - ultrasound machine, table, chair, monitor etc
- Work organisation - workload, scheduling and work area
- Professional issues - adoption of best practice and training

The Society of Radiographers (2003 and 2007) in the UK produced useful documentation to help trusts, departments and individuals to tackle the risks of MSD that appear to be linked to sonography work. The Health and Safety Executive (HSE) has produced guidance material that is not specific but highly applicable to the management of MSD risks in sonography. For example, HSG 60 – upper limbs disorders and L26 - the display screen equipment (DSE) regulations (sonography is classed as DSE work).

The above indicates there is a useful amount of information available on the management of MSD risks associated with sonography. It was not clear how far this had been used in practice and HSE Sector, Specialists and Operational Inspectors have been aware of a number of trusts tackling problems related to MSD affecting their ultrasound imaging staff. Consequently, a project was undertaken to examine MSD risk management performance in sonography within the NHS.

1.3 Project aims and objectives

This report describes a Specialist Inspector (Ergonomics and Human Factors) project examining the management of MSD risks associated with sonography work in the NHS.

The work delivered an inspection project examining MSD risks to sonography workers within the healthcare sector. Reference is made to stress issues where that could exacerbate MSD risks however risks of work related stress without an MSD link were outside the scope of the work. The focus was on establishing custom and practice with respect to management of MSD risks. The intention was to assess uptake and implementation of a range of risk reduction and control measures for sonography tasks.

This report is aimed at healthcare professionals involved with sonography work, their professional bodies and trusts that employ sonographers and operate services. It is also aimed at manufacturers of sonography equipment and training providers. This report will also be of use to regulators and other health and safety professionals involved with the health service.

2 PROJECT APPROACH

2.1 Checklist development

Pilot visits were carried out to obtain relevant information on sonography tasks and issues that surround the sonographer within their workplace. This information was used in conjunction with current and available guidance to develop the checklists for use by the participating Specialist Inspectors (Human Factors and Ergonomics). Two checklists were developed, one aimed at the NHS Trust and the other for the individual departments. The Trust checklist contained items to prompt the inspector to consider aspects such as Trust awareness of MSD issues, occupational health provision and the approach used to monitoring and investigate cases. The department checklist considered the number, range and duration of scans undertaken; risk assessments; and controls measures implemented.

2.2 Project briefing

A team briefing was undertaken to ensure that members of the inspection team were fully aware of the issues surrounding sonography, the aims of the visits and what needed to be delivered. A briefing pack was issued that contained relevant information: a literature review concerning MSD in sonography; the checklists; industry good practice guidance; and useful information from manufacturers and suppliers.

2.3 Project inspections

An opportunistic sampling approach was used to select trusts for inspection. Local HSE inspectors were contacted and potential candidates for inspection were identified. Scenarios when an inspection was considered particularly useful included Trusts that had raised sonography work as an issue or perhaps introduced measures to reduce the risks that the local inspector had been made aware of. Not all inspections were selected in this way but the potential bias associated with selecting visits in this way needs to be acknowledged. Checks with professional bodies representing sonographers strongly suggested that the standards that were observed were a reasonable reflection of UK wide sonography practice. Each visit used the checklists as a basis for the inspection to promote consistency of approach. Checklists were completed for each trust and the departments visited. Each trust visited was presented with the specific findings and actions. The completed checklists were returned to the project leader for analysis.

3 INSPECTION FINDINGS

Thirty-two departments undertaking sonography work were inspected from 14 NHS Trusts across the UK. All trusts conducted obstetric and general radiology sonography. Seven (50%) trusts operated an echo cardiology service and 12 (85%) operated a stand alone vascular service. The trusts were located UK wide (4 in Wales, 2 in Scotland and 8 in England). The sample was not selected at random but it was considered to reasonably reflect sonography practices in the UK.

3.1 Awareness of MSD risks

Awareness of sonographers being a group of workers with a particular MSD issue was exceptionally high in the departments and trusts visited. In 94% of departments visited managers were aware of individuals having experienced or currently experiencing MSD problems attributed to their work. In at least 4 trusts visited awareness of the MSD issue in sonography at the trust level was stimulated by employee litigation claims. As a result, Inspectors did not need to persuade managers and staff that MSDs were a real concern requiring attention.

An overwhelming majority of departments (96%) were aware of some form of guidance on the topic. The most commonly cited guidance was from the Society of Radiographers (SoR) and HSE's guidance on the Display Screen Equipment Regulations (L26). The SoR has done an effective job of raising levels of awareness but this may well have been limited to sonography modalities operated and run by Radiographers. Echo and vascular teams were less aware of the SoR guidance. In addition, guidance and information on MSD provided by their respective professional bodies appeared to be much less comprehensive than that supplied by the SoR. It is important to note that there is a great deal of commonality between sonography modalities in terms of the range and depth of MSD risks present in their professions. Hence, all modalities can make effective use of the range of existing guidance and should do so. It should be recognised that the industry has raised the issues of MSD in sonography to a large extent prior to this project.

A small opportunistic sample of sonographers in each department was asked about the musculoskeletal problems they had experienced. In common with the extensive literature supporting a high prevalence of MSD in sonography staff the interviews identified that nearly 90% had experienced some type of musculoskeletal discomfort during their career. Around half of the interviewees reported the discomfort they experienced as 'severe'. Almost 30% of those experiencing problems had also taken time off work as a result. There was strong agreement between the findings of the sonographer interviews and department manager awareness of MSD problems in their unit.

3.2 Occupational health provision

All of the trusts reportedly had systems in place for prompt access to occupational health support. However, it was unclear why, given that so many sonographers experienced musculoskeletal ill-health, occupational health support was not being utilised more often than it was? In some cases time pressure and workload may have been enough to deter sonographers seeking assistance. There were signs that some staff considered pain and discomfort to be 'part of the job'. Most Trusts investigated MSD incident reports with support from the BackCare Advisor and / or Occupational Health (OH). Triggering the involvement of these professionals appeared to take a mostly reactive route. It was also found that 85% of trusts' investigation process included identifying remedial actions. This suggested that most trusts recognised that part of the investigation process was to identify and implement interventions that will reduce the risk of injury occurring again.

3.3 MSD Monitoring

Effective and informative health monitoring for MSD was not widely observed at the trusts / departments visited. In fact, MSD monitoring was identified in just 35% of the Trusts visited and these were usually passive and reactive in nature.

3.4 Scanning workload

Sonographers can be expected to undertake up to 35 scans per day. Most departments seemed to operate in the range of 12 to 20 scans per sonographer per day. The number of scans did vary with department function and the mix of full and part time staff. The quickest scans can take as little as 5 minutes to complete but some abnormality, abdominal, echo and vascular scans can take between 25 – 50 mins to complete. Most general ultrasound departments tended to work on a 15 to 20 minute slot for scans when booking appointments. It seemed challenging for a general or obstetric department to work effectively using a standard expected slot time given the wide range of scan times reported (figure 3.1). Sonographers often commented that their work load encroached on their planned breaks. Some suggested that their workload was such that they were left with insufficient time for a proper lunch break. Extensions to the working day were frequently mentioned and at some departments it appeared to be common practice for extra patients to be added to the, already full, work list. There were suggestions that sonographers have been instructed to increase the number of patients they see in a day and/or take part in additional weekend or evening clinics without thorough assessment of the risks that this may pose. The considerable overlap between MSD and stress was particularly evident with respect to the issue of workload.

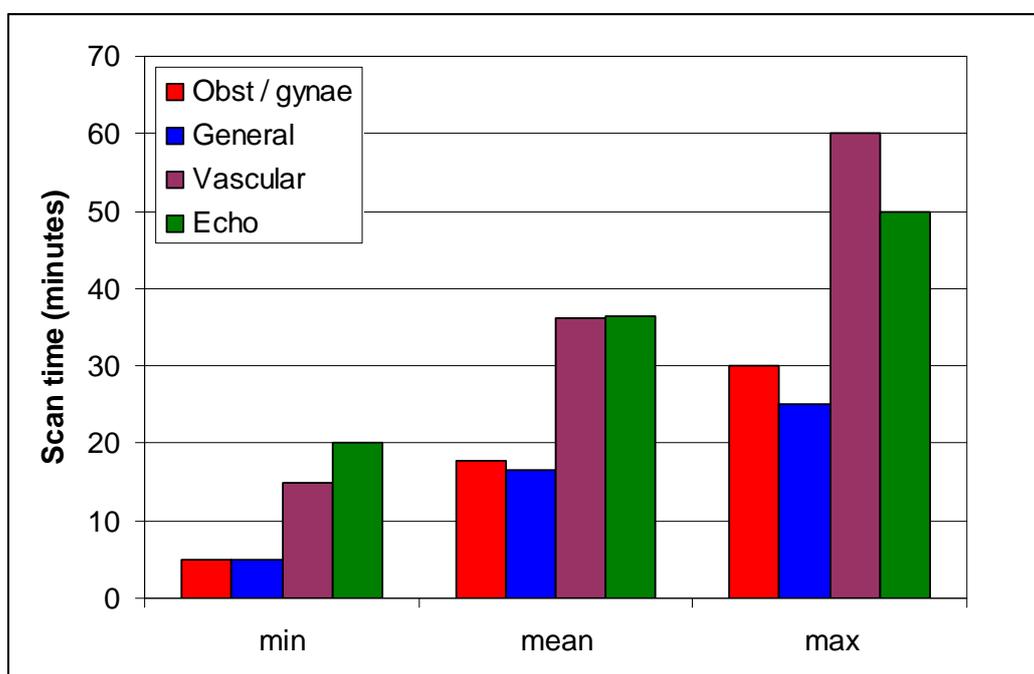


Figure 3.1. The range of scan times for various sonography modalities.

3.5 MSD risk assessment

Seventy percent of trusts had undertaken some risk assessment for sonography work with respect to MSD (see figure 3.2). Only 26% of the assessments were found to be suitable and sufficient in that they thoroughly examined the range of MSD risks involved. Adequacy of the assessment methods used was a concern at 90% of trusts with any MSD assessment. For example, the application of generic risk x probability style matrix assessments was commonly seen as was using a manual handling assessment approach (e.g. L23 manual handling checklist).

The trusts that utilised in-house professionals such as OH physios or Backcare Advisors produced high quality assessments. Only 35% of assessments appeared to identify potentially useful risk reduction and control methods. Given that industry better practice guidance has been around for several years and was generally well known in sonography departments this was quite disappointing. However, it was often found that assessments did not document control measures.

Thorough assessment of the MSD risks is required at each department. They need to take account of the specific mix of risks associated with the sonography task, equipment used,

scanning room, sonography staff, patients and work organisation. Checklist methods as described in HSG60 and L26 (DSE regs) provide a useful basis. Some professionals (e.g. ergonomists or physiotherapists) have used quantitative MSD assessment tools like the Quick Exposure Checklist (QEC) to assess sonography risks. Involvement of these individuals would seem to be a very effective approach to take given the level of sonographer ill-health in the UK.

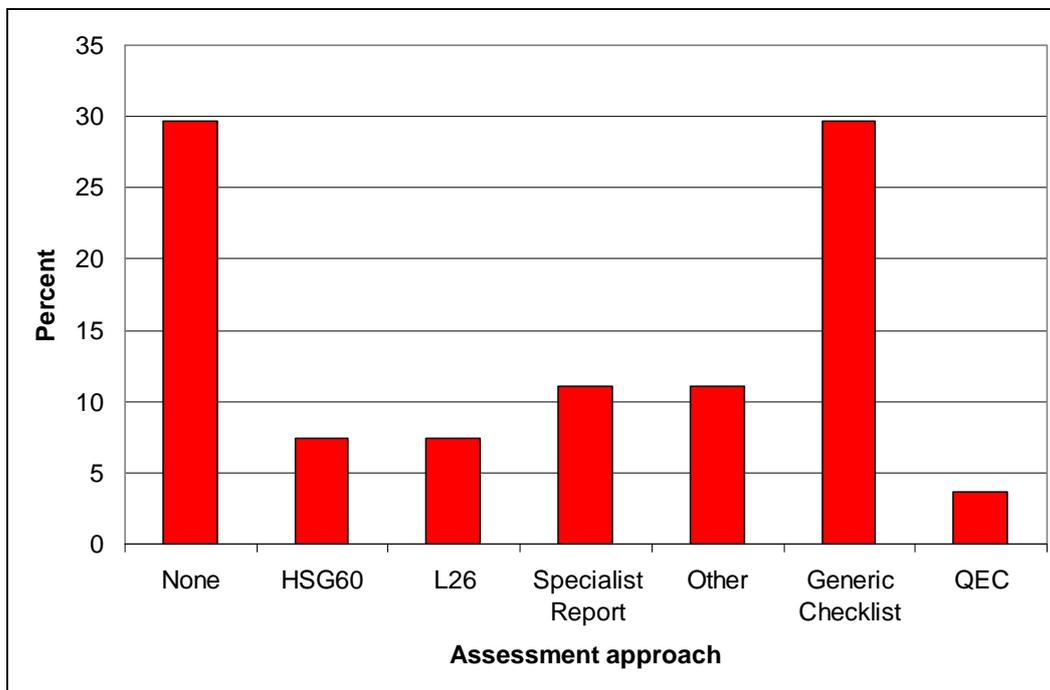


Figure 3.2. The distribution of assessment methods used in sonography departments

3.6 Risk reduction and control

Despite the poor quality of the risk assessments most departments (approx 90%) had made attempts to introduce MSD risk controls. The process of identifying control measures was usually not well documented or evaluated. Given the lack of assessment focus it was unsurprising that MSD issues and symptoms persisted despite some controls being introduced. Internal cooperation between departments that use sonography was poor in most cases as almost 75% showed no evidence of cooperation. Posture was the main focus for risk reduction and control and this overwhelmingly concerned the provision of seating.

The project illustrated that there are many ways to reduce / control MSDs in sonography. Selection of appropriate controls should receive consideration at department and trust level and for best effect needs to be underpinned by thorough risk assessment and worker involvement. It would seem most likely that a department would need to select a range of controls to reduce the risks to the so far as is reasonably practicable level. It is essential that the controls deal with work organisation (e.g. work lists and slot timings) as well as operator posture and working conditions. Controls introduced to tackle the work organisational aspects were less apparent. However, it is these measures designed to tackle the psychosocial aspects of the work that seemed to offer untapped potential to help mediate the MSD problems in sonography. The findings of Dodd-Hughes (2008) corroborates this opinion.

Fundamental changes in scanning practice using existing control measures and new innovations should be thoroughly examined. For example, adoption of methods to increase variation such as placing the patient in different positions ('Stockport position' in echocardiography) and using the left hand to scan (for some of the time). Changes to working practices can be difficult to introduce unless staff have the time and resource to develop the new skills. The involvement of ergonomics professionals would help trusts and departments question the fundamentals of how their sonography departments operate. Table 3.1 shows a variety of control measures that were identified and / or discussed during the visits. It certainly

was not the case that departments had explored all of these. However, it was noted that departments that had introduced measures tackling work organisation, working posture and used improved hardware (US machine, chair and couch) seemed to be faring better than those that did not. Posture was too often the singular focus for risk reduction and control and this overwhelmingly concerned the provision of seating.

3.7 Worker involvement

The Risk control indicator (RCI) is a scale used to rate performance against key health and safety topics. It uses a 4 point scale starting at full compliance (1) to limited or no compliance (4). In this case the topics that were assessed were associated with work related musculoskeletal disorders and sonography. The RCIs applied in this case were: Worker Involvement and Management Commitment in the Process of Tackling MSDs; and Avoidance and Control of MSD Risk Factors

As a guide, a score of 1 is only allocated when all the elements for the topic are in place and should represent a situation where the inspector believes that no further improvement is possible. A score of 4 would indicate that enforcement action is appropriate. For scores of 3 and 2 enforcement action may be appropriate. Below is the RCI assessment scale.

Assessment scale for scoring Risk Control Indicators (RCI)			
1	2	3	4
Full compliance in areas that matter	Broad compliance in areas that matter	Some compliance in areas that matter	Limited or no compliance in areas that matter

The overall response gathered by the inspectors was assessed and the results are shown in table 3.2. Most Trusts were considered to be at point 3 ('some...') on the scale above (66.7% and 82.6%). This suggests that there is room for improvement as some Trusts (11.1% and 13.1%) were considered to be complying broadly with managing the risk. However, there were some Trusts that were doing little in terms of making attempts to reduce the risks involved in MSDs and sonography. It was the inspectors' view that the poorer RCI ratings were given when there was a less effective MSD risk management approach in general and in particular poor risk assessment systems.

Table 3.1. Worker involvement and MSD risk control RCI results

Risk Control Indicator (RCI) Degree of compliance	Significant MSD Risk very well controlled; Few repetitive activities; appropriate task design, work equipment selection and layout; mechanical aids (%)	Managers and workers involved in addressing risks; Set aims; risks assess; avoid/control; monitor progress; review; change where needed (%)
Full	0	0
Broad	11.1	13.1
Some	66.7	82.6
Limited	22.2	4.3

The majority of departments sought the involvement of their staff in health and safety matters

(including ergonomics related issues). Around half the departments visited had introduced controls to reduce the MSD risks via worker involvement routes. However, this mainly concerned trialling seating options. The direction and effect of some of the worker involvement projects could have been better especially given the psychosocial risks observed. Departments that involved competent professionals (e.g. Ergonomists, Occupational Health Physiotherapists or Backcare Advisors) seemed to better facilitate the worker involvement.

It is more difficult to identify and introduce controls because of the generally poor state of department risk assessments – if the risks are not clearly understood how can methods to reduce them be identified? The failure to make effective use of the available published good practice guidance was a missed opportunity to identify useful risk controls. Worker involvement is particularly important in terms of the scanning workload and this would be expected to help reduce the psychosocial burden clearly identified.

3.8 Sonography workstation

A total of 59 exam rooms were inspected during the project. Conditions varied a great deal within and between departments.

The average age of the Ultrasound (U/S) machines seen was 3.6 years (range 4 months to 10 years). Overall, newer models of US machine appeared to offer considerable improvements. They were found to be easier to manoeuvre and adjust, possessed greater adjustability, lighter transducers and improved software compared to machines obtained 5+ years previously.

Most patient couches were pendant operated electric couches capable of height adjustment at the very least. Vascular departments tended to be equipped with couches capable of elevating the patient to an angle of 45 degrees or more for investigations of the legs. Echocardiography rooms sometimes used purpose designed 'echo' couches. These had handles to help patients adopt the right position and cut outs so access to the appropriate area was less of a hindrance. Patients are sometimes scanned while they are in bed or in a wheelchair. Sonographers reported that scanning a patient in the bed or in a wheelchair can be more awkward and demanding compared to scans on a purpose designed couch.

The room environments were also examined: 33% of rooms had dimmer switches, 37% were equipped with air conditioning and 24% were considered by the inspectors to be undersized. It was found that some aspect of basic room specification was an issue in approximately 80% of the consultation rooms visited during the project. Conversely, 20% of consultation rooms were found to be adopting better practice in terms of their specification for sonography work. Unsurprisingly, thermal comfort was an issue raised quite regularly by sonographers that used rooms without ventilation or air conditioning. Inadequate room space was tackled in two cases where room size was grossly inadequate for the scanning operations being undertaken in them. In one case a new larger room was identified and used, in the other case an adjoining wall was removed to create a larger single room. It was straight forward enough to identify situations when room space was inadequate but difficult to provide guidance on what room is needed for a sonography examination room. As a result, the Health and Safety Laboratory were tasked with conducting research on this issue. The first stage of the study is reported by Dalby (2009), with stage 2 to follow in May 2012.

3.9 Education and training

In almost two-thirds of visits discussion with staff and managers led the inspector to conclude that discipline training did not include MSD risk awareness and coaching that was specific to sonography. At 20% of departments manufacturers of US equipment had provided department staff with some special training and this may have included effective operation to reduce MSD risks. Efforts to integrate the health and safety messages with the practicalities of getting the work done to the quality standard did not appear to be commonplace.

3.10 Patients with a high body mass index

The issue of scanning obese patients was raised in nearly every visit. Sonographers have often reported that when scanning deeper tissues the obese patient can require greater transducer pressure and reaching or stretching postures. Scan quality can be difficult to guarantee with obese patients and staff may persevere with the procedure and still end up with unsatisfactory image quality. Reducing unnecessary transducer time should be a key priority and the issue extends beyond the obese patient issues. The extension of bariatric patient policies to also include sonography combined with specific working procedures should help to take account of some of these difficulties. Some departments have found it effective to use paired scanning whereby two sonographers cooperate to complete the scan – 1 on the transducer and 1 on the control panel.

3.11 Other DSE work

During the visits poor DSE arrangements were often observed in the consultation rooms (examples shown in figure 3.3). There is useful scope for improvements as this would have a beneficial influence over a sonographer's overall exposure to MSD risks. It should be remembered that sonography is considered to be a DSE operation. Once targeted, the trusts usually had the necessary DSE risk management system to tackle these risks appropriately. Separate rooms with PCs used for reporting on scans were often found to have a better desk, seating and configuration compared to workstations inside the consultation rooms. A period of time away from the scanning room to report might be a good way to introduce variation from intensive scanning. When considering workload it is appropriate to structure the scanning list to promote frequent breaks away from the scanning room even if that involves reporting work in a separate room.

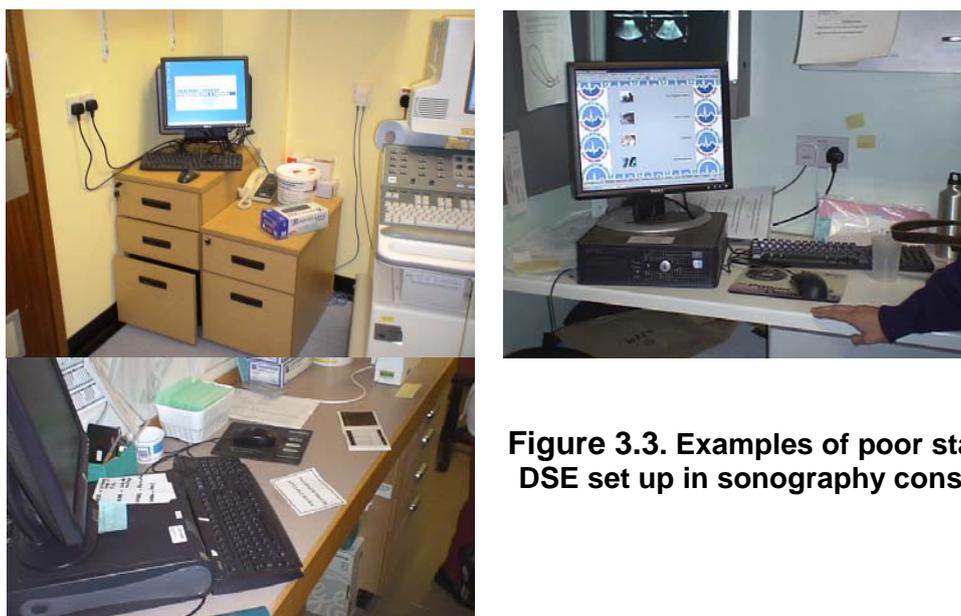


Figure 3.3. Examples of poor standards of DSE set up in sonography consult rooms

3.12 Professional and training issues

Scanning behaviour and the adoption of best practice scanning are of great importance. Work procedures and systems of work need to be designed to suit the particulars of each scanning discipline and should reflect the range of operations undertaken. A key function of this exercise is to consider and implement systems of work that best enable sonography workers to optimise and vary their posture. For example, consideration should be made of using alternative patient positions (e.g. the Stockport Position) or increasing task variation (e.g. scanning with the left hand on occasions for some tasks or scanning with a partner etc.). Appropriate coaching and supervision should help to ensure sonography workers refine their work practices over time and that behavioural changes are lasting. Individual staff members should be empowered to challenge the status quo and their colleagues if they perceive unnecessary MSD risks are present.

The important health and safety aspects of this education process should be integrated with the practicalities of getting the work done to the quality standard.

3.13 Human performance

Health status, pain and discomfort are factors capable of influencing human performance (performance influencing factors or PIFs). Their presence may increase the risks of human error and in the case of sonography this could have negative clinical implications. For example, pain can have a distractive effect and so it may be that a sonographer experiencing pain could miss or misclassify some aspect within a scan. The work organisational aspects (e.g. scan times, waiting lists and high work load) may contribute to this.

Sonographers are acutely aware of their professional responsibilities with respect to performing to the required standard. However, based on the findings of this project it would seem that this may be challenged because of the ergonomics of the sonography job in many UK trusts. Poor resolution of image on the screen related to aged ultrasound machines has been an issue that has been considered but the influence of other task and individual factors and how they may shape performance has probably not been considered at profession, trust or department level.

An awareness of the clinical and health and safety aspects combined can help to better demonstrate the business case for positive action to reducing MSDs in sonography work. Those Trusts that have been able to combine clinical and health and safety aspects have been more successful at securing the funding for improved equipment and facilities.

3.14 Sonography equipment manufacturers

A number of manufacturers of sonography equipment (U/S machines and furniture) were contacted with respect to the ergonomics of their products. Responses were not forthcoming from a number of the key manufacturers. Those companies that did respond were, as follows:

[Siemens Medical](#) – U/S machines

[B-K Medical](#) – U/S machines

[KeyMed / Aloka](#) – U/S machines

[Huntleigh / Akron](#) - Couches

3.14.1 Awareness of ergonomics issues

All of the manufacturers who responded were aware that there are ergonomics / comfort issues such as having to reach and hold static postures repeatedly and for long periods. One manufacturer appeared to be using a quantitative approach to 'body load' but there are difficulties in integrating that system into design (e.g. using it as a predictive technique for alternative designs).

Manufacturers may benefit from a standardised approach to considering the end-user in the design process. Examples include designing the system so it can be moved close to the patient and making sure controls are height adjustable. There is scope for equipment designers to take account of the information on MSDs.

3.14.2 Training / Provision of information on MSD's to users

Overall the manufacturers appear to provide guidance on what ergonomic features are present (e.g. height adjustment of screens etc), but they do not in all cases provide training that instils the ergonomics and operational benefits to ensure the equipment is used properly. The manufacturers considered this as being the responsibility of the employer.

There are various potential levels of training, for example from relatively simple aspects such as adjustment of screen / keyboards, maximisation of software through to posture and movement techniques when using transducers. There does not appear to be currently any clear consensus on who is best placed to provide training in those areas and what would be an appropriate basic level of training. However, given their expert knowledge of their product and its design, involving

the manufacturers would be very useful.

3.14.3 Ergonomics resource during product development

Expenditure on ergonomics appears to range from very little to approximately 1/3 of R and D. This variation may be due to what different companies considered 'ergonomics' and depending on how ergonomics factors are considered in the design process. For example, is it the physical interface? and does it include the software interface? However, the manufacturers' responses may reflect significant variations between manufacturers in the perceived importance of applying ergonomics in design. Some (not all) manufacturers reported making use of ergonomics expertise during the design process but the scope and the sequencing of that involvement seemed to differ greatly.

3.14.4 Development strategies

Manufacturers use experienced sonographers / user focus groups as design consultants which is a positive element of the design process. It is evident that not all manufacturers consult specifically with ergonomists, the aim would be to involve both expert users and ergonomists but that may be seen as introducing additional cost. The reasoning behind suggesting that involving an ergonomist would be useful is that sometimes it takes someone with no preconceptions about a process or type of work to ask pertinent questions about the accepted 'ways the work is done'.

3.14.5 Key Challenges

One of the key challenges identified is convincing users to work in different ways. There is some evidence of a view amongst manufacturers that users are stuck in their ways / have bad habits etc. and that it is difficult to get people to change the way they do things. One manufacturer showed good insight into the problems of addressing MSDs; they mentioned positive changes sometimes creating in the short term an increase in physical problems which indicated a good awareness of the challenges facing ergonomics in design.

One specific challenge was identified as there being a difficulty in showing the successfulness of design changes (prior to their implementation).

3.14.6 Gathering and making use of user feedback

The manufacturers do not appear to have a well defined process for this. It seems currently to be almost completely reactive rather than pro-active, relying on users to raise any issues they have. A proactive approach by manufacturers could involve anything from requesting information from a selection of their customers (i.e. sonography departments) at suitable intervals, down to maintaining an ongoing feedback site on the manufacturers' websites – which end users are made aware of and encouraged to use.

Dialogue between end users and manufacturers should form an important part of the ongoing research and development process.

3.14.7 New design concepts

Not a great deal of enthusiasm was shown in manufacturers' responses for radical design innovation. This seemed to be due to a perception that the customer either does not want them or won't use them if they are provided.

Voice recognition does not appear to be such a popular concept as might have been thought. Possibly one aspect of this is a need to maintain some communication with the patient, there is a social environment during the assessment process which may become awkward to maintain if operators are limited in what they can say because of voice controls being activated. Voice activation is developing rapidly and is overcoming the communication control interface issues of the past. As a consequence, this type of control system is likely to require reduced training and that will help make voice activation more attractive. U/S manufacturers continue to offer voice activated systems and trusts do purchase these. Ways to improve system set up and use could increase uptake of these important design innovations.

Workflow Design Assistance is a development that may be more popular and useful. An example was given of scanner software which can be set up to recognise what the next stage of a process is so avoids the need for operators to have to reach over to the controls when changing function. There may be scope to combine this with a simple voice activation system.

Another design development was to include additional controls in the transducer to avoid using both hands to control for at least some limited functions.

The manufacturers appear generally to make their own changes to transducer design and so they have good or maximum control over what can be done.

3.14.8 Contact with furniture manufacturers

There was not a great deal of cooperation between furniture and US machine manufacturers. The impression from responses is this sort of joint working is something which has been tried in the past but has not 'held together'. Providing direction and facilitating joint working is another area where qualified ergonomists could assist. There should be some scope for joint projects when designing new equipment and minimising mismatches and incompatibility.

3.15 Ergonomics and sonography education

Twenty educational establishments offering post graduate qualifications (PGCert, PGDip and / or MSc) in medical ultrasound or related qualifications were contacted to find out whether they included sessions on MSDs, ergonomics and scanning best practice in their courses. The main findings of the exercise were as follows:

- Eight Universities offered no response.
- Two Universities reported that they did not include MSD and scanning practice in their program. One of these respondents stated that they considered that to be the employer's responsibility.
- 1 or 2 sessions specifically highlighting MSD and ergonomics as an issue was common.
- Six of the universities offered a practical element, presumably under supervision. Aspects surrounding scanning practice, set up and workstation adjustment were part of this in varying degrees of detail.
- A few Universities involved experts in the area of ergonomics and MSD (e.g. ergonomists and physiotherapists).

The general consensus was that teaching and practical sessions focusing on ergonomics, MSD, equipment set up and adjustment were important to the development of sonographers in training. This view was confirmed by discussions with sonographers during the department visits.

It is important that the educational establishments make efforts to engrain the practicalities of how to obtain a quality image while also guiding the development of practices that reduce the risks of MSD. Including a degree of coaching by a competent person may be a useful way to stimulate this. MSD is worthy of detailed consideration in all ultrasound courses because it is a key professional issue. Getting the right message across to trainees before they become habituated to the situation at their home department would seem to be very important.

Some modalities adopt an in-house training procedure governed by standards produced by their professional body. It is important that those procedures also incorporate consideration of MSD risks, ergonomics and best practice scanning.

4 CONCLUSIONS

Inspections of 14 NHS trusts in the UK were undertaken to examine how effectively MSD risks were managed in sonography work. Overall, effective risk management controls were not in place and this is cause for concern because of the high levels of MSD associated with sonography professionals and the large amount of industry specific guidance in existence. The main issues were:

- Risk assessments generally weren't suitable and sufficient
- Despite widespread awareness of the MSD risks to sonographers, action to tackle the problems tended to be superficial
- Risk reduction and controls were generally not comprehensive enough to reach the 'so far as is reasonably practicable' standard
- Workload was generally high in sonography. Work organisational / psychosocial factors were seldom sufficiently assessed and controlled, despite their apparent influence in reducing risk
- In most cases training did not adequately address MSD risks, and how to conduct best practice scanning
- Occupational Health provision, whilst generally good, tended not to be used proactively for sonographers
- Health monitoring was rare, even for individuals with established MSD problems
- Manufacturers and education providers have a key role in developing improved systems in sonography work. Both should take account and facilitate fundamental changes to current scanning practice
- Generally the arrangements for sonography work are less than optimal. This may adversely affect the sonographer's health and performance

To deliver a sustainable, efficient and safe sonography service the ergonomics and human factors issues in sonography should be tackled in a thorough and fundamental way. Key risk factors and control measures are identified in the following section.

5 ACTIONS

The following actions apply to departments, trusts, education providers, manufacturers and the regulators within the health care industry.

5.1 Risk management approach

Trusts should adopt the HSG60 seven stage approach for managing MSDs in sonography and across other specialist departments. Sonography is classified as DSE work and L26 gives useful guidance on how to meet the particular legal obligations required in the DSE regulations. The guidance from the Society of Radiographers should also be taken fully into account for all sonography services. Efforts are needed most in the area of risk assessment and control. NHS trusts should provide the necessary resources to help all departments tackle their MSD risks as effectively as possible. There is considerable overlap between MSD and stress in the case of sonographer ill-health. Trusts should also action their stress management policy and consider the guidance described in HSG218 (Managing the Causes of Work Related Stress).

Key aspects that should be taken into account are:

- Work organisation
- Setting and monitoring scanning workload
- Scanning room specification (room size, layout, environment and equipment)
- MSD exposure assessment (using a suitable checklist or tools e.g. HSG60 and QEC)
- Assessing individual factors
- Stress
- Managing and developing systems to scan obese individuals
- Developing fundamentally new ways of working (voice activated system and left handed scanning)
- Training to develop best practice scanning behaviour (coaching and management time)
- Human performance and clinical risks

Efforts should be coordinated across the various sonography modalities at a trust. Risk management should target work organisation. Increased sonographer control and involvement should be considered as well as efforts to balance workload to enable rest breaks to be taken. Effective utilisation of the trust's in house competent personnel should help to maximise the potential for successful outcomes.

Ergonomic characteristics should be considered when selecting new machines, ideally involving sonographers in the evaluation. Again, in house ergonomics expertise can help to ensure product trials consider the key aspects. These include system usability and software interface benefits like workflow assistance, as well as the physical adjustability of the devices involved.

There are clear benefits of rapid access for sonographers (and other staff) with MSD to physiotherapy or other rehabilitative therapy. Delivering such a service through the trust Occupational Health department should be taken into account. Such schemes usually have a very strong business case where MSD is concerned (see www.hse.gov.uk/research/rrpdf/rr493.pdf).

By taking a positive approach to managing ergonomics and human factors risks in sonography there is considerable potential for the trust to learn lessons that could be applied to other departments or hospital professions experiencing similar issues.

5.2 Risk reduction and control measures

This section summarises a range of potential MSD / ergonomics risk reduction and control measures that were identified during the project. This is not an exhaustive selection of risk controls and there may be other means to reduce MSD risks in sonography.

Slave monitors (figure 5.1) can be used to prevent sonographers compromising their posture to enable the expectant mother to see the screen while undertaking pregnancy scans. A slave monitor can also be used when two sonographers undertake a demanding scan (1 operates the controls, the other the transducer close to the individual – each with a suitably directed screen to look at).

There is a variety of arm supports available (e.g. padding cushions, arm rests or the scan ease device – shown in figure 5.2) and these can reduce the muscle loads required to reach and apply the transducer during an examination. The scan ease device, for example, uses an overhead articulating arm to support the sonographers arm or transducer. Cable supports (figure 5.3) can be helpful too as these reduce the turning force being applied to the wrist and forearm by the sagging transducer cable. For some scans the sonographer may support the breast of the patient while conducting the scan. Simple breast supports should be used to reduce the need for the sonographer to do this. We are aware of a trust that has achieved this by inserting a foam wedge under the patient's bra strap. Purpose designed breast slings are also available.



Figure 5.1. A ceiling mounted slave monitor positioned to be viewed by a patient laying on the couch. The US machine can be seen positioned at the side of the couch.

Fundamental changes in sonography practice such as scanning with both hands, alternative patient positioning and making effective use of voice activated systems should be considered. However, these fundamental changes to working practice will require management effort, staff involvement and resource to ensure they develop into enduring working practices. Scanning with the left hand is possible, the transfer of skill from the right to the left hand will be relatively straight forward for simple scans but staff need the time and room layout to permit that to occur. In addition, sonographers need not switch entirely to left handed scanning. Indeed, the aim of switching scanning hand is to give their main scanning hand a rest and opportunity to recover. Left handed scanning for as little as 10% of the shift could be sufficient to permit that. It may be best for the department to dedicate a single room for left handed scanning and then manage sonographers to swap room periodically. Alternatively, sonography rooms could be designed and laid out to permit sonographers to adjust layout as and when they wish to switch scanning hands. Dalby (2009) illustrated that with sufficient space these changes can be undertaken easily and quickly.

Up to date voice activated systems should be considered as part of the suite of control measures

because once set up it can reduce exposure considerably. A sonographer that experienced severe MSD problems was able to secure funding for voice activated software for the ultrasound machine using the [access for work](#) initiative. She felt that the system enabled her to continue as a sonographer. She tended to use the voice activated functions for more straight forward procedures at first but as the voice system became ‘trained’ to her voice she was able to widen its use. There is a perception that using a voice system would prevent conversation and discussion during a scan. This is not necessarily the case because systems tend to operate using a trigger word and systems are trained to only respond to the individual user’s voice. These aspects also reduce the potential for false voice commands being accepted during general conversation.

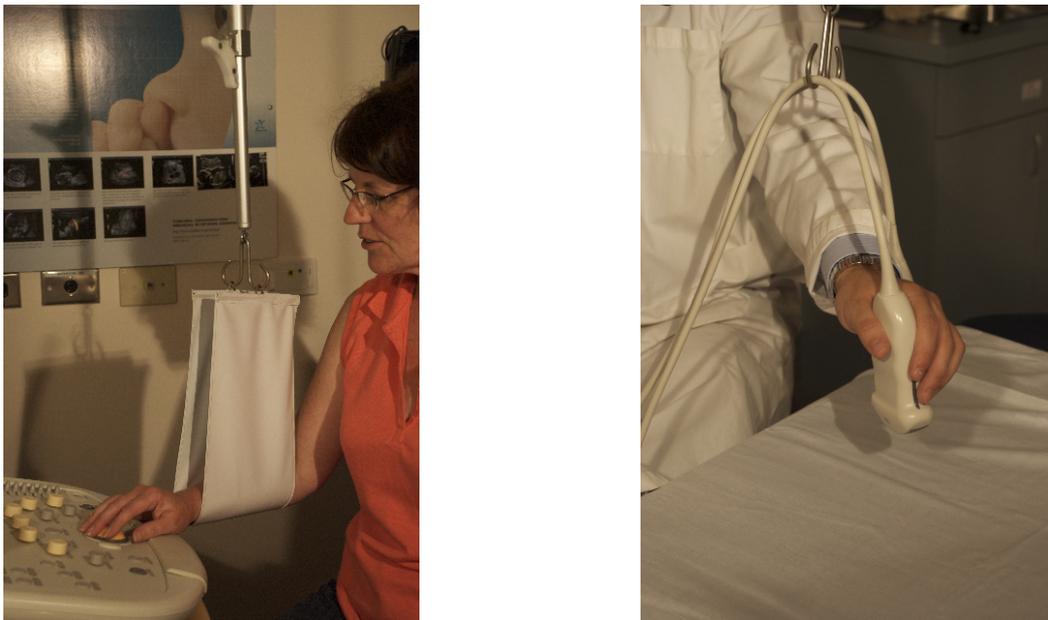


Figure 5.2. The scanease limb / transducer support system.

Seating is an area that trusts have made good progress on in sonography. Options like the saddle seat can suit some individuals. The capisco chair can also act to support the trunk by turning the seat sideways and leaning on the backrest. There are several options that might require some individually tailored trials to confirm selection of chair. It is also worth considering increasing variation in scanning by undertaking some scans standing up, especially those scans involving greater force application.



Figure 5.3. A simple cable support that reduces loading at the wrist associated with cable sag.

The sonography rooms should be set up to promote best practice scanning. To do this space needs to be appropriate to allow the couch and U/S machine to be positioned appropriately for the scan, sonographer and patient. Dalby (2009) identified room space as an important risk factor

in sonography. The interim findings of this study suggested that clear room space of approximately 3.6m x 3.2m, 3.6m x 3.6m and 3.2m x 4.2m was required, for general sonography, echo and vascular work, respectively. For existing scanning rooms it is important to increase free floor space as much as possible. For example, work benches, storage cupboards and other non essential furniture should be removed to permit this. Environmental conditions in the scanning rooms ideally need to be adjustable for the individual using them as much as possible. For example, climate control and sufficient remotely dimmable lights can help achieve this. The implications of this study will be taken into account once the follow on study is completed in May 2012.

Additional DSE work (e.g. reporting) should be undertaken using optimal workstation arrangements and equipment (see section 3.11).

5.3 Work organisational aspects

Tackling the work organisational and workload aspects are crucial in terms of reducing the impact of MSD in sonography. Some examples of methods to do this are described in this section.

Departments should plan the day's list of patients to ensure that sonographers can rest, take a break, complete admin tasks and provide enough available resource to ensure urgent or last minute walk-in examinations can be conducted.

Departments should fully consider and risk assess session and clinic slot times. To achieve a balanced workload will require more flexibility than the current system of estimated or average time slots. It is anticipated that with increased planning and sonographer involvement workload can be set at a suitable level for sonographer health as well as task performance.

Any additional working or over-time needs to be thoroughly taken into account in light of the individual sonographer's profile of MSD symptoms.

Paired scanning was raised by sonographers at a few sites. There are two varieties of paired scanning. The first, involves two sonographers working together to undertake a difficult scan, one operating the controls and the other the transducer. The second variety involves two sonographers sharing a scanning room. One scans while the other reports and vice versa. Both varieties appeared popular in the departments that operated them and both have considerable risk reduction potential. Departments that use sonography assistants could expand the role to assist in demanding scans. For example, the risks involved with vascular leg scans could be greatly reduced if an assistant squeezed the patients leg while freeing the sonographer to adopt an improved posture while applying the transducer and using the control panel.

Some trusts have selected to use a midwife led sonography service in obstetrics. This mainly focuses on first trimester and 20 week scans. In one trust the midwives split their duties 60:40 between sonography and standard midwifery work. This approach has been sought partly because of difficulty filling sonographer vacancies. However, combining the time limited sonography role with some degree of in built job variation may help to reduce the MSD risks.

5.4 Training and educational providers

Efforts should be made to integrate the important MSD, ergonomics and procedural aspects with the practicalities of getting the work done to the quality standard.

Trust based training to sonography staff should include some form of MSD / ergonomics related training. Ideally it should take a practical form with appropriate coaching from competent people. Effective working procedures should be reinforced within the training. Occupational Health Physiotherapists and Alexander Technique practitioners have been involved to help individual sonographers develop better practice scanning techniques. Biofeedback methods can give the sonographer that extra insight into their behaviour that is sometimes quite challenging to get across. Using mirrors, video, photographs or even capturing muscle activity (using a simple

electromyographical device) is helpful in promoting postural awareness.

Posters describing possible musculoskeletal tension relieving exercises are in place in a number of departments. It may be effective to develop this approach further (e.g. how to undertake the exercises safely, when to do them, which exercises could help certain body specific discomfort etc.). This may be usefully undertaken in cooperation with the assistance of in-house specialist knowledge such as Occupational Health and Physiotherapists.

5.5 Manufacturers

Most ultrasound machines appear to be deployed in a dedicated scanning room and often seemed to remain in a largely static position. A modular construction would permit some of the bulk found in the current design to be installed remotely and out of the way (e.g. on a wall). The advantage of having a smaller lightweight mobile section (i.e. keyboard, transducer and screen) is that it will reduce the space envelope currently required and enable easy positioning around the consultation room. The space requirements with this equipment would be reduced. Importantly, leg room would also be substantially improved if the main bulk of the system was clear of the sonographer using it.

An alternative U/S system design has been identified previously (www.ohsah.bc.ca/index.php?section_copy_id=759 see figure 5.4).



Figure 5.4. Alternative design sonography system.

Portable machines could be more frequently used because they are much smaller than full size U/S machines. Discussions with users of these portable devices found that some systems can deliver a high quality clinical image (figure 5.5) and have been rated as very easy to transport and position. It may be that portable systems could be used more often within clinics rather than only for ward based examinations.

Difficulties were usually identified in terms of deriving optimal user set up of the sonography workstation because of fundamental mismatches between the ultrasound machine, the couch, the chair and then the patient and sonographer. Manufacturers could aid the process by improved integration of the seat, couch and U/S machine and delivering a system that is easy to adjust to suit the individuals and the type of scan being undertaken.

Cable arrangements in U/S machines can hinder movements as the cables limit range and catch under wheels. Retractable cabling and or flexible trunking may be effective means to direct and protect the cables (power and data links) during movement of the U/S unit.



Figure 5.5. A small portable ultrasound machine used for ward based examinations.

Transducer design should be a key consideration when selecting a new U/S system. Manufacturers of U/S machines have made useful design modifications to transducers – they are lighter weight and afford an improved grip. However, further work should be undertaken to develop grips that are less hand and finger intensive. Glove or loop systems may be possible in some situations. I am also aware that design improvements such as cordless transducers have been considered. Sonography departments should consider matching transducers to their sonographers to ensure they fit and can be held without unduly stressing the soft tissues of the hand and forearm. Working with their suppliers they should be able to improve transducer matching to the sonographer's individual needs.

Manufacturers should be encouraged to develop systems that enable the sonographer to adopt less risky postures and reduce transducer intensive time. Examples currently available are voice recognition systems and work flow design assistance.

6 REFERENCES

- Brown, G., and J. Baker. 2004, Work-related musculoskeletal disorders in sonographers. *Journal of Diagnostic Medical Sonography*, **20**, 85-93
- Dalby, M. 2009, *An Investigation into Space Requirements for Sonography Best Practice*, Health and Safety Laboratory Report ERG 09/05
- Dodd-Hughes, K. 2008, *An Evaluation of Musculoskeletal Discomfort Experienced by Sonographers*, CSD HF Team report
- Health and Safety Executive. 2002, *Upper Limb Disorders in the Workplace*, HSG60, HSE Books
- Health and Safety Executive. 2002, *Work with Display Screen Equipment (L26)*, HSE Books
- Magnavita, N., L. Bevilacqua, P. Mirk, A. Fileni and N. Castellino. 1999, Work-related musculoskeletal complaints in sonologists, *Journal of Occupational and Environmental Medicine*, **41**, 981-988
- Russo, A., C. Murphy, V. Lessoway and J. Berkowitz. 2002, The prevalence of musculoskeletal symptoms among British Columbia sonographers, *Applied Ergonomics*, **33**, 385-393
- Schoenfeld, A., J. Goverman, D. Weiss and I. Meizner. 1999, Transducer user syndrome: and occupational hazard of the ultrasonographer, *European Journal of Ultrasound*, **10**, 41-45
- Society of Diagnostic Medical Sonography. 2003, *Industry Standards for the Prevention of Work-Related Musculoskeletal Disorders in Sonography*, SDMS, Texas
- Society of Radiographers. 2002, *The Causes of Musculoskeletal Injury Amongst Sonographers*, SoR, London
- Society of Radiographers. 2007, *Prevention of Work-Related Musculoskeletal Disorders in Sonography*, SoR, London
- Smith, A., J. Wolf, G. Xie and M. Smith. 1997, Musculoskeletal pain in cardiac ultrasonographers: results of a random survey, *Journal of the American Society of Echocardiography*, **10**, 357-362
- Vanderpool, H., E. Friis, B. Smith, and K. Harms. 1993, Prevalence of carpal tunnel syndrome and other work related musculoskeletal problems in cardiac sonographers. *Journal of Occupational Medicine*, **35**, 604-610
- Village, J. and Trask, C. 2007, Ergonomic analysis of postural and muscular loads to diagnostic sonographers, *International Journal of Industrial Ergonomics*, **37**, 781 – 789.

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APPENDIX 1

Summary of An Evaluation of Musculoskeletal Discomfort Experienced by Sonographers (Dodd-Hughes, 2008)

Introduction

Modern research has shown that sonographers are experiencing a high prevalence rate of musculoskeletal discomfort and disorders (Horkey et al., 2004; Pike et al., 1997; Smith et al. 1997; Village, 2007; Wihlidal et al., 1997). Many recent studies have attempted to measure the prevalence amongst sonographers and most studies concur that between 80-90% are reporting pain or discomfort at some point during their career (Brown and Baker, 2004).

The aim of the study was to investigate the possible occupational, causal or contributory factors associated with sonography work and suggest recommendations to reduce the risk of experiencing musculoskeletal discomfort. The study surveyed 155 employed sonographers to evaluate the ergonomic risk factors in sonography such as posture and psychosocial issues. The sonographers were required to complete a self-administered questionnaire in order to analyse the ergonomic risk factors for MSDs.

Findings

The study found that 95% of the respondents experienced musculoskeletal discomfort within the past 3 months of completing the questionnaire. This included transient discomfort, as it was difficult to separate this from the discomfort that may be more repetitive or sustaining, therefore this figure could potentially exaggerate the actual musculoskeletal discomfort experienced. However, 75.5% of this group believed that this discomfort was caused or made worse by their job.

A detailed analysis was undertaken and found various significant findings. It found a high proportion (48.7%) of sonographers felt that they often were bending or twisting whilst scanning followed by 24% who felt that this always occurred. Sonographers were subjectively asked what was the most force they thought they were exerting whilst scanning on a scale of 0 (no force) to 4 (high force). Moderate force (2) was the highest response (42.2%) followed by (28.6%) of substantial force (3). No respondents felt they never twisted or bent or exerted no force whilst scanning. This suggests that carrying out sonography work requires some awkward postures to be adopted and some force is needed to scan. Duration of time in a static posture was also reported for a typical day, there was an equal response rate for sometimes and often (42.2%). The final statement for posture asked the respondents the position of their wrist on a typical day, majority (65.6%) believed that their wrist was slightly bent or deviated followed by significantly bent or deviated (23.2%). Most of these results suggest that in order to carry out sonography work the sonographer needs to adopt awkward postures and exert some force.

Respondents indicated that they could experience fatigue (78.7%), headaches (64.5%), problems with attention (57.1%) and recovery from musculoskeletal discomfort that took more than 1 hour (50.3%). This suggests that a sonographer's general health can be affected by work. A regression model was applied to some of the risk factors (i.e. perceived general health, posture, work environment, work organization, age, experience (years) in sonography, BMI and hours spent scanning in a day).

An alarming 49.7% of respondents felt that they sometimes found it difficult to keep up with the work, this can contribute to the next factors' figure, as 39.9% felt that they were sometimes under pressure to do the work that was expected of them and this pressure was often experienced by 25.5%.

The statistical analysis (regression) found that perceived general health could explain most of the variance in the musculoskeletal discomfort prevalence. In addition to this, work organization (psychosocial) factors (such as demand, control, support and role) were found to be associated with musculoskeletal discomfort in this study.

Psychosocial aspects in Sonographers

Perceived general health correlated strongly with the work organization (psychosocial) and amount of time in a static posture. It also correlated well with the prevalence data, specifically musculoskeletal discomfort in the last 7 days in the neck and last 3 months in the right shoulder. The correlation with the prevalence of all MSDs was also significant.

Concerning response rates, there was a high response rate for sometimes (48.7%) experiencing trouble when concentrating at work. A substantial majority of sonographers felt that it could take between 1 – 6

hours to recover from musculoskeletal discomfort (25.5%). These statistics can indicate that their general health could contribute to the musculoskeletal discomfort experience.

An alarming 49.7% of respondents felt that they sometimes find it difficult to keep up with the work. The majority (39.9%) also felt that they were sometimes under pressure to do the work that is expected of them, this was closely followed by often (25.5%) feeling this pressure. Majority (35.3%) of sonographers felt that they could not influence amount they work they do on a daily basis. However, this item scale and the lack of senior management support response did not fit a normal or skewed distribution curve. The statement regarding there is a lack of colleague support fitted a positively skewed distribution, majority (50%) felt that they disagreed there was a lack of support from this source. This fell significantly to the negative end of the scale, hence the positively skewed response.

The psychosocial factors analysed as one factor correlated well with perceived general health, posture and total MSD prevalence. There was a positive correlation with the lack of senior management support, the inability to influence their workload and feeling under pressure to do the work that is expected of them.

Psychosocial factors (such as demand, control, support and role) analysed in this study were found to be associated with musculoskeletal discomfort in this study. This concurs with other studies that investigated the associations between MSDs and psychosocial risk factors (Deveraux et al., 2004; HSE, 2008). This study suggests that psychosocial risk factors were also a predictor for musculoskeletal discomfort within the last 3 months. Interestingly, there were positive associations, as the lack of senior management increases so does the inability to influence the workload and the pressure to do what was expected of the sonographers. This can suggest that the lack of senior management support may increase the significance of psychosocial risk factors, which can in turn contribute to the musculoskeletal discomfort (Deveraux et al., 2004).