The Adoption of Ergonomic Innovations for Injury Prevention – Sonographer’s scanning support device.

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Abstract

Studies of how people relate to the risk of occupational injury indicate that there is a tendency to underestimate the risk at work compared to other risks in society. Ultrasound examinations of the heart involve a static and very uncomfortable working posture for the sonographer. As a result many sonographers experience shoulder and neck pains which can result in long term sickness leaves.

The purpose of the study was to evaluate how a more radical ergonomic innovation, a remote controlled ultrasound robot for cardiac examinations, Medirob, has been adopted. The study was conducted by interviews with department heads and heads of clinics, responsible for the procurement of the equipment.

The results of this study have shown that it is not maybe enough to solve an ergonomic problem with an innovation to get it accepted and used. To prevent injuries the intervention must also have other qualities, for example improved productivity.

Background

Studies of how people relate to the risk of occupational injury indicate that there is a tendency to underestimate the risk at work compared to other risks in society. Most people are aware of traumatic injury and are willing to prevent such injuries. But they consider the risk of an occupational accident to be low [1].

Musculoskeletal symptoms or musculoskeletal disorders (MSDs) are defined as , “the conditions that involve the nerves, tendons, muscles, and supporting structures of the body” [2].

MSDs are especially prevalent in diagnostic sonographers [3-6].

Ultrasound examinations of the heart involve a static and very uncomfortable working posture for the sonographer. As a result many sonographers experience shoulder and neck pains which can result in long term sickness leaves. Because of the difficulty in replacing these highly skilled individuals this can cause big disruptions at the cardiac- or medicine departments. In the worst case the sonographer might not be able to return to this job again [7].

More than 80% of sonographers experience work-related pain and more than 20% of these suffer a career ending injury [8]. Sonographers responding to a survey indicated that the shoulder, neck, wrist and lower back were the most prevalent sites for pain and discomfort. An increasing loss of
sonographers due to work-related MSD (WRMSD) exacerbates an already existing shortage, and affects productivity and patient care. While injuries are traumatic individually, they affect all members of the cardiology department by impacting workflow, scheduling, staffing and budgets. It’s estimated that staffing shortages due to WRMSD result in revenue loss, medical bills, payout of worker’s compensation claims and new staff recruitment of US$764,000 annually per injury. Temporary staffing can add US$150,000 per year. [8, 9]

![The Cost of WRMSD and which body part that is most exposed](image)

The average length of time a sonographer is working in this profession before experiencing pain is about 5 years. A reported 80% of sonographers have been scanning in pain/discomfort for almost half of their career. It is estimated that 20% of the 80% of sonographers who are scanning in pain/discomfort will eventually end their career in the profession due to musculoskeletal symptoms and injuries. [7, 8]

**The ergonomic innovation, Medirob**

![The Medirob](image)

Medirob is a Mobile Remote Controlled Sonographer Scanning Support device, which helps the Sonographer during an ultrasound examination of a patient. A Sonographer is a health care professional specially trained to perform ultrasound examinations of the human body. The intended use of Medirob is to hold the transducer during an ultrasound examination. Medirob can hold transducers built by any manufacturer on the market and therefore be used to aid the sonographer.
in almost all types of ultrasound examinations such as heart, liver, gallbladder, bladder, spleen, pancreas, kidneys etcetera.

The Medirob holds the transducer and the Sonographer controls it using a joystick or a trackball. One of the benefits of this is that the sonographer does not have to use his/her arm to hold the transducer and work-related musculoskeletal disorders are avoided. Medirob is also remote controlled so it is possible to separate the person performing the examination from the patient, implying that the ultrasound examination can be performed over large or small distances.

**Ultrasound examinations performed over distance**

Initially Medirob was developed in northern Sweden to analyse the costs and benefits of cardiac consultation in healthcare centres involving long-distance, remote-controlled, real-time echocardiography [10, 11].

Long geographical distances often make it difficult to perform cardiac ultrasound examinations. Providing local care centres with the ultrasound robot allows these examinations to be performed remotely by a Sonographer. Thus the long travel times can be avoided for both the Sonographer and the patients saving money and improving care.

![Image](image_url)

**Figure 3.** The set-up of Medirob for an long distance examination

By using a video conferencing system the echocardiography expert can examine the patient without being present in the examination room. The ultrasound images, video information and all required sound information are transferred in real-time to the echocardiography expert.

The echocardiography expert can act as the Sonographer and control the transducer through the robot.

**Ergonomic local set up**

The initial market for Medirob is to introduce it as an ergonomic solution to the traditional ultrasound examination of a patient.
The below illustration shows the key components of a set-up of Medirob in an examination room in a hospital or physician clinic or wherever else the ultrasound equipment is placed. In this set up the customer has purchased a Medirob with a control panel and trackball with necessary software. These are the basic components of the Medirob product line.

![Image](image.jpg)

Figure 4. The set-up of Medirob in an examination room

With the Medirob the physiology assistant doesn’t have to work in the uncomfortable posture and will be spared the shoulder and neck pain. Instead Medirob does the heavy and static work while the Sonographer controls it comfortably using a control stick or trackball.

In a comparative study conducted by Blomgård [12] can be stated that the introduction of robotic assisted ultrasound examination (Medirob) has completely eliminated the risk of musculoskeletal injuries, however, other health and safety deficiencies remain such as physical and psychosocial factors. Sonographer’s who have been on sick leave due to musculoskeletal injuries have been able to return to work.

**Evaluation**

The purpose of the study was to evaluate how a more radical ergonomic innovation, a remote controlled ultrasound robot for cardiac examinations, Medirob, has been adopted. The Medirob is a more system-dependent innovation and requires the acceptance of both the individual sonographer and the health care organization in order to be adopted. Since MSD is a common problem among sonographers, you would think that the adoption of this ergonomic solution would be substantial, particularly among those with problems and also for prevention purposes.

**Method**

The study was conducted by interviews with department heads and heads of clinics, responsible for the procurement of the equipment.

The aim was to find out which aspects decided whether the equipment was adopted/bought or not. The interviews were conducted with heads, who had bought the equipment, heads who had tried but not bought the equipment, and with heads who had not yet tried the equipment.

The studies have been conducted in Sweden where the Medirob been available on the market since 2006. The study only included applications where the Medirob was used to reduce the ergonomic workload for sonographers.
Results
In Sweden there are about 80 hospitals of different sizes and half of them have clinic/departments where ultrasound examinations are a frequent work. Since Medirob was introduced to the market only 4 are sold.

A total of 9 clinic / department heads were interviewed. 3 who bought the equipment (I), 3 who had tested the equipment but have chosen not to buy (II) and 3 that have chosen not to test the equipment (III).

The results of the interviews show that all respondents were aware of the equipment, the Medirob, and all admitted that they have MSD problems in each department.

The approach to the MSD problems has primarily been job-rotation; 8 of 9 state that the Sonographers only work with ultrasounds examinations either morning or afternoon. However, MSD problems persist, but on a somewhat reduced level.

The image quality and examination time are important factors in the introduction of new working practices. Asked how the Medirob affects the quality of the pictures or the task time or how the respondents answered as follows:

*How do you think or know Medirob affects the quality of the pictures?*

Table 1. Quality effects

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*How do you think or know Medirob affects the time for an examination?*

Table 2. Time for an examination

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Users of Medirob point out the importance of getting extra time for practicing to handle the Medirob. After introduction and training, the number of ultrasound examinations per day has to be reduced during a transitional period.

The departments that bought the Medirob have all acquired the equipment due to one or more of the sonographers at the department had such severe MSD problems that they frequently was on sick leave.
Non-users were asked if, hypothetically, the examination time was decreased by 20% per patient, would that have an effect on the decision to purchase? All of the non-users claimed that this would have a positive impact on the decision.

_How do you think a 20% reduction on the time for examination would affect your decision?_

Table 3. Effects of a time reduction

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Other comments about Medirob were:

- Only 1 of the 9 respondents thought that the price of Medirob (~ $100,000) had an effect on the decision to buy or not to buy.
- A bit unwieldy
- Not the same feeling as driving manual
- Hard to learn to drive with joystick
- Hard to fine tune the transducer
- Does not work on all patients (heavy overweight)

**Discussion and conclusions**

Recommendation to reduce the risk of MSD so far, has been more specific ergonomic interventions reported in the literature including adjustable chairs, beds, and equipment, varying postures throughout the day, reducing the amount of reaching to and over the patient, alternating between standing and sitting when scanning, alternating scan hands, rotating between scan types, doing stretching exercises, providing education programs on proper posture and technique while scanning, and taking frequent breaks. It appears that these recommended ergonomic interventions have not had a significant effect on improving the health and safety of cardiac sonographers according to Horkey [8]

The intervention, Medirob, might have a major impact on reducing and preventing MSD problems among Sonographers. Still, there are only a few users and they all have such severe problems that the intervention helped them to stay in the occupation.

The majority of the heads of clinics/departments said that they did not want to change the way they work because it takes time to learn how to do things in a new way. A great number said that the work is not done fast enough with the tool. When asked how much faster the work must be done in order to change a working method the answer for the majority is “the same speed.” Still, 6 heads claimed a need for improved productivity.
The results of this study have shown that it is not maybe enough to solve an ergonomic problem with an innovation to get it accepted and used. To prevent injuries the intervention must also have other qualities, for example improved productivity [13, 14].

A limitation of this study is the small sample of interviewed persons and the limited use of the innovation Medirob. Further research needs to be conducted to evaluate the innovation and to evaluate if an ergonomic innovation needs to have more qualities than just “reduced work-load” to be used to prevent injuries.

References