



HEALTHCARE ERGONOMICS

Part one of a two part self-study monograph for continuing education for healthcare workers with an interest in occupational and patient safety and infection prevention.

ISSUE 5 Part 1

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LEARNING OBJECTIVES

After completing this continuing education activity, you should be able to:

1. Discuss the importance of ergonomics in healthcare;
2. Identify the unique characteristics of operating room design, equipment, and workflow and their ergonomic challenges to healthcare providers;
3. Recognize the importance of ergonomic programs that addresses the culture of the workplace, work practices, management procedures and employee education.



Cathryn Murphy PhD, CIC

Executive Director – Infection Control Plus
Honorary Adjunct Associate Professor,
Faculty of Health Sciences and Medicine
Bond University
Gold Coast, Queensland, Australia.

Associate Professor Murphy provides consulting services to Ansell worldwide and is the editor of this edition of AnsellCARES™ InTouch™.

The opinions expressed in this edition are the authors' only and may not represent the official position of Ansell or Bond University.

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GUEST FACULTY

In this edition we welcome contributions from three experts in ergonomics. Kevin Costello, Founder and President of United States Ergonomics (US-Ergo) and colleagues Amanda Ho, Project Manager, Ergonomist and Caroline Burchell, Project Ergonomist provide a comprehensive overview of Ergonomic Considerations in Healthcare. Their insights come from their work at US-Ergo where they collaborate with a team of more than 150 ergonomists and safety and health professionals who perform workplace services including site audits and risk assessments, job design, training and product testing across the United States.

EDITORIAL

A previously published edition of InTouch™ introduced readers to the concept of safety in the operating room (OR). That edition acknowledged the many risks faced daily by OR staff and it also briefly outlined strategies for improving OR safety. It also focused primarily on prevention of blood and body fluid exposures including sharps injury. This special two-part edition of InTouch™ builds upon that previous information by looking more generally at ergonomic risks in clinical healthcare.

Recent actual and estimated workplace injury data from the US, Great Britain and Australia report 58,000, 48,000 and 17,500 incidents in the healthcare workplace per year respectively. Whilst not all of these injuries are likely related to ergonomics or human factors oversight many may be and it is therefore useful in this section to consider the importance of ergonomics in clinical healthcare.

A clinical environment which is deemed to be ergonomically sound is one where the environment fits the job and the worker(s). Whilst this sounds easy enough, for clinical environments it can be incredibly difficult to determine and align the ergonomic needs of the worker, the limitations imposed by the variety of procedures and interventions provided in a clinical setting and the challenges of most clinical environments. These challenges usually include limited space, high activity and often use of bulky, heavy and space occupying equipment. The often unpredictable nature of work performed in clinical environments, due largely to various individual patient needs, also potentially poses an uncontrolled ergonomic risk. In the clinical setting it is not always feasible to apply a single ergonomic solution and the system may require a degree of flexibility. This may manifest in providing workers with various options for example, choice of personal protective or other safety equipment.

As an experienced healthcare worker with very recent personal experience of a work-related carpal tunnel syndrome significant enough to require surgery, the true cost of ergonomic injury; pain, time away from work, extended rehabilitation and therapy, reduced function and scarring; appears to be under appreciated. Six months post-surgery and still unable to have a fully functioning hand makes one very much appreciate the importance of a safe and functional work environment. It has also helped me accept that ergonomics in healthcare are not just about the design of workplaces but equally reliant on the provision of adequate training and quality equipment, both single use and re-usable, to workers. In addition regular review of workplace safety and timely remediation and removal of workplace risks ensure optimum workplace safety and in doing so can position the organization as an employer who truly values and respects their staff. This is the type of organization we all long to be part of. As readers review the contents of this special two-part issue of InTouch we hope they too will be able to classify their own work environment as one which is ergonomically sound and occupationally safe. We are acutely aware of ergonomic challenges in the operating room and so in the second part of this edition we will be dedicating specific attention to this area. As well we will be looking in depth at how ergonomic considerations influence glove design. Many of the principles discussed in this special two-part series apply equally across other like healthcare settings and even though the content focusses on solutions applied in US operating rooms they would likely be just as successful in non-US ORs. Finally we wish for readers to understand that whilst InTouch always attempts to provide global perspectives, for this special edition we are focusing on North American (N.A.) viewpoints given N.A.'s long history in the field and the respective public policy investment. Similar information is not readily available in most other countries.

ERGONOMIC CONSIDERATIONS IN HEALTHCARE

KEVIN COSTELLO, AMANDA HO AND CAROLINE BURCHELL

BACKGROUND

Healthcare is one of the largest employment sectors in the U.S. economy with the fastest projected employment growth between 2014 and 2024.⁽¹⁾ The nature of healthcare work can be physically demanding involving patient handling, awkward postures related to patient treatment, extended shift lengths and data entry demands. Injuries experienced by nurses and personal care facility result in over 200,000 work-related injuries and illnesses each year, twice the rate experienced in general industry.⁽²⁾ The direct costs from these musculoskeletal disorders (MSDs) are estimated at about \$1 billion per year⁽²⁾ with indirect costs estimated to exceed \$20 billion.⁽³⁾

Injuries to medical professionals can limit the services available to patients, impact response times, disrupt schedules and place larger workloads on the non-injured employees' peers. To combat these risks and ensure worker and patient safety, hospitals must make safe work practices intuitive by promoting a culture of prevention and enhancing the ergonomics of workplace.

COMMON ERGONOMIC INJURIES

Most injuries in the healthcare sector are a result of overexertion. These injuries can result from repetitive stress, awkward postures, poor equipment handling or lack of appropriate equipment. Data from the Bureau of Labor Statistics shows that in 2014 hospital workers had an overexertion injury rate that was twice that of general industry average.⁽⁴⁾

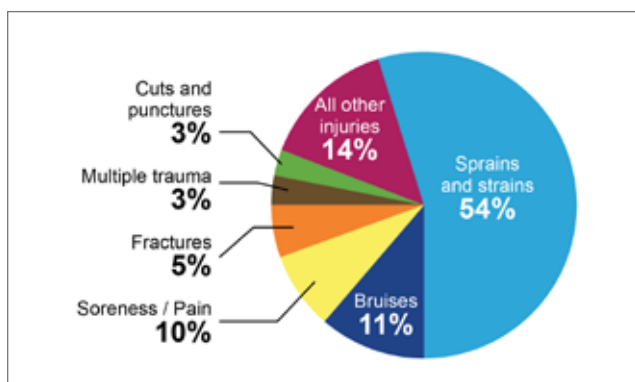


Figure 1: Hospital Worker Injuries Resulting In Days Away From Work, by Nature of Injury

Nursing home and ambulance employees had even higher rates with three, and five times the average respectively.⁽⁴⁾ The majority of these reported injuries consisted of sprains and strains (see figure 1). These statistics do not include unreported injuries, so the actual incidence rate is estimated to be even higher.

Injuries experienced by nurses and personal care facility result in over 200,000 work-related injuries and illnesses each year, twice the rate experienced in general industry.⁽²⁾

Injuries are unique to the various job tasks assumed by healthcare workers. The most common overexertion injuries are to the shoulders and lower back. Nurses bear the brunt of these injuries from their high frequency of patient handling, and have the highest incidence rate of MSD injuries out of healthcare workers.⁽⁵⁾ For operating room surgeons, the hands, wrists, neck, and shoulders are at the highest risk for MSDs. The long hours, repetitive movements, fine movements, various tool handling, and awkward postures required by the nature of surgery all contribute to cumulative stress injuries. To control the risks requires diligence in job-specific ergonomic programs and equipment.



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COSTS

Three major interwoven concerns in healthcare safety include: injuries, indirect/direct costs, and employee turnover rates. Workplace injuries lead to high worker's compensation from both direct and indirect sources. Direct costs are made up of the actual healthcare bills, while indirect costs include lost productivity, paying overtime for other employees, finding and hiring temporary or new employees, and retraining.⁽⁶⁾ Direct and indirect costs associated with back injuries alone in the healthcare industry are estimated to be \$20 billion annually.⁽³⁾ As new employees replace their injured counterparts, productivity suffers and more work (including the risks associated with the work) are placed on the existing employees.⁽³⁾ Research conducted by Taylor et al. noted that for every 10 percent increase in turnover, nurse injuries increase by 68 percent.⁽⁷⁾ This perpetuates the cycle of injury → costs → turnover as per figure 2. Implementing a preventative program is the most effective method for stopping this cycle with proper training, ergonomics awareness, proper tools and accessibility to assistive technologies.



Figure 2: The cycle of injury

CULTURE

Within the healthcare setting caregivers follow their ethical duty to put the patient first responding immediately in times of crisis. This is particularly true in instances of patient falls and emergency treatment. Unfortunately, this immediate response may place undue stress on practitioner's bodies, that could be avoided through proper training and preventative measures. Additionally, healthcare staff tend to underreport injuries and illness,

instead pushing through their discomfort to deliver care, or treating themselves by changing their shifts to give themselves some recovery time.⁽³⁾

The acute musculoskeletal injuries (sprains and strains) typically develop suddenly and often from a known event (e.g., an awkward lift or high force exertion). In contrast cumulative trauma disorders (CTD) develop slowly from repeated exposure to stressful technique. An individual will often feel a building discomfort for many weeks and months before a serious injury develops. To reduce severity it is imperative that discomfort is reported and treated as soon as it is experienced.

Healthcare staff tend to underreport injuries and illness, instead pushing through their discomfort to deliver care

RETURN ON INVESTMENT

The implementation of ergonomic programs have resulted in major returns on investment, while significantly improving worker well-being and job satisfaction. In a study that aggregated 250 case studies of the outcomes of ergonomic programs in healthcare and other industries, it was found that there was a significant reduction of MSDs, injuries, and turnover rate, along with an increase in productivity.⁽⁸⁾ Ergonomic considerations for the ambient environment including lighting, acoustics, and layout additionally improved staff health and lowered rates of error.⁽⁹⁾ Economically, the reduction of direct and indirect costs from injuries has the potential to amount to billions of dollars saved.^(2,3) Overall, the long term health benefits of implementing ergonomic programs, investing in ergonomic equipment, and fostering a culture of ergonomic awareness extend beyond the workers to the quality of patient care.

ERGONOMIC CONSIDERATIONS IN HEALTHCARE

ERGONOMIC PROGRAM COMPONENTS

The most effective ergonomic programs focus on prevention and support a culture focused on employee health and safety (a fundamental tenant of healthcare). The best practices in ergonomics include five major components as outlined below:

1.0 Management Commitment and Employee Involvement

- A culture dedicated to employee health & safety
- Visible commitment by top management
- Aggressive goals clearly stated
- Supervisor/management responsibility & accountability
- Active employee involvement

2.0 Worksite Analysis, Hazard Prevention & Control

- Working ergonomics policies
- Worksite evaluation process
- Administrative and engineering controls
- Physical demands documented and applied
- Ergonomics job design references and equipment specifications

3.0 Injury Case Management

- Injury/illness records management
- Comprehensive injury investigation & reporting
- Aggressive case management
- Active surveillance of symptoms
- Employee fitness & wellness programs

4.0 Training and Education

- New hire education process
- Continuous awareness training
- Appropriate training for all staff levels
- Roles and responsibilities clearly defined

5.0 Program Monitoring

- Effective 2-way communication
- Positive reinforcement through auditing
- Benchmarking across departments and site to site
- Program monitoring using historical, current and leading indicators

RISK IDENTIFICATION

A critical step in preventing ergonomic injuries is identifying the areas of risk (see figure 3). The levels of force, repetition, contact stress, posture, and personal factors (physical fitness, health) must be controlled to minimize ergonomic injury potential. Additionally,

mental workload poses a unique risk for the healthcare industry and is particularly high for emergency workers, ambulatory care workers, and for workers in high patient intake hospitals. The environment of the hospital contributes to all workers' overall ability to perform their tasks, including factors such as lighting, acoustics, and hospital layout.

The Occupational Safety and Health Administration (OSHA) has identified patient handling tasks as high risk if they involve:

- High repetition (repeatedly cranking manual adjustments for beds, >20 patient lifts per shift)
- Awkward postures (reaching across beds to lift patients/residents)
- High force (pushing chairs or gurneys across elevation changes)
- Handling or lifting heavy objects (e.g., manually lifting immobile patients/residents alone)
- Ineffective training of employees in body mechanics and proper lifting techniques

Ergonomic risks common in surgical and patient treatment areas include:

- Poorly positioned electronic equipment for electronic records data entry
- Awkward and static postures for extended durations during surgical procedures
- Surgical equipment and treatment methods requiring high hand forces
- Challenges related to treatment of bariatric patients
- Poorly fitting surgical or exam gloves



Figure 3: Ergonomic Risk Factors

ERGONOMIC CONSIDERATIONS IN HEALTHCARE

ERGONOMIC DESIGN

Designing the risks out of the operations is the most effective method of prevention. The design of the hospital including the layout of exam rooms, surgical suites, nursing stations, and patient rooms is critical. Ergonomic purchasing specifications for commonly used equipment should be established. These may apply to hospital beds, patient handling assists, equipment mounting, as well as surgical equipment, IV stands, crash carts and computer stations, etc.

Ergonomic performance is measurable and some products perform better than others. The healthcare industry should work with its vendors and suppliers to specify improvements in equipment design. Vendors must integrate ergonomic design into the product development process. The purchase of proper equipment should be supported with adequate training and reinforcement of safe work practices.

An investment in appropriate equipment, furniture, and tools has been proven to significantly reduce the risk and incidence of ergonomic injuries. When specifying or selecting equipment it is desirable to involve those that will be using the equipment in the decision making process.

Proper equipment should be supported with adequate training and reinforcement of safe work practices

CARTS AND FURNITURE

There has been a trend toward mobile technologies and furniture, such as hand-held devices, portable diagnostic equipment, modular workstations, and mobile computer stations. Mobility increases the ease of movement between nurse hubs and patient rooms, but brings with it unique ergonomic considerations.⁽¹⁰⁾ Due to the nature of

healthcare work, staff switch their workstations multiple times throughout the day meaning the workstation must be adjustable to each new user. Examples of adjustable furniture include, height adjustable desks, chairs, monitors, keyboard trays, and mobile workstations. Workers must be trained in the proper furniture adjustments and make habit of adjusting the workstation to better fit their stature, rather than making do with a previous setting.

An investment in appropriate equipment, furniture, and tools has been proven to significantly reduce the risk and incidence of ergonomic injuries

ERGONOMICS IN THE OPERATION ROOM

Within the surgical setting, key ergonomic considerations include instrument design and placement, over-standing and fatigue, forward-leaning, neck posture and screen positioning, table height, and foot pedal positioning. The types of gloves used will also affect the amount of hand and finger force associated with a task.



ERGONOMIC CONSIDERATIONS IN HEALTHCARE

THE ERGONOMIC RISK FACTORS RELATED TO SURGERY, ASSOCIATED HEALTH CONCERNS AND PROPOSED CORRECTIVE ACTIONS ARE OUTLINED IN THE TABLE BELOW:

ERGONOMIC RISK	RECOMMENDATION
<p>Instrument Design & Placement:</p> <ul style="list-style-type: none"> Awkwardly sized surgical tools force upper arm movement away from the body's midline and flexion/ulnar wrist deviation, which cause upper body discomfort.^(11;13) Increased instrument weight and distance from hand to tool tip causes neck and shoulder strain.⁽¹⁴⁾ 	<ul style="list-style-type: none"> Instrument handles should be positioned at elbow height of the surgeon.⁽¹¹⁾ Tools should be chosen based off ergonomic guidelines:⁽¹⁾ Allow one-handed use;⁽²⁾ Interchangeable shafts;⁽³⁾ Easily accessible buttons;⁽⁴⁾ Allows both force and precision grip;⁽⁵⁾ Can be comfortably held throughout different rotation;⁽⁶⁾ Requires low amounts of force to operate.⁽¹¹⁾
<p>Glove Considerations:</p> <ul style="list-style-type: none"> Improperly-sized gloves can either slip too easily or compress the sensitive muscles within the palm and thumb region – leading to chronic discomfort and mobility impairment. As thickness increases, tactile sensitivity tends to decrease, impacting ease of tool manipulation. 	<ul style="list-style-type: none"> Surgical gloves should be available in multiple sizes to best fit each individual while allowing for dexterity and rotational movements. Prevent exposure to fluids while being thin enough to allow for maximized tactile sensitivity. Grip is important to consider during tool. Consider latex sensitivity of staff and patients.
<p>Over-Standing & Fatigue:</p> <ul style="list-style-type: none"> Long-periods of standing can lead to leg, knee, foot, and lower back discomfort, joint locking and varicose vein development.⁽¹³⁾ Static postures can lead to surgical fatigue syndrome which weakens coordination and slows reaction times.^(11;14) 	<ul style="list-style-type: none"> Incorporate frequent rest breaks into the workday. Surgeon should try to vary posture while operating, when possible.⁽¹⁴⁾ Anti-fatigue mats should be used during prolonged standing periods to reduce discomfort.
<p>Forward-Leaning:</p> <ul style="list-style-type: none"> Forward-leaning during open surgery increases lower back muscular activity, prolongs static flexion of the neck and lower back, and leads to neck and lower back pain.⁽¹⁴⁾ 	<ul style="list-style-type: none"> Frequently stretch and take rest breaks. Forward tilting seats can be used depending on the user, but be cautioned that compression on the chest/abdomen may cause discomfort.
<p>Neck Posture & Screen Positioning:</p> <ul style="list-style-type: none"> Looking down during open surgery creates neck flexion and increased pressure at the cervical spine.⁽¹⁴⁾ During laparoscopic procedures, neck discomfort is highly dependent upon screen positioning, which can lead to repetitive extension when the screen is positioned above the line of vision. 	<ul style="list-style-type: none"> Monitors in laparoscopic surgery should be set at a visible distance, without necessitating forward-leaning/squinting. Monitor height should be set such that the top of the screen is at eye height. Monitors should be on a flexible arm.⁽¹³⁾
<p>Table Height:</p> <ul style="list-style-type: none"> Surgical tables are often set too high, leading to shoulder-shrugging and discomfort. If operating tables are adjustable, they are typically fitted to the main surgeon, and the surgical team is of varying heights.⁽¹¹⁾ 	<ul style="list-style-type: none"> The surgical table should be set such that the tools being used by the surgeon are positioned at elbow height. This requires height adjustability, and unfortunately does not fit the work surface to the whole surgical team. Alternatively, the surgeon should stand on a height-adjustable platform.
<p>Foot Pedals:</p> <ul style="list-style-type: none"> Foot pedals with small surface areas limit the range of motion and creates a static posture. Discomfort may occur if the tension is high or the positioning is held for a prolonged period of time. 	<ul style="list-style-type: none"> The foot pedal should be aligned in the same direction the surgeon is facing to minimize body and leg twisting.⁽¹³⁾ Consider use of a pedal with a built-in footrest, to mitigate need to repetitively lift and lower the foot from the floor.

PATIENT HANDLING

The lifting and transferring of patients plays a pivotal role in employee health and musculoskeletal risk. According to the Occupational Health Clinics for Ontario Workers, repetitive patient transport and handling has been identified as the most common cause of reported back injury among healthcare employees. This injury risk can impact employee turnover and lead to staffing shortages, thus affecting overall levels of patient care.^(15;16) This risk of injury has increased with the rising number of bariatric patients seeking healthcare.⁽⁵⁾



To address these risks, healthcare facilities frequently engage in training programs that focus on proper posture and two-person assistance during manual tasks. However, lifting guidelines typically consider only the vertical elements of weight-bearing, failing to consider that lifting and turning patients is performed on a horizontal plane (with use of the weaker muscles of the arms and shoulders rather than the muscles of the legs).⁽⁶⁾ The National Institute for Occupational Safety and Health (NIOSH) highlights 51 lbs as a safe weight to lift for the average person. However, due to the consideration of horizontal forces, NIOSH has established 35 lbs as the limit for safe patient handling tasks.⁽¹⁷⁾ In this way, although proper body mechanics can reduce lower back stress, training cannot fully mitigate an inherently unsafe task.⁽⁶⁾

The utilization of special lifting equipment is therefore highly recommended, if not necessary. One case study, of the Veterans Health Administration,

highlighted its success with having implemented moving equipment – reducing hospital nursing injuries related to lifting by 40 percent.⁽¹⁸⁾ An investment in both policies and equipment for safe patient handling can lead to the long-term benefits of reduced injuries, increased productivity, improved staff retention and patient satisfaction.^(19;20;21;22) This requires training on proper equipment handling and technique.

Repetitive patient transport and handling has been identified as the most common cause of reported back injury among healthcare employees

The OSHA Lifting guidelines for health care workers (nurse assistants, licensed practical nurses, registered nurses) suggest a safe patient handling program should strive for the following:

- Minimize manual lifting of patients/residents and eliminate lifting when possible.
- Never transfer patients/residents when off balance.
- Lift loads close to the body.
- Never lift alone, particularly fallen patients, use team lifts or mechanical assistance.
- Limit the number of allowed lifts per worker per day.
- Avoid heavy lifting especially with spine rotated.
- Training in when and how to use mechanical assistance.

Once workers learn to identify their risks, they are more likely to be able to adopt techniques to prevent injury to themselves and others.

COMMON RECOMMENDED EQUIPMENT FOR PATIENT LIFTING INCLUDES:

- Shower chairs or stalls
- Mechanical lift equipment such as Lean-Stand assist lift, sling-type full lift
- Overhead track mounted patient lifters
- Electric Height adjustable patient beds
- Lateral transfer devices
- Sliding boards
- Descent Control System (DCS)

AMBIENT ENVIRONMENT

Environmental variables including lighting, acoustics, and layout can contribute to higher risk of injury and error within the healthcare setting, and should be considered within hospital design.

LIGHTING

Lighting affects staff health, productivity, rate of error, and adaptation to their work shift (night shift vs. day shift). Due to the 24-hour cycle of many healthcare facilities, various levels of lighting need to be considered for the myriad of job tasks required of healthcare workers. For example, medication dispensing requires higher light levels than natural light to ensure accuracy, employee age impacts brightness requirements, and overnight workers need high enough light levels to disrupt their natural circadian rhythm in order to reduce fatigue. In addition to adjustability, access to natural light is imperative as it reduces stress for both workers and patients.



ACOUSTICS

Noise interferes with staff concentration, prevents reliable communication between staff, and increases stress for both workers and patients. Hospitals and healthcare facilities commonly exceed the 35 dB level of acceptable noise. Common sources of noise are machinery, trolleys/mobile furniture, paging systems, telephones, and voices. Hard surfaces reflect and amplify noise, so sound absorbing materials must be considered for flooring, ceiling tiles, and wall insulation.

FLOORING

The flooring should accommodate staff members standing for long periods of time (often for 8-12 hour shifts). Research has shown anti-fatigue mats, or softer flooring materials can significantly decrease weight-shifting and pain/stiffness in the legs and feet for employees standing for more than 4 hours.⁽²³⁾ Optimally, total standing work would decrease by implementing sit/stand stations, or rotating seated and standing tasks which would provide comfort to the worker.⁽²³⁾



HOSPITAL LAYOUT

Visibility to patients and staff is a vital component of healthcare work. Nurses and doctors need a clear view of their patients, especially in emergencies when the time to notice and reach a patient in need is crucial. Workers who have clear sightlines are able to identify other staff faster for assistance, and communicate more to ensure accuracy about patient records/needs.⁽¹⁶⁾ To ensure visibility, many healthcare settings have implemented a pod layout where nurses can cluster at various points to gain clear visual access to surrounding patient rooms.⁽¹⁶⁾

Visibility to tools/equipment is also important in emergencies for selection accuracy. For example, if nurses are not in the sightline of a lift assist device and need to act in the moment to lift a patient, they may try to lift without any assistance and risk a sprain/strain injury. Through the manipulation of the location, size, color, and texture of materials of tools, decision time and accuracy could be improved.⁽¹⁶⁾

CONCLUSION

Ergonomic risks and injuries in the healthcare industry are numerous and costly affecting employee health and safety as well as the quality of patient care. These risks are measurable and can be controlled. The most effective approach considers the design of the hospital, equipment, and tools where improvements have resulted in measurable reductions to the ergonomic risks. Proper design must be supported with an ergonomic program that addresses the culture of the workplace, work practices, management procedures and employee education. Effective efforts have resulted in significant reductions in injuries while boosting productivity and the quality of patient care.

ABOUT UNITED STATES ERGONOMICS

US Ergonomics is a national consulting company providing services to a broad range of industries including healthcare, laboratory, manufacturing, office work, and others.

Services include:

- Ergonomics Systems Audit & Strategy
- Comprehensive Training & Education Programs
- Job Evaluation, Risk Assessment & Solution Development
- Physical Demands Analyses/Job Hazard Analyses
- Product Purchasing Specifications
- Workplace Design Specifications
- Ergonomic Standard Operating Procedures



In addition, US Ergonomics maintains a state-of-the-art ergonomics laboratory providing advanced workplace and product testing services. The lab specializes in objectively quantifying the effects of design on human performance, ergonomic risk, error potential and user comfort.



Amanda Ho



Caroline Burchell



Kevin Costello

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111 Wood Avenue South
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Iselin, NJ 08830, USA

Europe, Middle East & Africa

Ansell Healthcare Europe NV
Riverside Business Park
Blvd International 55
1070 Brussels, Belgium

Asia Pacific

Ansell Services Asia Sdn. Bhd.
Prima 6, Prima Avenue
Block 3512, Jalan Teknokrat 6
63000 Cyberjaya, Malaysia

Australia & New Zealand

Ansell Limited
Level 3, 678 Victoria Street
Richmond, Vic, 3121
Australia

www.ansell.com