

Technological Innovations in Occupational Health and Safety in the Healthcare Industry

New and emerging technologies report

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Occupational Health & Safety Agency for Healthcare in BC

#301-1195 West Broadway, Vancouver, BC V6H 3X5

Table of Contents

Table of Contents.....	2
Background.....	3
Overview of Technological Innovations.....	4
New Technologies in Ergonomics.....	4
Surgical Hand Tools.....	4
1. A handle system for pinch grip activities.....	5
2. A parallel handle system for squeezing activities.....	6
3. A handle system for power grip activities.....	7
Pipettes.....	8
Housekeeping in Healthcare.....	9
Automated Pill Crusher and Medication Cart.....	10
1. OHSAH automated pill crusher.....	11
2. PowderCrush from Manrex Ltd.....	12
3. OHSAH medication cart.....	12
Emerging Technologies in Disease Prevention.....	13
Safety Engineered Medical Sharps.....	13
Neutral zone compliance or Hands Free Technique.....	15
The Exposure Prevention Information Network (EPINet).....	15
WHITE/EPINet.....	16
New Technologies in Violence Prevention and Working Alone.....	16
New Technologies in Home and Community Healthcare.....	18
Conclusion.....	19
References.....	20

Background

The Occupational Health and Safety Agency for Healthcare (OHSAH) in British Columbia is a provincial occupational health and safety organization for the healthcare sector with the goal of reducing workplace injuries and illness in healthcare workers and returning injured workers back to the job as quickly and safely as possible. OHSAH works under a bipartite mandate that is jointly governed by employers and unions. OHSAH's programs and initiatives are founded on the premise that decreasing workplace injuries and illnesses, and their ensuing costs, requires a multi-faceted, collaborative, integrated approach based on solid evidence. OHSAH works with all members of the healthcare community and in partnership with healthcare stakeholders including unions and employers; and others, such as WorkSafeBC, university researchers, and the Ministry of Health Services to strive for the missions which underlie the success of the organization.

OHSAH has been involved in various technology based initiatives since its inception in 1998, which include the implementation and evaluation of ceiling lifts; the design, development, implementation, and evaluation of an ergonomically designed medication cart and automated pill crushing device; the implementation of safe needle technologies; and the implementation and evaluation of an automated microtome. Although the medication cart and the pill crusher are still in the prototype phase, ceiling lifts, safe needle technology, and the automated microtome are excellent examples of how the implementation of technological innovations in this industry are important for reducing the risk of injury to healthcare workers.

As a result, the Board of Directors for OHSAH agreed upon a number of deliverables for the 2006/2007 fiscal year, including a comprehensive report on promising technological innovations related to occupational health and safety (OHS) in the healthcare industry. The following report outlines current technological innovations focused on OHS in the healthcare industry. This report is to be completed on an annual basis and provided to our stakeholders through various media, such as on-line print, newsletters, and industry presentations. This and subsequent reports will also provide recommendations and open the door to potential new initiatives for OHSAH, which may include the pilot testing and evaluation of new technologies.

Overview of Technological Innovations

Technological advances play a vital role in our lives in diverse areas, including communications, medical procedures and treatment, transportation, learning and academic development, leisure, and entertainment. Technology can also play an essential role in workplace health and safety, reducing and even preventing occupational risks and hazards faced by workers on their job. This latter aspect is of particular importance to the healthcare sector due to the fact that there is a high prevalence of work-related injuries and illnesses among healthcare workers. The impact of these injuries and illnesses not only debilitates the physical and mental well-being of the healthcare workers performing routine duties specific to their job demands, but it may also have a negative impact on the overall quality of patient care delivery. Technological innovation provides a promising avenue in cultivating a culture of OHS from the perspective of injury and disease prevention in healthcare.

Based on preliminary research, which was conducted in scientific literature, the worldwide web, and the Canadian and US Full-text and Image Patent Databases, recent innovative technologies in areas of ergonomics, disease prevention, violence and working alone, and home and community care were identified.

New Technologies in Ergonomics

Along with common injuries such as cuts, lacerations, and bruises, frequent and prolonged use of hand tools can cause signs and symptoms of musculoskeletal injury (MSI). Signs and symptoms include discomfort, redness, swelling, numbness, and fatigue, which, when ignored, can lead to more serious chronic health effects. There are several risk factors for MSI associated with operating hand tools, but proper tool design can help reduce these risks and maximize mechanical efficiency of their use.

Surgical Hand Tools

Hand tools are commonly used by operating room (OR) personnel, which typically includes a surgeon, a surgeon's assistant, an anaesthesiologist, an OR nurse, and a scrub technician. Standard surgical instruments such as forceps, clamps, and scissors present many ergonomic risks to surgeons while performing surgical procedures. They are prone to awkward and static postures, forceful exertions, and contact stress due to improper design of the instrument handles. Recognizing the significance of this concern amongst surgeons, Dr. Stephen L. Tillim, a neurosurgeon from California, developed three prototypes for different handle systems. These innovative ideas were

based on anatomical function of the hand targeting pinching, gripping, and squeezing actions during their use. The designs can be integrated with various surgical instruments and can provide solutions to mitigate the risks of MSIs. Prototypes have been developed and approved for patent licensing in the US, but are not currently available commercially. The features of each of these systems are summarized below:

1. A handle system for pinch grip activities¹

The first handle system was designed for forceps and tweezers. Forceps and tweezers are made in the shape of a stylus with a functional tip on one end and a piece that rests on the space between the base of the index finger and the thumb on the other end. Typically they are held like a pencil and enable the hand to pick up and hold parts of various objects by applying a range of pinch grip forces at the handle. This action recruits muscles of the index finger and thumb, producing opposing forces to manipulate the tip of the tool. Meanwhile, support must be provided by these muscles to hold, control, and stabilize the tool in the desired position. This simultaneous need for both force and support can cause muscle and joint strain. Hand strain can also occur because the thumb and index finger have a natural tendency to move forward toward the tip of the tool, creating exaggerated finger flexion and awkward hand posture and in turn placing excess demands not only on the hand muscles, but the forearm muscles as well. Due to various anatomical constraints during application of the tool, past patented designs do not function with optimal efficiency. Pinch grip strength is compromised by opposing the thumb to the index finger only; the current tools do not take advantage of the greater pinch grip strength available from opposing the thumb to the index finger and the middle finger. Furthermore, the palm of the hand is not utilized to provide optimal support during movement and the ring finger and small finger are not recruited for stabilization.

The intent of Dr. Tillim's design was to account for these constraints. He came up with a design that would modify and improve on existing features of the standard handle in forceps or tweezers (see figure). Specifically, it is designed to separate pinch grip force from the simultaneous need for



support by the recruited muscles. It also provides greater contact area with the hand to improve stability during manipulation. The handle does not contact the skin over the carpal tunnel region so there are no concerns for developing carpal tunnel syndrome due to contact stress over that area.

In addition, the handle includes an elevated surface for positioning of the fingers; the natural arcs of

the fingers and palm are maintained, such that the handle is comfortable to hold. The design further reduces pinch grip effort by recruiting forearm muscles and muscles in the middle finger in addition to the muscles in the thumb and index finger. At the same time, excessive demands on the forearm muscles and the hand muscles due to unnecessary finger flexions are minimized. Support is provided by the ring and small fingers and the overall design acts like an extension of the hand, allowing the tool to be easily manipulated with minimal straining to the wrist and hand.

2. *A parallel handle system for squeezing activities?*

The second handle system is designed for hand tools such as pliers that are used for holding, gripping, cutting, and biting objects. Current plier designs have two handles joined at a hinge that allows rotation relative to each other. The handle of the pliers is commonly convex or straight and is operated based on a levered system. One handle can be fixed and the other can be moved or both handles can be moved concurrently. The fixed handle is usually held in place where it touches the prominent muscles of the palm. Both handles are moved toward each other from the hinge to close the working end of the tool. Hinged tools can be seen in surgical instruments such as bone rongeurs and endoscopic instruments.

The drawback of any hinged handle is that the typical moveable end requires longer reach and harder work for the ring finger and small finger than for the rest of the fingers. It also requires the smallest and weakest forearm flexor muscles to initiate the squeezing motion. In addition, the handle places undue pressure in the carpal tunnel region of the palm. With repeated use, this can lead to discomfort and fatigue in the hand and wrist. The tool is sometimes clumsy to use and is not made for single-handed operation; it takes one hand to stabilize while the other to spread the handles apart, thus adding time to complete a given task.

Dr. Tillim invented a parallel handle system that moves the two sections toward each other to squeeze objects (see figure). As compared to the traditional design where pulling force can only be initiated by the small and ring fingers, this innovative design allows all fingers to pull simultaneously and more muscle power is recruited. The design also accommodates the anatomical shape of a hand and aligns the finger tips, enabling a stronger and more comfortable grip, and does not place undue pressure in the carpal tunnel region of the hand. The parallel system is applicable to a variety of surgical instruments and other tools and instruments as well.



3. *A handle system for power grip activities*³

Humans have the capability to hold, grasp, and move objects of various sizes, shapes and weight. Handles and handgrips are tools to assist these functions; however they present several problems. Common handles and grips are usually tubular and made of a single size. They tend to fill in the gap between the two most prominent muscles of the palm and put pressure in the carpal tunnel region. Due to individual variation in the length of long finger bones, finger tips do not always end at the same line when grasping tubular handles, resulting in deviation from the neutral posture of the hand, and creating awkward gripping posture that compromises grip strength. In addition, it results in the forearm muscles producing asymmetrical forces when pulling different parts of the fingers that are required to hold the handle or are required for forceful gripping. These disadvantages limit efficient use of the tool due to forearm muscle tension as well as stress in the finger and wrist joints, the carpal tunnel, the muscles in the hand, and the median nerve.

The third handle system Dr. Tillim developed is intended to prevent or reduce traumatic injury and mechanical strain to the hand due to repetitive or improper use of a tubular handle (see figure).

Design features are based on anatomical measurements of a gripping hand to facilitate efficient



functioning of the tool and to achieve optimal grip strength. With this feature, finger tips will also end at a single line and will compensate for differences in finger lengths, allowing the strongest muscles to do the most efficient job possible. Another added advantage of this design is that it allows more contact surface area with the hand and

therefore it requires less muscular exertion by the forearm. Furthermore, by leaving a gap over the median nerve, it avoids placing substantial external pressure on the carpal tunnel region. The ultimate goal is to promote functional efficiency during use of the hand tool and ensure comfort for the users with minimal stressful demands on the hand.

Dr. Tillim has approached OHSAH with interest in testing these prototypes within a healthcare setting. It is recommended that OHSAH do some initial research in the BC healthcare industry to determine the prevalence of hand injury due to the use of the tools, such as those described above. If the above outlined concerns warrant the implementation of control measures to reduce the risk of injury, then it may be worthwhile for OHSAH to pursue testing and evaluation of these designs further with Dr. Tillim.

Pipettes

MSIs and associated time loss are a significant and growing problem among laboratory technologists who are involved in pipetting work. Aside from the physical layout of the workstation that predisposes the workers to awkward upper body postures, the design of traditional pipettes is also a significant contributing factor to MSI in this occupation. Technologists are often required to work in awkward postures with the hand and wrist, a factor that is often overlooked when considering the ergonomic design of pipettes. Compounding the situation is the fact that, because of the repetitive nature of the tasks and high level of concentration required in the job as well as the time pressures imposed in a busy lab, taking mini-breaks and stretching to reduce the risks of MSI is often not possible, even though this is a common ergonomic recommendation.

Traditional pipettes require a firm grip around the barrel of the pipette, resulting in static grip and strain of the forearm muscles before pipetting begins. During pipetting tasks, the plunger located on the top of the barrel requires the thumb to extend, straining the ligaments and muscles from the first joint to the wrist. For tip ejection, the thumb is extended even further, and the peak force of the cycle is applied.

There are pipettes such as those supplied by BrandTech Scientific Inc⁴ (Transferpette[®]) whose design allows a relaxed handgrip throughout the pipetting procedure (See figure). The premise of the design is to reduce the awkward posture assumed by the thumb as well as the force required during ejection



of the pipetting tips. The latter aspect of the design is important because research has indicated that pipette design can influence applied thumb force and muscle activity.^{5,6} To hold the device when completing a single-channel pipetting task, the hand is extended in a hand-shaking position. The fingers are relaxed and gently curved, and the thumb is slightly elevated and extended forward. In this position, the pipette fits onto the hand, with the pipetting key located directly under the relaxed extended thumb. To eject the tips, the thumb sweeps slightly sideways, and applies the tip ejecting force using the stronger muscles within a short range of motion, potentially avoiding the strenuous position as used in traditional pipettes.

In pipetting tasks involving multiple channels, more force is often required to operate the pipette than a single channel pipette. This particular design of handgrip position offers the advantage of decreasing the amount of force exerted. The multi-channel pipettes are also designed with a hassle-

free tip loading mechanism that minimizes the occurrence of jamming during loading, allowing ease of tips ejection with a minimal amount of force exerted by the thumb.

Recently, a Lab and Safety Show hosted by Thermo Fisher Scientific exhibited the latest scientific products from across the world with participation from over 120 vendors. The show featured an innovative ergonomic design of pipettes emerging on the market today. Its unique design consists of a detachable handle and a pipette (see figure)⁴. The pistol-shaped handle not only has the benefit to accommodate different hand sizes of laboratory technologists, but it also enables activation of the device by alternatively flexing the index and middle fingers instead of flexing the thumb. When tasks are performed repetitively and forcefully with this type of handle, it was found that alternating between the index and middle fingers was effective in providing an optimal force required for activating a trigger⁷. Modifying the traditional pipette handle design is therefore a logical approach to minimizing awkward posture of the wrist and hand and reducing the amount of force necessary when dispensing liquid from the pipette and ejecting the tips.



Housekeeping in Healthcare

Housekeeping jobs in healthcare are physically demanding and may expose workers to several risk factors for the development of MSI. Tasks that may involve MSI risk factors include bed making, room or bathroom cleaning, and floor mopping.

The typical musculoskeletal issues faced by workers performing floor mopping tasks are associated with the design of cleaning tools that induce awkward postures of the trunk and the upper body as well as excessive bending of the wrist. The handle width and length of a mop play an important role in determining comfort and ease of use. An optimal handle width that accommodates different sizes of the hand will avoid excessive overlap of the thumb with the index finger and therefore allows comfortable gripping. Furthermore, an optimal handle length does not dig into the palm and avoids inducing awkward postures. A long straight handle restricts access to areas that are difficult to reach. It may require the worker to squat or kneel on the floor instead of using the tool, which is supposed to improve efficiency and lower the physical demands on the mopping task, rather than interfering with the task.

Redesigning a cleaning tool enables workers who perform floor mopping tasks to maintain a more upright posture, reducing the biomechanical load on the spine⁸. In a research study conducted by

Kumar et al⁸, a cleaning tool was redesigned in such a way that it was bendable at the upper, middle, and lower part of the handle, thus forming an arc. This design, although originally intended for train wagon cleaning, would be appropriate for use in a healthcare setting such as cleaning the upper walls of a bath tub and behind the toilet. The feature on the handle allows neutral wrist posture while mopping the floor as compared with conventional tool where flexion and extension of the wrist is needed. It was found that cleaners who participated in the study were required to bend less at the trunk when they used the redesigned tool. The study further suggested that when formulating user requirements for new cleaning tools, the development of ergonomic criteria or recommendations would be deemed necessary in enabling manufacturers to specify and evaluate usability qualities. Designers should always take ergonomics into account when redesigning any cleaning tools to address the MSI risk factors associated with the cleaning task.

Automated Pill Crusher and Medication Cart

In most healthcare settings, medications are prepared and delivered to patients several times per day, often requiring the pills to be crushed for those who have difficulty swallowing. Nurses have traditionally used manual pill crushing methods to crush pills. Common manual pill crushers consist of a metal head attached to a long lever arm, and are usually placed on top of a medication cart during medication distribution. The existing designs of both the manual pill crushers and current medication carts pose several MSI risks for those who perform these tasks on a regular basis.

The design of most manually operated pill crushers requires forceful exertions to push down on the lever arm. At the same time, the working surface height of the medication cart is designed primarily for precision tasks such as pill counting and sorting as opposed to the physical task of crushing pills. Repetitive movements are often required in order to meet the needs of medication delivery to a large number of patients. Nurses are therefore faced with an increased risk of MSI due to awkward postures, repetition, and forceful exertions on their job.

The two primary problems with medication carts are the height and weight of the carts. The height is a problem for shorter nurses when using the top working surface, such as crushing pills, as described above. The working surface height of most medication carts is in the range of 37" to 43". According to Grandjean⁹, this height is suitable for precision tasks such as reading, note taking, pill counting and pill sorting, but not ideal for the more physical task of crushing pills. Heavier work such as pill crushing should be done at a height of 28-35". Access to lower drawers is also an issue due to awkward postures of the trunk that are required and the weight is an issue for pushing and

maneuvering, especially when turning corners or if the medication cart must be moved suddenly out of the way of a resident in a wheelchair. Fully loaded medication carts weigh over 200 lbs¹⁰.

1. *OHSAH automated pill crusher*

To overcome the recognized pill crushing issues, OHSAH held a two-day workshop in October 2000 to discuss pill crushing and explore ways of addressing the concerns. Participants at the workshop included union and management representatives, front-line workers, and health and safety professionals from across BC. A key outcome of the workshop was collaboration between OHSAH and the British Columbia Institute of Technology (BCIT) Health Technology Research Group to research, design, develop, test, and commercialize a pill crushing prototype that addresses these concerns.

Automation of the pill crusher seemed to be the best way of eliminating physical risk factors. As a result, five automated prototypes were originally constructed and tested; however, only one successfully met all of the design requirements (see figure). This prototype consists of a rotating piston that simultaneously compresses and twists to crush the pills. To operate the device, pills are placed between two medication

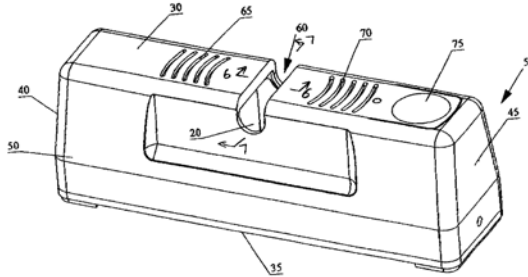


cups. The cups are then placed in the crushing chamber and the door closed. The crushing operation is started by pressing a button on the top portion of the housing. One crushing cycle takes approximately 7 seconds, during which time the operator can perform other duties such as preparing additional medications or chart writing. Depending on the type of pill, additional crushing cycles may be required. The device has multiple safety features to prevent fingers being accidentally crushed and also has a digital display to alert the operator of a low battery level.

Feedback was obtained through focus group settings with end users, and additional modifications were made. The prototype was then beta tested in 6 healthcare settings for a two month period. The next step in this project is to develop a relationship with a manufacturer to commercialize the design. Although unsuccessful to date, OHSAH continues to receive interest from manufacturers, and will continue to investigate a business partnership with them in an effort to commercialize the pill crusher while maintaining its affordability for healthcare facilities across the province.

2. PowderCrush from Manrex Ltd.¹¹

Another automated pill crushing device has recently been developed and patented for the purpose of eliminating the physical requirements of a pill crushing task (see figure). This particular invention offers the advantage of portability and can be placed on the medication cart or any other surface. A



transverse slot located on top of the pill crusher opens into a holding container to house pills that are stored in a plastic pouch, which can be manually inserted through the slot. The device is powered by rechargeable batteries, which drive two vertical plates toward one another within the holding container to provide

repeated impact and crushing of the pills. The frequency of impact is in turn controlled by the operator pressing on a manual switch and releasing when the crushed pills reach the desired consistency. This product is currently the only known automated pill crusher available to the healthcare industry.

3. OHSAH medication cart

A medication cart was developed by OHSAH in 2003 to address a number of concerns related to the operation of these devices, primarily height and weight. This medication cart is flexible and its automated height adjustable feature can accommodate most of the users in the general population without inducing awkward postures. Additionally, a fixed shelf situated at a lower height than the main work surface is intended for operation of a manual pill crusher if an automated pill crusher is not available for use. The medication cart further addresses other issues such as inadequate workspace by offering additional sliding shelves to free up working space on the top of the cart. The new design incorporates ergonomically correct handles and high-quality castors that improves maneuverability and minimize pushing forces required to move the medication cart.

OHSAH attempted to gain interest from potential medication cart manufacturers, but was unsuccessful, and has since ceased any further efforts on this initiative. However, since the fall of 2006, OHSAH has been approached by two companies who may be interested in manufacturing the product. Further discussions will occur in the coming months, and any significant updates will be posted on the OHSAH website.

Emerging Technologies in Disease Prevention

According to WorkSafeBC, there were 950 time-loss claims for injuries from needles and other sharps within the healthcare sector accepted between 1995 and 2004. Amongst these claims, 891 claims were from needlestick injuries¹². Typically, the average duration of time loss and the costs associated with these claims are low; however, the potential severity of the injuries are very high (i.e. contracting a blood borne pathogen such as HIV or Hepatitis C).

Safety Engineered Medical Sharps

WorkSafeBC has recently approved the proposed amendments to the British Columbia Occupational Health and Safety Regulation Part 6 (effective on January 1st, 2007) related to the use of safety engineered hollow-bore needles for vascular access; they are strictly enforced to address the risk of blood borne pathogen exposure for workers caused by injuries related to conventional hollow-bore needles. These changes require workplaces to protect workers against needlestick injuries from used needles by ensuring that safety-engineered needles are implemented and used across the province. Safety-engineered needles should be used whenever clinically appropriate, for collecting blood or accessing a vein or artery or while caring for or treating a person. Needleless devices may also be used when safe and appropriate. The requirements also state that employers must establish and implement safe work procedures and practices relating to the use of safety-engineered needles and needleless devices. The priority is on eliminating or minimizing potential exposure to blood borne pathogens or other biohazardous material¹².

Safety-engineered needles are specifically designed to protect workers against needlestick injuries as a result of unforeseen circumstances, unsafe work methods and/or improper disposal of devices following their use. There are many safe needle devices that are entering the market at a rapid pace today. Currently, they are more widely used in hospitals within the US than in Canada because regulations had not been established until recently regarding their implementation in Canadian hospitals. In general, safe needle devices can be categorized into two standard types: active and passive. The active design feature requires workers to activate the safety mechanism themselves, which means it is possible to use the device without the safety mechanism. The passive design feature, on the other hand, has a safety mechanism that deploys automatically, thus removing the extra step needed to activate the safety features. Variations in safety mechanisms are dependent on the types of devices used during procedures. Examples of the types of devices and their available safety mechanisms can be summarized as follows¹³:

1. *Syringes and injection equipment*

- Needleless: injection is given using the force of liquid under pressure to pierce the skin.
- Retractable needle: the needle is fused to the syringe and is spring-loaded; it retracts into the barrel when the plunger is completely depressed after the injection is given.
- Locking needle cover (©First Principles, Inc)¹⁴: a needle slides through a passage channel, while a resilient cover retracts to allow the needle to penetrate the skin. When the needle is withdrawn, the cover returns to its original extended position and is moved laterally to cover the needle tip and lock it into place.
- Protective sheath: the worker slides a cover over a plastic barrel or flips down a shield over the needle after giving an injection and locks it in place.
- Hinged re-cap: the worker flips a hinged protective cap over the needle after giving an injection and locks it in place. The cap may be fused with the syringe or come separate and detachable.

2. *IV Access – insertion equipment*

- Retractable: the spring-loaded needle retracts into the needle holder upon pressing a button after use or the needle withdraws into the holder when withdrawn from the patient's arm.
- Passive: a metal safety clip unfolds over the needle as it is withdrawn.
- Shielded IV catheters: a protective shield slides over the exposed needle.
- Hemodialysis safety fistula sets: a protective shield slides over the needle as it is withdrawn.
- Positive displacement design: utilizes an internal plunger to expel fluid when the Luer taper is removed to prevent fluid from being drawn back into the IV system.

3. *Blood-collection and phlebotomy*

- Retractable needle: the spring-loaded needle is retracted into the vacuum tube holder.
- Shield butterfly needle: a protective shield slides over the needle after use.
- Self blunting needle: the needle is blunted while still in the patient after use.
- Plastic blood collection tubes: used to replace glass tubes.

4. *Suture needles* – the needle is blunted after use.

5. *Lancets*

- Retracting lancet: sharp automatically retracts back into the device following skin puncture.

6. *Surgical scalpels*

- Retractable scalpel: the blade is withdrawn back into the body of the scalpel.
- Quick-release scalpel blade handles: a lever is activated that allows for a “touch-less” attachment of the blade to the handle and releases it after use.

The California Department of Health Services also provides detailed information on available safety engineered medical devices from specific manufacturers through a web-based device list. More information can be found at www.sharpslist.org.

Neutral zone compliance or Hands Free Technique

“Neutral zone” is defined as “a previously agreed on location on the field where sharps are placed from which the surgeon or scrub can retrieve them, so hand-to-hand passing of sharps is limited”. This is called a “Hands free technique”. OSHA has proposed this technique as a method to reduce healthcare workers’ exposure to BBF during operations¹⁵, and it has been recommended by the America College of Surgeons¹⁶ and the Association of Perioperative Registered Nurses¹⁷.

Passing sharp instruments during operational procedures could be a potential unsafe practice which can cause BBF related needlestick and sharp injuries. Using metal trays, magnetic pads, or transfer basins as a “neutral zone” to transfer surgery instruments among surgical team members will avoid passing sharps directly from one hand to another. This technique is considered a work practice control or administrative control, which requires group planning, education and training, clear communication, coordination, and practice as a team.

The Exposure Prevention Information Network (EPINet)

Recording and tracking data and evaluating injury trends are other means of reducing or eliminating blood and body fluid injuries and exposures to healthcare workers. Evaluation of data provides an excellent opportunity to pinpoint the types of injuries commonly experienced by healthcare workers so that proper control measures can be implemented accordingly. Currently, the most popular means of collecting blood and body fluid injuries and exposures data is the use of EPINet (The Exposure Prevention Information Network)¹⁸. This system was developed by Janine Jagger, M.P.H., Ph.D., and colleagues at the International Healthcare Worker Safety Center at the University of Virginia. First

introduced in 1992, more than 1500 hospitals in the US acquired it for use. It has also been adopted in other countries, including Canada, Italy, Australia, Spain, Japan and Brazil. EPINet has been translated into 14 languages and distributed to 43 countries.

WHITE/EPINet

In BC, EPINet has been integrated into the Workplace Health Indicator Tracking and Evaluation (WHITE™) database, which was developed by OHSAH to collect injury incident data among healthcare workers. Four of the six Health Authorities (two of which have had safety- engineered needle programs already implemented) use the software to track exposure incidents. A fifth Health Authority is currently working with OHSAH to implement the system. The initiative is a collaborative effort between OHSAH, University of British Columbia researchers, and the health authorities to facilitate analysis of workplace incidents and injuries as well as provide healthcare stakeholders with comparative performance indicators on workplace health and safety. WHITE EPINet™ blood and body fluid exposure data includes: descriptions of incidents; demographics of the workplace and injured worker; contributory factors related to location and circumstance of injury; nature of injury, body part involved, type of device, etc.

New Technologies in Violence Prevention and Working Alone

Violence is an escalating problem in both the public and private sectors. Aggressive and violent behaviour directed at healthcare workers is common. From 2001 to 2005, 9% of WorkSafeBC claims in the BC healthcare industry were related to workplace violence. According to the 2006 Statistics Canada National Survey of Work and Health of Nurses¹⁹, 29% of nurses providing direct care said they had been physically attacked by a patient in the previous year and more than 40% had been emotionally abused by a patient. Nurses, care aides, community healthcare workers (CHW), and workers in residential care are among the most likely to encounter aggressive behaviour.

In response to these increased violent incidences, Sydney Stanners of CELPHINDER Technologies Inc. has invented the CELPHINDER Work Alone System. It is a wireless technology that helps protect workers who are at risk of becoming victims of workplace violence. Although initially designed at the request of social service workers, CELPHINDER Work Alone System is applicable to a wide spectrum of occupations and will offer tremendous safety and security measures to various groups of healthcare workers who work alone or are required to travel to secluded locations and provide client care and/or treatment.

The CELPHINDER Work Alone System comprises two separate electronic components: a cellular telephone and a triggering device. The mobile phone enables healthcare workers to report relevant information on all their assignments for the day through a message recording system. When workers are involved in a potential or actual violent situation, they activate the triggering device immediately without a client's knowledge. The triggering device is small enough to fit in a pocket and may be worn by the worker as a watch, bracelet, belt buckle, etc. This action relays previously recorded information such as the location of the worker and a physical description of the worker, from the cellular phone to an external monitoring station. The monitoring station then notifies police officials for immediate assistance and rescue. The system is designed to cycle within two minutes.

The CELPHINDER system is designed specifically to address safety issues in workplace environments where workers are involved in life-threatening situations due to violence and aggression. The safety features available from this innovative technology are particularly beneficial to healthcare workers. It gives workers a degree of peace of mind when they are required to meet with clients in their homes or work alone in isolated locations. The electronic components transmit accurate information without delaying intervention by police. The triggering device is simple to use, as only a click of the button is required. But more importantly, it can be done so in a secretive manner without alerting the clients and aggravating the severity of the situation. The time elapsed gives the workers an opportunity to diffuse the situation or concentrate on defending themselves, rather than frantically attempting to call for help or leave the premises.

On February 26th, 2007 the CELPHINDER technology was exhibited at the Home and Community Care Conference sponsored by OHSAH. Feedback from participants indicated that they would like OHSAH to help develop a universal system (common call center) based on a technology like the CELPHINDER for CHWs across BC for the purpose of quick response to incidents of violence and emergencies as well as to potentially fulfill working alone or in isolation check-in protocols. Sydney Stanners is currently seeking to establish partnerships with manufacturers so that the device can be available to the market. Due to a high interest from the home and community care community in moving this forward, it is recommended that OHSAH work with Sydney Stanners to assist in the testing and evaluation of this product with the Health Authorities and affiliate home and community care facilities in BC in hopes of making this technology available to the industry in the near future.

New Technologies in Home and Community Healthcare

Community Health Workers work in the homes of clients (patients), assisting with activities of daily living. As their workplace is the client's home, the CHW is faced with unique health and safety challenges. Transferring and repositioning clients, which CHWs experience on a daily basis, produces considerable stress to the spine and the upper limbs. In the event that a client is unable to weight-bear or unexpectedly collapses, the CHW experiences an even greater risk of injury.

In response to this concern, the research team at the BCIT Technology Center developed an innovative manual ceiling lift device focused on reducing MSIs in CHWs. It was realized that mechanical lifting devices, which have been repeatedly shown to reduce risk of injury to healthcare workers, are more often found in hospitals, nursing homes and institutional settings than in clients' homes. Presently, most of the available lift devices are prohibitively expensive and are often inappropriately designed for home use. The intent of this novel design was to provide a less expensive ceiling lift alternative for home care clients (as they are responsible for the costs associated



with implementing assist devices in the home) and to improve the health and safety of home support workers by eliminating or at least minimizing the need to complete manual client handling activities in a home environment. The lift is compatible with commercially available sling and ceiling lift tracts. It meets the industry standard and the necessary requirements for fatigue strength. It has a pair of

folding arms to suspend the sling and handles that allow ease of carrying and transporting from place to place. An ergonomic chain initiates the raising and lowering mechanisms of the lift and the drive mechanism has a one-way roller bearing that minimizes the amount of noise produced. Furthermore, safety features are incorporated into the design such as a magnetic clutch to ensure that the lift can withstand no more than 400lbs.

Currently, a US patent has been granted for various elements of the lift device and the Technology Commercialization Office is negotiating the licensing of these technologies with a lift manufacturer so that the lift can be accessible to community health workers in Canada, the US and in other global markets. The invention shows promise in the community health sector simply because the device

costs approximately half the price of currently available automated lift devices in the market and it is affordable for most clients.

Conclusion

This report summarizes recent innovative technologies within the area of occupational health and safety; several technologies in ergonomics, disease prevention, violence and working alone, and home and community care have been identified and briefly described along with their associated benefits to mitigate the risks of injuries in the healthcare sector. The preliminary research conducted gives insights into potential new initiatives for OHSAH, which may include establishing partnerships with Dr. Tillim and Sydney Stanners in pilot testing and evaluating their prototype products. The necessities of their applications in the BC healthcare industry, however, merit further research to identify the extent to which frontline BC healthcare workers will benefit from the use of these technologies.

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