

A faint, light blue ECG (heart rate) line is visible in the background, running horizontally across the page. It features several distinct peaks and troughs, typical of a cardiac rhythm tracing.

PROVINCIAL GUIDELINES FOR ADULT SPINAL CORD ASSESSMENT

Neurosurgery Education and Outreach Network (NEON)
Version 1.0 | Critical Care Services Ontario | May 2016

**This document is a product of
Critical Care Services Ontario (CCSO)**

The *Provincial Guidelines for Spinal Cord Assessment* are the result of a collaborative effort between CCSO, the Neurosurgery Education and Outreach Network (NEON) and Provincial Neurosurgery Ontario. CCSO supports system-wide improvements for Ontario's neurosurgical services through education and outreach across neurosurgical and non-neurosurgical centres. Aligned with the work of Provincial Neurosurgery

Ontario, the goal of the guideline is to increase the knowledge and expertise of Ontario's nurses to support equitable and timely access to neurosurgical care and to help maintain the province's neurosurgical capacity.

How to Use This Document

This document provides direction for bedside spinal cord testing to ensure consistency within and across organizations. It was developed by a sub-group of clinical neurosurgical nurses and neurosurgical educators for Registered Nurses (RN) across Ontario that assesses patients' neurological status. These Guidelines are not meant to be exhaustive and its contents are recommended but not mandated for use. The Guidelines have been reviewed and approved by the Provincial Neurosurgery Ontario stakeholder board. RNs should use their clinical judgment and utilize other assessment parameters if determined necessary.

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Disclaimer: The contents of these guidelines may change over time. Clinicians and hospital administrators should use sound judgment for individual patient encounters. Critical Care Services Ontario and Provincial Neurosurgery Ontario strongly recommend evidence-based practices.

Acknowledgements

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*Please see **Appendix 1** for a list of the Neurosurgery Education and Outreach Network membership*

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Critical Care Services Ontario | May 2016

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Introduction

In 2011, the Ministry of Health and Long Term Care committed 66 new nursing positions, including 22 Clinical Neurosurgical Outreach Nurse and Neurosurgical Nurse Educator positions, to support the management of specialized paediatric and adult neurosurgical patients.

The Neurosurgery Education and Outreach Network (NEON) was established in May 2013 to work in collaboration with Provincial Neurosurgery Ontario to support the educational component of recommendations to better integrate access to neurosurgical services in the province. Originally comprised of Nurse Educators and Program Directors from each of the province's adult neurosurgical centres, their work formed the foundation for an educational outreach program designed to provide a wide breadth of education to non-neurosurgical centres on neurosurgical patient's care across the continuum. The expanded network has grown to include Clinical Nurse Specialists, Advanced Practice Nurses and Nurse Practitioner's working in both adult and paediatric neurosurgery.

In parallel, the Ministry requested Critical Care Services Ontario (CCSO) to lead a planning process to develop a comprehensive neurosurgical system to meet the needs of adult and paediatric patients across Ontario. The advisory committee was co-chaired by Dr. Robert Bell, then President and CEO, University Health Network and Dr. James T. Rutka, Chair, Department of Surgery, University of Toronto. Their efforts resulted in a final report (December 2011) which outlined recommendations aimed at improving the access, quality and responsiveness of neurosurgical care. These recommendations are being implemented by the Provincial Neurosurgery Ontario committee supported by Critical Care Services Ontario (www.criticalcareontario.ca).

About this Document

These Guidelines were developed by the provincial Neurosurgery Educator and Outreach Network (NEON) to document the processes associated with performing an assessment of the spinal cord function, in patients with a potential or actual acute spinal cord injury (SCI). The Guidelines provide direction for local development of bedside spinal cord assessment or testing (SCT) protocols, in order to enhance existing skills and to ensure consistency of SCT within and across different organizations. For the individual patient, this provides a baseline from which changes in the patient's spinal cord function may be identified, reported, and managed in a timely manner.

Registered Nurses (RN) assess patients' spinal cord function as per physician order and as needed. The frequency of SCT depends on the severity of the patient's illness as well as his/her underlying condition. The physician orders the frequency of SCT depending on the extent of the injury and potential for worsening of the injury. The RN should use his or her clinical judgment to determine the need for an increase in the frequency of SCT and whether observations should be expanded to include other assessment parameters.

The accurate and precise performance of SCT has important implications for patient care. It provides a snapshot in time of the patient's spinal cord function and establishes a baseline. Changes from this baseline may indicate deterioration in the patient's condition, necessitating an increase in the frequency of monitoring, and the notification of the most responsible physician. In order to improve the accuracy and decrease variability in the SCT related to an individual staff's perception of patient response to applied stimuli, it is recommended that observations during a particular shift are performed primarily by the same RN/health care provider.

The patient's neurological status is assessed according to and documented on a SCT record or an equivalent patient care record, providing a concise and accurate record of the assessment. It is suggested that institutions develop a SCT record for documenting the assessment. The SCT should at a minimum include a motor and a sensory assessment. In addition, depending on the completeness and level of the SCI, a number of important body functions related to the autonomic nervous system may be affected. These functions include vital signs, bowel and bladder function. A number of other systems may be affected by a SCI and the result of immobility. However the comprehensive care of the SCI patient, such as levels of respiratory and cardiovascular support, prophylaxis of thromboembolic complications, skin care, mobility, and psychosocial support, is beyond the scope of this document.

SCT may yield inaccurate results on patients who are unable to follow commands appropriately (e.g. in patients who are intubated, sedated, confused, language barrier). In this case, the RN should document in the nursing notes the reason the SCT may be inaccurate or could not be performed and any details of spontaneous movements that are observed. Portions of the basic neurological assessment (Glasgow Coma Scale, limb movement and strength) can be used to establish some movements and responses to painful stimuli. A decrease of movements in this patient population may be an indicator of a progression of the injury, and should be reported to the physician right away.

Note: These Guidelines are for adult SCT only.

Definitions

Spinal Cord Injury

Spinal cord injury results from compression or severing of the spinal cord due to for example spinal cord trauma, vertebral fractures, expanding hematomas, disc herniation, spinal tumors or epidural abscesses (Tymianski, 2012). This may result in temporary or permanent loss of sensory, motor or autonomic functions below the level of the injury (Tymianski, 2012). The severity of this loss of function depends on the level of the injury and whether or not the injury to the spinal cord resulted in incomplete or complete injury.

Spinal Cord Testing

Spinal cord testing is an assessment of the sensory, motor and autonomic function of the spinal cord. The American Spinal Injury Association (ASIA) and International Spinal Cord Society have published an assessment tool called the International Standards for Neurological Classification of Spinal Cord Injury (ISNCSCI) which is available from the [American Spinal Injury Association learning centre](#) (American Spinal Injury Association, 2015). Information obtained from this extensive motor and sensory assessment (American Spinal Injury Association, 2008). is used to classify the severity of a spinal cord injury according to the ASIA Impairment Scale (AIS). The AIS rates the injury between a Category A (complete motor and sensory loss) and Category E (no impairment). The calculation of the score is described on the second page of the ISNCSCI.

A number of different SCT tools have been developed based on the ASIA tool, but simplified for ease of use at the bedside (Tymianski, 2012). They should at a minimum include:

- Motor Assessment: Different levels of the spinal cord correspond with different muscles (myotomes); therefore testing the function of these muscles provides information on the location of a SCI.
- Sensory Assessment: Different levels of the spinal cord correspond with different areas of the skin (dermatomes); therefore testing the sensation of these areas provides information on the location of a SCI.

Autonomic functions commonly affected by SCI

A number of homeostatic responses can be affected by a SCI. The extent of these changes are related to the timing of the injury (acute versus chronic), the level of the disability and the completeness of the injury. Some changes can result in discomfort for the patient, while some can be life threatening. Therefore signs & symptoms of these deficits should be part of the assessment of the SCI patients. The changes include:

- *Heart rate & blood pressure:* A decrease/loss in sympathetic outflow from the level of T1-L2 can result in systemic peripheral vasodilation with hypotension and bradycardia, due to an unopposed vagal response. This is typically seen in patients with SCI at the level of T6 or above, and can result in neurogenic shock (Tymianski, 2012). Although it may occur simultaneously, neurogenic shock should not be confused with spinal shock. Spinal shock is a transient physiologic depression of spinal cord function below the level of injury, leading to loss of all sensorimotor function, decreased reflexes, and flaccid paralysis below the level of the injury. Symptoms typically last from hours to days until the reflex arches below the level of injury begin to function again (Tymianski, 2012).

- *Temperature:* The inability to constrict blood vessels, due to a decrease sympathetic outflow, may also affect the patient's ability to maintain normal body temperature (Tymianski, 2012).
- *Respiratory function:* Depending on the level of a spinal cord injury, the respiratory function may be affected to a varying degree. A SCI at the level of C1-4 usually results in the loss of the function of the phrenic nerve, which innervates the diaphragm, and mechanical ventilation is needed. Injuries from C5-T6 results in varying impairment of the intercostal muscles with a decrease in the patient's vital capacity and ability to clear airway secretions. Varying degrees of ventilator support and assistance with clearance of airway secretions are needed. Injuries below the level of T6 usually do not impair respiratory function (Hickey, 2009).
- *Bowel & Bladder function:* A SCI at any level can impair the normal function of the bowel and bladder resulting in constipation, urinary retention or inability to control either bowel or bladder function (Hickey, 2009). A distended bladder or bowel is the most common cause of autonomic dysreflexia (AD*).

* AD is a potentially life threatening condition affecting patients with SCI at or above the level of T6, which usually occurs after spinal shock has subsided. It is caused by an excessive autonomic response to a stimulus below the level of the injury, resulting in a considerable sympathetic response below the level of injury, and a parasympathetic response above the level of injury (Hickey, 2009). This results in an uncontrolled increase in blood pressure and bradycardia, additional signs & symptoms, may include headache, anxiety, blurred vision, chest tightness, arrhythmias, seizures, blushed skin above the level of injury, and cold skin below the level of injury. The initiating stimulus is frequently a distended bladder or bowel, but can also be caused by other noxious stimuli (Tymianski, 2012). Prevention is the best way to avoid AD (Hickey, 2009).

Procedures

Motor Assessment

- Use the motor grading scale to grade and document motor strength (see Table 1)
- Assess motor strength bilaterally (each level should be tested bilaterally before proceeding to next level). If there is a difference between right and left indicate so on the SCT record.
- SCT is usually done with the patient in the supine position (can be done sitting). Begin each segment to be tested by asking the patient to put the limb in motion.
- If the patient is able to move the limb through the full range of motion they are usually graded a 3.
- Apply mild resistance, using only one or two fingers, to attempt to return the limb to its original position. If you are able to return the limb to the original position then they remain a 3, if they are able to resist you, then they are graded a 4.
- Now apply full resistance, using your hand, if you are able to return the limb to the original position then they remain a 4, if they are able to resist you, then they are graded a 5 (normal power).
- If the nurse is unable to test a muscle group due to pain, fractured limb, splint/cast etc. he/she is to document NT (not testable) on the SCT record and provide follow up documentation in the interdisciplinary note section.

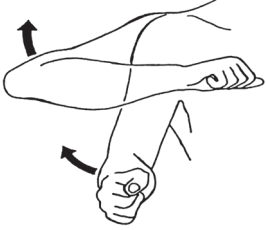




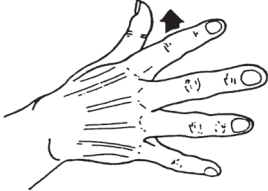
Table 1: Motor Grading Scale

Grade	Motor Grading Scale
Grade 0	Total paralysis
Grade 1	Palpable or visible contraction
Grade 2	Active movement gravity eliminated
Grade 3	Active movement against gravity
Grade 4	Active movement against some resistance
Grade 5	Active movement against full resistance

(American Spinal Injury Association, 2015)

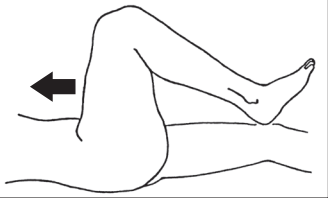
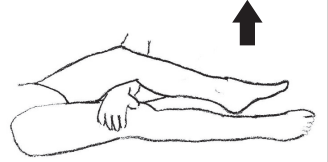
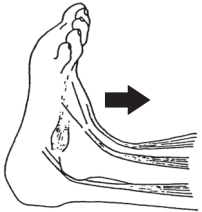
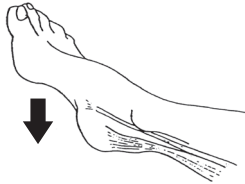
For examples of motor testing, see figure 1 and figure 2.

Figure 1: Example of motor assessment of upper limbs.

SPINAL TESTING: UPPER EXTREMITIES	
<p>C5 Shoulder Abduction (Middle Deltoid) <i>Starting Position: Patient supine, examiner at head of bed facing patient's feet, one hand under scapula, thumb on top of shoulder.</i></p> <p>0 No contraction palpated over the lateral aspect of shoulder.</p> <p>1 Contraction palpated/flicker seen or incomplete range of motion.</p> <p>2 Full Range of Motion: Active abduction to shoulder level (may allow elbow to bend).</p> <p>3 One finger mild resistance above elbow.</p> <p>4 Two finger moderate incomplete range of motion.</p> <p>5 Whole hand full resistance.</p>	
<p>C5, C6 Elbow Flexion (Biceps, Brachialis) <i>Starting Position: Patient supine, palm up, examiner stabilizing above elbow.</i></p> <p>0 No contraction palpated on inside of forearm above elbow.</p> <p>1 Contraction palpated or flicker seen.</p> <p>2 Incomplete range of motion.</p> <p>3 Full Range of Motion: Hand comes up to shoulder.</p> <p>4 Two finger moderate resistance above wrist.</p> <p>5 Whole hand full resistance.</p>	
<p>C7 Elbow Extension (Triceps) <i>Starting Position: Patient supine, elbow pointed at ceiling, hand beside ear, examiner supporting elbow.</i></p> <p>0 No contraction palpated on back of arm above elbow.</p> <p>1 Contraction palpated or flicker seen.</p> <p>2 Incomplete range of motion.</p> <p>3 Full Range of Motion: Extension of arm towards ceiling so elbow is straight.</p> <p>4 Two finger moderate resistance above wrist.</p> <p>5 Whole hand full resistance.</p>	
<p>C7 Wrist Flexion (Flexor Carpi Radialis & Ulnaris) <i>Starting Position: Patient supine, palm up, examiner stabilizing above wrist.</i></p> <p>0 No contraction palpated on inside of forearm below elbow.</p> <p>1 Contraction palpated or flicker seen.</p> <p>2 Incomplete range of motion and palpable contraction.</p> <p>3 Full Range of Motion: Hand pulls up to face.</p> <p>4 Two finger moderate resistance on palm of hand.</p> <p>5 Whole hand full resistance.</p>	
<p>C6 Wrist Extension (Extensor Carpi Ulnaris, Radialis Longus & Brevis) <i>Starting Position: Patient supine, palm down, examiner stabilizing above wrist.</i></p> <p>0 No contraction palpated below elbow on top of forearm.</p> <p>1 Contraction palpated or flicker seen.</p> <p>2 Incomplete range of motion.</p> <p>3 Full Range of Motion: Hand pulls up to face.</p> <p>4 Two finger moderate resistance on back of hand.</p> <p>5 Whole hand full resistance.</p>	
<p>C8/T1 Finger Abduction (First Dorsal Interosseous) <i>Starting Position: Patient supine, arm straight, hand turned so thumb is up, examiner stabilizing bottom three fingers.</i></p> <p>0 No contraction palpated over fleshy part of web space between the thumb and the index finger</p> <p>1 Contraction palpated or flicker seen.</p> <p>2 Incomplete range of motion.</p> <p>3 Full Range of Motion: Index finger elevates fully towards ceiling.</p> <p>4 One finger mild resistance to tip of index finger.</p> <p>5 One finger moderate resistance.</p>	

(London Health Sciences Centre, 2012)

Figure 2: Example of assessment of lower limbs.

SPINAL TESTING: LOWER EXTREMITIES		
L2 Hip Flexion (Iliopsoas)		
<i>Starting Position: Patient supine, examiner's hand placed on patient's opposite hip.</i>		
0 No contraction palpated over the lateral aspect of the groin.	3 Full Range of Motion: Able to bend the hip to 90°.	
1 Contraction palpated or flicker seen.	4 Two finger moderate resistance above knee.	
2 Incomplete range of motion.	5 Whole hand full resistance.	
L3 Knee Extension (Quadriceps)		
<i>Starting Position: Patient supine, examiner lifts patient's knee 8 - 10" off the bed and maintains support under the knee with his/her forearm.</i>		
0 No contraction palpated a hand's breadth above the knee.	3 Full Range of Motion: Able to fully straighten knee.	
1 Contraction palpated or flicker seen.	4 Two finger moderate resistance above ankle.	
2 Incomplete range of motion.	5 Whole hand full resistance.	
L4/5 Ankle Dorsiflexion (Tibialis Anterior)		
<i>Starting Position: Patient supine, examiner supports under the leg proximal to the ankle so the heel is off the bed.</i>		
0 No contraction palpated on lateral aspect of shin below the knee.	3 Full Range of Motion: Pulls toes up towards nose.	
1 Contraction palpated or flicker seen.	4 Two finger moderate resistance on top of foot.	
2 Incomplete range of motion.	5 Whole hand full resistance.	
S1/2 Plantarflexion (Gastrocnemius, Soleus)		
<i>Starting Position: Patient supine, examiner supports under the ankle lifting heel off bed, other hand placed on sole and maintains full dorsiflexion.</i>		
0 No pressure felt by hand on sole of the foot.	3 Full foot pointing against mild resistance.	
1 Contraction palpated/flicker seen above the heel or incomplete range of motion.	4 Full foot pointing against moderate resistance.	
2 Full Range of Motion: Full foot pointing.	5 Not applicable due to supine position.	

(London Health Sciences Centre, 2012)

Documentation of Motor Assessment

The responses to motor testing are documented separately for the left and right side. The placement of an asterisk (*) or other institutional specific indicators on the SCT record, can be used to indicate that further documentation is included in the nursing/interdisciplinary notes. For example see figure 3:

Figure 3: Example of documentation of motor function.

SPINAL TESTING RECORD Patient Name & PIN #: _____

COMPLETE RELEVANT DATA. LEAVE OTHERS BLANK.
 * = See Significant Findings WDL = Within Defined Limits Document Vital Signs on Graphic Record. Document Intake and Output on Fluid Balance Record.

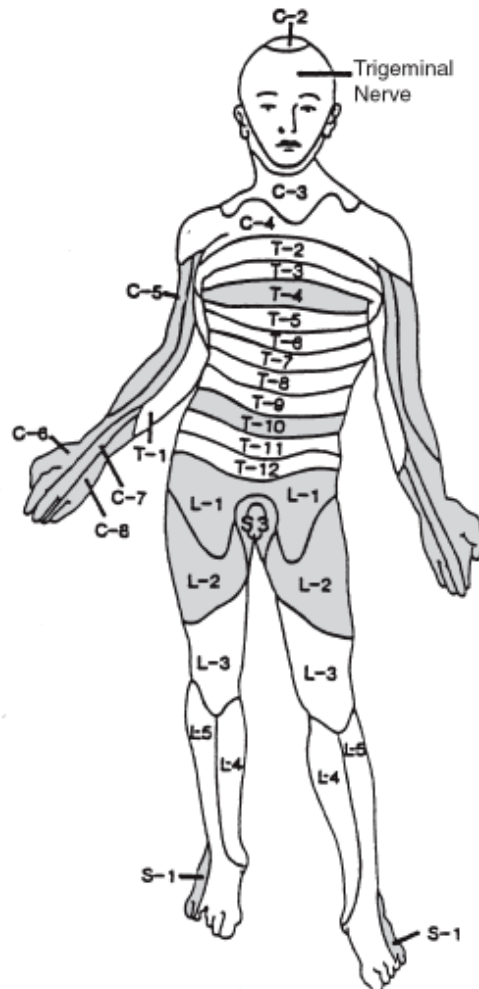
DATE:																									
TIME:																									
UNIT:																									
MOTOR FUNCTION:		R	L	R	L	R	L	R	L	R	L	R	L	R	L	R	L	R	L	R	L	R	L	R	L
U P P E R	SHOULDERS ABDUCTION (C5)																								
	ELBOWS FLEXION (C5, C6)																								
	EXTENSION (C7)																								
	WRISTS FLEXION (C7)																								
	EXTENSION (C6)																								
FINGERS ABDUCTION (C8, T1)																									
L O W E R	HIPS FLEXION (L2)																								
	KNEES EXTENSION (L3)																								
	FEET DORSI FLEXION (L4, L5)																								
PLANTAR FLEXION (S1, S2)																									

(London Health Sciences Centre, 2012)

Sensory Assessment

- Patient should be tested with eyes closed.
- The sensation of each dermatome (figure 4) is tested by the application of two different sensory stimuli, pin prick and light touch (American Spinal Injury Association, 2015) although some abbreviated SCT tools only test select dermatomes and with pinprick only (London Health Sciences Centre, 2012., St-Michael's Hospital, 2002., Sunnybrook Health Sciences Centre, 2005., Windsor Regional Hospital, 2011)
- Use a sterile safety pin to assess pin prick, discard after each testing. Use a cotton tip applicator for light touch.
- Never apply enough pressure to draw blood.
- Explain the procedure to the patient and establish a baseline for the sensation by touching the pin and the cotton tip applicator to their cheek so they can reliably distinguish between normal and abnormal sensation.
- Complete testing of sensation of all dermatomes to soft touch, before starting testing with pin prick. The order of testing doesn't matter.

Figure 4: Dermatome distribution



(Sunnybrook Health Sciences Centre, 2005)

Documentation of Sensory Assessment

The patient sensation to pinprick and light touch is documented on the SCT record. Although ASIA guidelines for SCT recommend documenting sensation as normal, abnormal or absent (American Spinal Injury Association, 2015), some organizations document normal or abnormal (University Health Network, 2003), or simply the lowest level with normal sensation. Any abnormal sensation the patient is experiencing e.g. burning, tingling, pins and needles, or numbness can be also documented in the nursing/interdisciplinary notes and indicated by the placement of an asterisk (*) or other institutional specific indicators on the SCT record. For example of sensory testing documentation see figure 5.

Figure 5: Example documentation of sensory testing.

Spinal Cord Testing Record													
Sensory testing													
Date: _____													
Legend:													
0= absent sensation													
1= abnormal sensation													
2= normal sensation													
LT= light touch													
PP= pin prick													
Time													
Dermatome	Right		Left		Right		Left		Right		Left		
Stimulus	PP	LT	PP	LT	PP	LT	PP	LT	PP	LT	PP	LT	
C5-upper lat. arm													
C6-thumb													
C7-middle finger													
C8-little finger													
T4-nipple line													
T10-umbilicus													
L1-groin													
L3-anterior thigh													
S1-sole of foot													
S3-5-perianal													

(Sunnybrook Health Sciences Centre, 2005)

Vital Signs Assessment & Documentation

Vital signs including heart rate, blood pressure, respiratory rate, oxygen saturation, and temperature should be obtained as ordered by physician and documented in the patient care record as per institutional practice. In some institutions the measurement of vital capacity (maximum volume of air that a person can exhale after maximum inhalation) is part of the respiratory assessment of the SCI patient (Sunnybrook Health Sciences Centre, 2005). The vital capacity measurement should be ordered by the physician and is usually obtained by the respiratory therapist.

Bowel & Bladder Assessment & Documentation

Particular attention should be paid if there are any changes in urinary function e.g. losses of continence or a new inability to void, since this can be a sign of progression of the SCI. After spinal shock has subsided bowel and bladder function is particularly important, since a distended bladder due to a blocked urinary catheter, or full bowel can result in an episode of AD. Bowel and bladder function should be documented in the patient care record as per institutional practice.

Notify the physician immediately when there is a decrease or loss of motor function or sensation OR if there are any changes in urinary function. The RN should increase frequency of assessment while acute changes are happening.

Appendix 1: Neurosurgery Education and Outreach Network Membership

Name	Representation	Organization
Sean Hopkins (Co-Chair)	Neurosurgery Nurse Educator	Windsor Regional Hospital - Ouellette site Windsor
Lisa Beck (Co-Chair)	Administrative Director	Thunder Bay Regional Health Sciences
Brenda Bousfield	Neurosurgery Nurse Educator	Hamilton Health Sciences
Jennifer Phillipchuck	Clinical Outreach Specialist	Hamilton Health Sciences
Kristen Postma	Clinical Outreach Specialist	Hamilton Health Sciences
Louise Macrae	Administrative Director	Hamilton Health Sciences
Lisa Weiler	Neurosurgery Nurse Educator	Health Sciences North
Karin Ruddy	Clinical Outreach Specialist	Health Sciences North
Lindsay Roach	Clinical Outreach Specialist	Health Sciences North
Debbie Gray	Administrative Director	Health Sciences North
Marnie Cranston	Neurosurgery Nurse Educator	Kingston General Hospital
Nicole Chenier-Hogan	Clinical Outreach Specialist	Kingston General Hospital
Richard Jewitt	Administrative Director	Kingston General Hospital
Kimberly Salway	Clinical Outreach Specialist	London Health Sciences Centre
Jill Craven	Administrative Director	London Health Sciences Centre
Jean Morrow	Neurosurgery Nurse Educator	London Health Sciences Centre
Monica Olanski	Administrative Director	London Health Sciences Centre
Tina Petrelli	Paediatric Clinical Outreach Specialist	McMaster Children's Hospital
Denise Ouellette	Neurosurgery Nurse Educator	St. Michael's Hospital
Chrisanthi Lefkimmatis	Clinical Outreach Specialist	St. Michael's Hospital
Sonya Canzian	Administrative Director	St. Michael's Hospital
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Debra Carew	Administrative Director	Sunnybrook Health Sciences
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Jennifer Payne	Neurosurgery Nurse Educator	The Ottawa Hospital
Dianna Hughes	Clinical Outreach Specialist	The Ottawa Hospital
Fred Beauchemin	Administrative Director	The Ottawa Hospital

Name	Representation	Organization
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Kim Belluz	Clinical Outreach Specialist	Thunder Bay Regional Health Sciences
Marcella Veenman-Mulde	Clinical Outreach Specialist	Trillium Health Partners
Beverly Espedido	Neurosurgery Nurse Educator	Trillium Health Partners
Dawn Tymianski	Clinical Outreach Specialist	University Health Network
Janet Newton	Administrative Director	University Health Network
Charmaine Arulvarathan	Neurosurgery Nurse Educator	University Health Network
Janet Reddam	Administrative Director	Windsor Regional Hospital - Ouellette site Windsor

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