2014 BCAS Paramedics Ergonomics Report

Version 2

Prepared by: Workplace Health, PHSA

Presented to: BCAS Senior Operations & PHSA Executive

Department: BCEHS - BCAS

Occupation: Paramedic

Location: Based on data from Metro Area, Vancouver

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Executive Summary:

In response to increasing paramedic injuries, WorkSafeBC issued an order to review paramedic duties (April 2013) and implement controls to reduce musculoskeletal injuries (MSIs). This ergonomics project was initiated in response to this order, and to protect the health and careers of working paramedics. As of January 2014, the WSBC claims costs related to patient handling activities are estimated to be $2.3 million for injuries occurring in 2012. Furthermore, the WSBC premium rate has more than tripled since BCAS switched to a Rateable Classification Account in 2010; it is predicted to more than double over the next five years. BCAS paid $2.2 million in premiums in 2013.

A review of musculoskeletal injuries (MSIs) from the year 2012 [1]identified the top eight activities to which ergonomics related injuries were attributed. These activities are presented below in decreasing order of claims costs (see appendix D for activity pictures and definitions):

1. Lift and lower patient on stretcher
2. Manually lift patient without equipment
3. Lift and carry patient on clamshell
4. Unload and load stretcher with patient from/into ambulance
5. Lateral patient transfer
6. Lift and carry patient on chair cot
7. Reposition patient on stretcher
8. Prevent patient from falling

A physical ergonomics assessment of the activities confirmed that they are associated with high levels of risk. Force is the predominant risk factor in all of the activities, although in the case of preventing a patient from falling the unexpected nature of the force is also important.

Due to the high magnitude of the forces typically involved (i.e. the weight of adult human beings), elimination or substantial reduction of required forces using mechanization is the only realistic way to make significant improvements. Key control recommendations which address the top six categories, representing 97% of these claims costs, include investigation of the following:

- Power stretchers - to mechanize raising and lowering stretchers
- Power loading system - to mechanize loading of stretchers into the ambulance
- Evacuation HoverJack - to mechanize raising patients from ground level, with or without clam shell
- Utilization of transfer aides - for patient lateral transfers (e.g. HoverMatt, patient lift, slider board)
- Powered chair cot accessory - to mechanize transporting patients up and down stairs

Organizational factors, such as training and work design, practices and procedures, shift schedules and work culture were also considered. Organizational factors are known to influence injury rates as well as mental and physical health and performance and further assessment of such factors may be undertaken at a future date.

Additional recommendations include

- Review of training and associated demonstration of knowledge transfer
- Review of policies and procedures
- Health Promotion initiatives
- Inclusion of ergonomics in ambulance design
- Equipment preventative maintenance

[1] 2012 was the most recent year injury data available at the outset of this project, during the Risk Identification stage.

JOB DESCRIPTION:

Paramedics provide emergency medical assistance and lift support for patients who have been acutely injured in the field. Paramedics work in pairs on each ambulance alternating between driver and attendant. There are many types of paramedics (Emergency Medical Responder (EMR), Primary Care Paramedic (PCP), Advanced Care Paramedic (ACP), Critical Care Transport (CCT), and Infant Transport Team (ITT). This assessment focusses on PCPs, who make up 69% of the provincial paramedic population. BCAS has 512 ambulances working out of 191 stations across the province.

The work of paramedics involves manual handling of patients, such as lifting patients from the ground, lifting patients on stretchers, laterally transferring patients, assisting patients from sitting to standing positions, and assisting ambulatory patients walking.

Shifts are generally 11 or 12 hours in duration (2 days and 2 nights on, 4 days off), and paramedics take breaks as work demands permit.

Paramedics generally begin their careers by working part-time, often in rural areas where competition for jobs is lower. When seniority permits, they often transfer to the Lower Mainland, where they continue to work on call and part-time, working out of various stations with various partners. Typically it takes two to four years to find a full-time “Irregular” position in which paramedics work full-time hours, but remain on-call, float around various stations, and do not adhere to typical schedules. After a period of time, based on seniority, paramedics move to full-time positions with regular hours at a permanent station. Overtime is not uncommon.

BACKGROUND:

Musculoskeletal injuries (MSIs) account for the largest proportion of injuries among paramedics. BC Ambulance Service operates throughout the province in diverse conditions, ranging from rural northern BC to the Lower Mainland. Based on a review of the 2012 injury stats for paramedics and in response to a WSBC order, ergonomic risk assessments of the highest risk activities based on claims costs, are included in this report. See the Injury Statistics Review section and Appendix B for more information.

As a starting point and for the purposes of this report, ride alongs and task analysis were completed in the Lower Mainland only. Further studies may be necessary to better understand different regional demands. The statistics reviewed were province-wide, however, and the authors believe that the recommendations herein are likely largely generalizable.

METHODOLOGY:

Standard ergonomic assessment process risk assessment process includes the following stages: Risk Identification, Risk Assessment, Risk Control, and Evaluation of Controls. Each stage is discussed in detail below.

RISK IDENTIFICATION

A comprehensive review of the 2012 injury statistics was completed to help in the identification of the high risk activities addressed in this report. Paramedic demographics were also reviewed. Job observation, interviews and mock-ups were also performed to further facilitate risk identification. Job observation involved two ride alongs with Duty Supervisors and two ride alongs in ambulances with paramedics. The mock-up sessions examined various lifting/lowering activities and patient transfers incorporating paramedic input.
The physical risk factors assessed for include the following:

- Force
- Awkward/static postures
- Repetition
- Contact stress
- Vibration

Although the focus of this study was on the physical risk factors present, during the course of data collection organizational risk factors were also identified. Organizational risk factors known to impact risk of injury, as well as health and well-being include the following:

- Work culture (Canadian Standards Association (CSA), 2012; Hagberg, 1995)
- Practices and procedures (CSA, 2012)
- Workload (CSA, 2012; Hagberg, 1995)
- Scheduling (CSA, 2012; Hagberg, 1995)
- Work design (Hagberg, 1995)
- Training (CSA, 2012)
- Personnel selection (Rice, 1999; Mital et al.; 1997, Chaffin & Andersson, 1991)

Information on organizational factors was gathered primarily via interviews with paramedics and Duty Supervisors, with additional information elicited from Safety Advisors and BCAS personnel.

RISK ASSESSMENT

During the four ride alongs, information regarding frequency and durations of work activities was gathered via interviews and job observation. Ergonomics Advisors also attended the Musculoskeletal Injury Prevention training currently offered to paramedics, which provided an opportunity to informally interview additional paramedics, and begin to evaluate the education being delivered.

For more detailed information on Risk Assessment methodology refer to Appendix A.

RISK CONTROL

The development of risk controls is done in consultation with front line staff, management, vendor specialists, and other Workplace Health specialists. They are presented in table format below, and include prioritization to help with planning and allocation of resources. Review and discussion regarding implementation timelines of these controls will be ongoing with BC Ambulance Leadership.

EVALUATION OF CONTROLS

Evaluation of controls must be ongoing and include annual reviews of the injury statistics and continual monitoring of the injury reports through the JOHSCs. If risk reduction is not observed, re-evaluation of the control measures in consultation with the Workplace Health team must take place.

RESULTS:

RISK IDENTIFICATION

Demographics

Paramedic demographics as of Dec 2013, reveal that 34% of paramedics are female, 44% are 45 years or older; 17% are 55 or older, and a small contingent (1.6%) are 65 years or older. These workforce demographics have implications with respect to job design and acceptable lifting limits, as workers' strength (and general health) declines, particularly once workers enter their fifth decade (Sanders & McCormick, 1993). The average strength of workers between ages 51 and 60 is 75 to 85% of that of 25 to 35-year-olds when people typically peak in strength (Grandjean & Kroemer, 1997), and the average overall strength of females is 63% of their male counterparts (Konz & Johnson, 2000). Work design needs to consider the different capacities of these populations working within BC Ambulance.

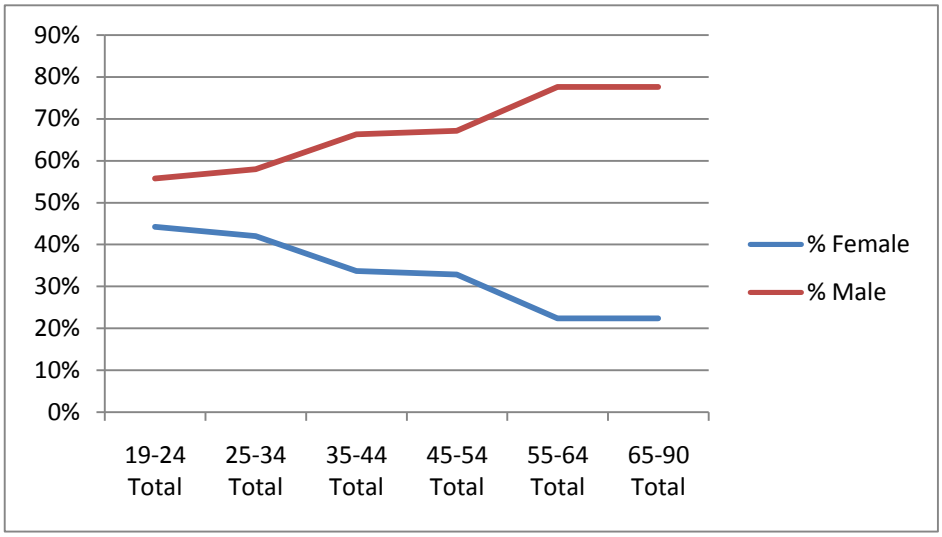
Table 1. Paramedic Demographics (2013)

Gender	**# of Paramedics**	**% of Paramedics**
Males	2360	66%
Females	1233	34%
Work Status	**# of Paramedics**	**% of Paramedics**
Full-time	1275	35%
Part-time	10	<1%
Casual	2308	64%
Total	3593	100%

Age Group	**# of Paramedics**	**% of Paramedics**
19-24	199	6%
25-34	916	25%
35-44	941	26%
45-54	940	26%
55-64	539	15%
65+	58	2%

The graph below illustrates the gradual proportional decline in numbers of female paramedics, relative to male paramedics, as age increases. The high physical demands of the paramedic job likely play a role, forcing weaker paramedics to move out of the position, which includes a greater percentage of women than men. This is discussed further in the discussion below of injury rates observed in the two genders.

Graph 1. Number of Paramedics by Gender over Time



Injury Statistics Review

A comprehensive review of 2012 MSI claims revealed the top 14 activities resulting in MSIs. Removing four categories unrelated to physical ergonomics (e.g. motor vehicle incidents) and combining activities where applicable (e.g. lifting and lowering the stretcher were combined), a list of eight high risk resulted, presented in decreasing order of WSBC claims costs:

1. Lift and lower patient on stretcher
2. Manually lift patient without equipment
3. Lift and carry patient on clamshell
4. Unload and load stretcher with patient from/into ambulance
5. Lateral patient transfer
6. Lift and carry patient on chair cot
7. Reposition patient on stretcher
8. Prevent patient from falling

These eight activities were derived from an original list of 14 high risk activities (see Appendix B for the complete list), based on claims costs. The total WSBC claims costs for the eight activities related to ergonomics amounted to $1.8 million, as of May 2013. A February 2014 update from WorkSafe BC shows a 60% increase in all claims, (i.e. for all injury claims, not just those associated with the 8 high risk activities assessed in this report) cost since May 2013. Applying this 60% increase to the costs associated with these 8 high risk activities results in an updated total of $2.8 million. These claims costs continue to accrue as additional costs associated with the injuries that occurred in 2012 continue to come in.

It is worth noting that WorkSafe BC (conservatively) estimates that indirect costs associated with injuries are four times those of direct costs. Indirect costs include incident investigations, administration, overtime coverage, hiring and training replacement workers, lost productivity, and reduced morale. Factoring for such indirect costs, the total estimated cost of the 8 high risk activities alone that occurred in 2012 could have already amounted to as much as $14 million.

Aside from the financial costs discussed above, there is an emotional burden placed on injured workers and their families. As an injured worker moves along the continuum from acute injury to chronic pain and disability, rates of mental health issues, such as depression and addictions, increase (Brown, 2009).

Furthermore, such issues can place strain on families who may struggle to understand and cope with their injured family member's changes in behavior, and divorce rates rise (Brown, 2009).

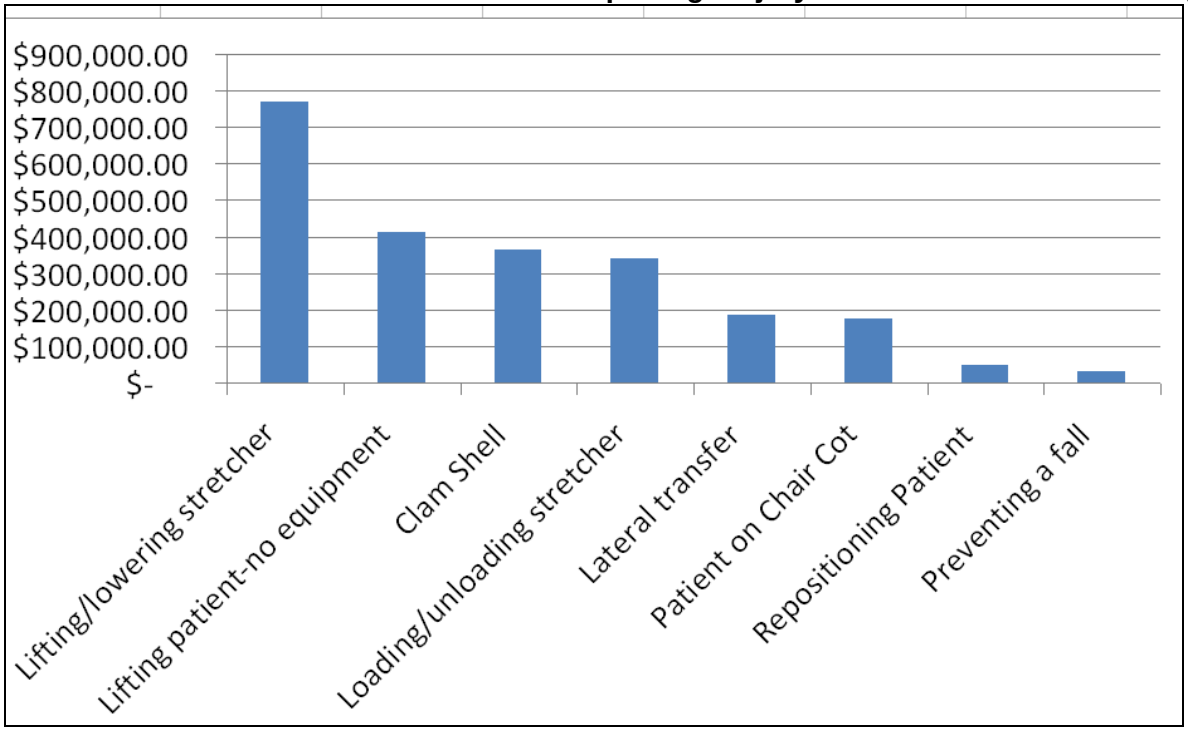
The following table shows the eight high risk activity claims costs, number of incidents, claims cost per incident, total days lost and days lost per incident as of May 2013.

Table 2. Claims Cost Statistics for Top Eight High Injury Risk Paramedic Activities (2012)

Activity	2012 WSBC Claims Costs	Number of incidents	Average Claims cost per incident	Days Lost	Average Days lost per incident
1. Lifting/lowering patient on stretcher	$595,202.97	69	$8,626.13	3247	47.1
2. Manually lifting patient - without equipment	$318,427.71	40	$7,960.69	8494	212.4
3. Lifting/carrying patient on clam shell	$281,387.22	18	$15,632.62	1161	64.5
4. Loading/unloading stretcher onto ambulance	$262,760.72	41	$6,408.80	1902	46.4
5. Lateral patient transfer	$144,245.71	18	$8,013.65	852	47.3
6. Lifting/carrying patient on chair cot	$135,237.37	26	$5,201.44	936	36.0
7. Repositioning of patient on stretcher	$36,910.45	6	$6,151.74	128	21.3
8. Preventing a patient from falling	$23,074.01	8	$2,884.25	171	21.4
TOTAL (as of May 2013)	$1,797,246.16	226	$7,952.42	16,891	75
Feb/2014 updated estimate of costs	**$2,318,447.55**	**226**	**$10,258.62**	**-**	**-**

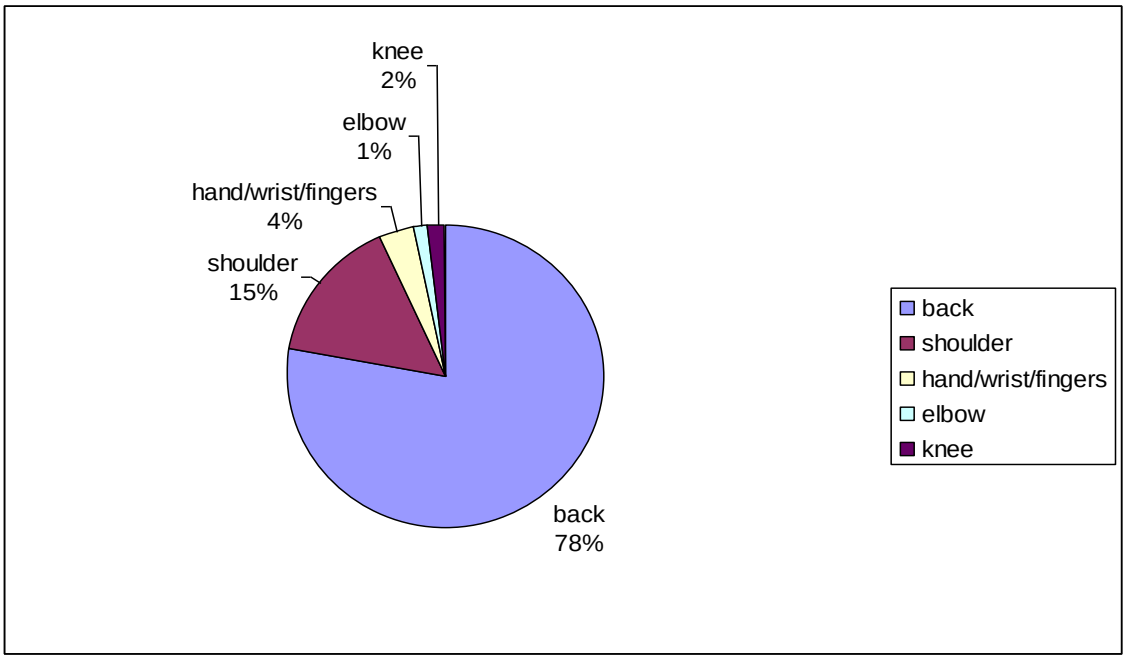
Graph 2 below shows the 2012 WSBC claims costs for each of the eight activities (updated estimates from February 2014)

Graph 2. Feb/2014 Estimated Claims Costs for Top 8 High Injury Risk Paramedic Activities (2012)



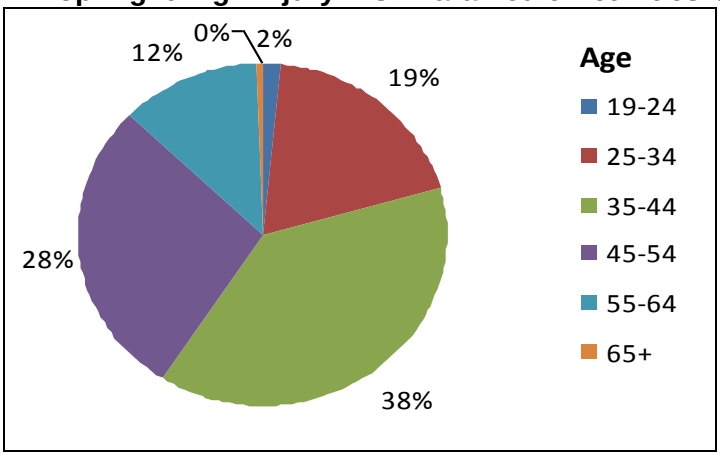
Graph 3 below shows that 78% of the musculoskeletal injuries under consideration from 2012 are back injuries, by far the largest in number. The shoulder follows with 15% of the injuries, followed by hand/wrist/fingers, knee and elbow at 4%, 2% and 1%, respectively.

Graph 3. Musculoskeletal Injuries by Body Part (2012)



Injury statistics related to the top 8 high risk activities from 2012 show marked increases in injury rates in the age groups of 35 to 44 and 45 to 54 compared to younger paramedics, with the 35 to 44 age group being the highest with 38% of these injuries. The numbers suggest a paramedic in the 35 to 44 age group has a 10% chance of acquiring one of the injuries in question in a given year; the overall chance is 6%. This higher injury incidence in the 35 to 44 age group may be partially explained by the gradual accumulation of daily micro trauma over years of wear and tear, eventually culminating in injuries. Explanations for the reduction in these injuries beyond age 54 may include a survivor effect, in which weaker, more injury prone paramedics move out of these physically demanding positions (by either transferring into a less physically demanding position, or leaving BCAS altogether); paramedics learning to work “smarter”, perhaps utilizing resources when available, only lifting when necessary (thus reducing exposure to risk factors), and paying more attention to body mechanics; and a seniority effect, in which more experienced paramedics transfer to less demanding positions (e.g. transfer fleet and low volume stations).

Graph 4. Top Eight High Injury Risk Paramedic Activities by Age



Overall, the 2012 statistics show that female paramedics are 8% more likely to be injured over the course of their careers than males. This is not surprising since, on average, females are more at risk by the physical demands of the job, due to their lower average physical capacity.

Interestingly, female paramedics between ages 19 and 44 are 20-30% at greater risk of becoming injured than their male counterparts, and female paramedics are less likely than males to be injured beyond age 44. In the 19-24 age group, this may be explained by the small sample size and coinciding small number of injuries within it. However, there remains an additional potential mechanism which extends beyond this small population and into the 25-34 age group: the physical capacity of females is being exceeded by a greater magnitude than males, as shown in the Risk Assessment section. The survivor effect, seniority effect and reality of working smarter likely all play a roll in describing injury trends amongst different age groups. In particular for females, there may be an increased survivor effect, as more greatly taxed female paramedics are forced earlier in their careers to make the decision to move away from paramedic work. This hypothesis is supported by the steady reduction in female paramedics with age as discussed in the Demographics section.

These statistics along with the fact that one third of paramedics are female were used to determine that female strength data must be used to assess risk and to guide assessment of solutions; neglecting to do so fails to protect at least one third of the paramedic population.

Physical Risk Identification

Table 3 outlines the physical risk factors identified for each of the high risk activities: frequency of exposure, duration of exposure, and the magnitude of the risk factor (i.e. postural angles or forces involved). This information is used to determine whether a Risk Assessment is required for each activity, and subsequently to quantify the level of risk during Risk Assessment. All forces reported under the magnitude column refer to forces required by a single paramedic (i.e. for two-person lifts the reported value is half of the total weight lifted by two paramedics). All risk factors are referenced against WorkSafe BC's Worksheets A and B.

Table 3: Physical Risk Factors Identified for the 8 High Risk Activities

	Activity	Risk Factors	Frequency	Duration	Magnitude
IDENTIFICATION	Lifting/ stretcher with patient	Fwd bending	Typical: 3-6x/shift Max: 8x/shift	<10s	>30°
		Heavy lifting			79-170 lbs*
		Forceful gripping			40-85 lbs*
		Awkward wrist postures			>30°
		Neck extension			>30°
	Lowering stretcher with patient	Fwd bending	Typical: 3-6x/shift Max: 8x/shift	<10s	> 30°
		Heavy lifting			79-170 lbs*
		Forceful gripping			40-85 lbs*
		Awkward wrist postures			>30°
		Neck extension			>30°

	Activity	Risk Factors	Frequency	Duration	Magnitude
IDENTIFICATION	Manually lifting a patient without equipment	Heavy lifting	Typical: 1x/shift Max: 2x/shift	<10s	28-154 lbs*
		Fwd bending			> 30°
		Deep knee bends			>90°
		Neck extension			>30°
	Lifting and carrying patient on a clam shell	Heavy lifting	Typical: 1x/shift Max: 2x/shift	Typically <10s Up to several km	44-142*
		Fwd bending			> 30°
		Deep knee bends			>90°
		Neck extension			>30°
		Forceful gripping			22-71
	Loading stretcher with patient onto ambulance	Fwd bending	Typical: 3-6x/shift Max: 8x/shift	<10s	>30°
		Heavy/awkward lifting			54-148 lbs*
		Forceful gripping			27-74 lbs*
		Awkward wrist postures			>30° flexion
		Neck extension			>10°
	Unloading stretcher with patient from ambulance	Fwd bending	Typical: 3-6x/shift Max: 8x/shift	<10s	>30°
		Heavy/awkward lifting			54-148 lbs*
		Forceful gripping			27-74 lbs*
		Awkward wrist postures			>30° flexion
		Neck extension			>10°
	Lifting and carrying a patient on chair cot	Fwd bending	Typical: 2-3x/month Max: 2x/shift	10-30s	>30°
		Heavy/awkward lifting			59-147 lbs*
		Forceful gripping			30-74 lbs*
		Awkward wrist postures			>30°
		Neck extension			>10°

IDENTIFICATION	Activity	Risk Factors	Frequency	Duration	Magnitude
	Lateral transfer of a patient	Fwd bending	Typical: 2-4x/shift Max: 8x/shift	<10s	>30°
		Heavy push/ pull			23-56 lbs**
		Heavy lifting			Not measured***
		Forceful gripping (non-optimal grip)			11-28 lbs.
	Repositioning a patient	Fwd bending	Typical: <2x/shift	<10s	>30°
		Heavy push/ pull			23-56 lbs†
		Heavy lifting			Not measured**
		Forceful gripping			11-28 lbs
	Preventing a patient from falling	Unexpected heavy/ awkward load	Typical: 1x/month	<10s	Up to full patient weight, applied suddenly and unexpectedly
	All heavy lifting/ lowering activities	Exposures to heavy lifting /lowering loads	Typical: 14-26/shift Max: 36/shift <u>Hourly Rate</u> Typical: 1.2-2.2x/hr Max: 3x/hr	<10s	45-158 lbs

*5^{th} to 95^{th} percentile female and male patient, respectively plus equipment weight.
**Best case scenario assuming good technique using standard ambulance flannel sheet.
***Observed poor technique in which paramedics lift and push/pull patient. Force highly paramedic dependent and not measured.
†Assumed to be at least equal to lateral patient transfer, under ideal conditions with stretcher laid flat, good technique and using standard ambulance flannel sheet.

Physical Demands – Posture and Mobility

Postural and mobility requirements (amount of time spent in sitting, standing, walking, etc.) are displayed in the table below. In the context of this assessment, the table shows that in addition to the high physical demands associated with the top eight activities, paramedics also spend considerable time sitting. Much of this is in a moving vehicle while exposed to whole-body vibration, some of it with an unsupported back—factors associated with low back pain and injury reporting.

Table 4. Posture and Mobility Requirements for Paramedic Activities

Posture / Mobility Requirements		Duration / Frequency	Total Daily Exposure
Sitting	Moving ambulance	5-30 min/ instance	4-6 hours/shift
	Moving ambulance unsupported	5-30 min/ instance	1-4 hours/shift*
	Stationary	Max: 30 min/ instance	1-2 hours/shift
		Total	5-8 hours/shift
Standing (dynamic)		Max: 1 hour/ instance	3-6 hours/shift
Walking		Max: 2 min/ instance	<1 hour/shift
Kneeling/squatting		Typical: <2 minutes Max: 45 minutes/instance	<1 hour/shift
Bending/scooping		Max: 2 min/ instance	<1 hour/shift

*Paramedics trade off daily driving; this exposure would only be 1 out of 2 days.
Note: "Cross-covering" adds to seated time, waiting in front of ambulance 2-4 hours when cross-covering.

Organizational Risk Identification

While physical risk factors associated with increased risk of musculoskeletal injuries are clear, research shows that factors related to the organization also have an influence, with the ability to increase or decrease injury reporting. Organizational factors also influence general health and well-being of workers, with impacts on performance, chronic disorders and mental health.

Organizational risk factors are discussed in detail in Appendix C, and summarized here:

- **Shift scheduling** – Both shift work and long shifts have potentially negative impacts on employee health, including musculoskeletal disorders. There are also concerns related to aging workers and shift work, as well as safety concerns when driving when fatigued, particularly at night.
- **Work culture** – Attitudes related to self-sufficiency and "getting the job done" as quickly as possible, as well as mixed corporate messaging, regarding "patient first" and "safety first", may be contributing to the perpetuation of poor practices.
- **Work practices** – There is confusion among paramedics regarding policies and procedures. Discrepancies between policy and practice were observed, suggesting issues related to training, supervision and communication, and may suggest impractical policies. Examples include policies/ practices regarding oiling stretchers for preventative maintenance, forbidding use of chair cot handles, and that all patients (including ambulatory) must enter ambulances on a stretcher.
- **Training** – Equipment and MSI training concerns include insufficient training and training consistency.
- **Personnel selection** – The pre-employment capacity testing system may not be properly functioning. Reports of candidates failing portions of the test but still being hired were heard. Additionally, once hired, no further testing is done, meaning some paramedics likely do not meet the physical requirements of the job.
- **Work design/ workload** – Patient hold times may be excessive, resulting in system inefficiencies from both BCAS and hospital perspectives, and possibly increasing perception of workload.

MSI Risk Assessment

MSI Risk Level of Lifting and Lowering Activities

Lifting and lowering activities are evaluated using Mital et al.'s (1997)[2] lift/lower tables, and the results displayed in the table below. It is worth noting that Mital et al.'s guideline is intended for use in industrial manual material handling tasks and may underrepresent the risk for patient handling, particularly lifting patients without equipment. The organizational factors are known to further increase injury reporting, further suggesting an underrepresentation of risk.

The table below reveals that paramedics are exposed to high MSI risk activities on a daily basis, as all individual activities were determined to be high risk. Even the lightest weight scenarios, involving 90 lb patients, and empty stretchers, are associated with high levels of risk. Although numerous factors affect the amount of weight which can be safely lifted (e.g. body postures used, height of the lift, hand holds, stability of the load, etc.), the sheer weight involved—of adult human beings and of the stretchers themselves—is the largest limiting factor.

See Appendix A for a more detailed description of the methodology, as well as the rationale for choice of weight limits.

[2] Mital, Nicholson and Ayoub's *A Guide to Manual Materials Handling* is a respected reference guideline for the design and evaluation of manual materials handling tasks, such as lifting, lowering, pushing and pulling.

The following table shows quantitative data collected for each activity along with recommended weight limits and the MSI risk level for each.

Table 5. Activity Risk Levels

Activity	Condition*	Lift Height		Heaviest Weight Lifted by single Paramedic (lbs)**	Weight Limits (lbs)***		Number of Times Over Weight Limit		Risk Level†
		Min lift height (inches)	Max lift height (inches)		50th %ile Male	50th %ile Female	50th %ile Male	50th %ile Female	
Load/ unload stretcher††	Empty	25	39	54	45	27	1.1x	1.9x	High
	90 lb patient			79			1.6x	2.7x	High
	172 lb patient			120			2.5x	4.1x	High
	224 lb patient			148			3.1x	5.1x	High
Lift/ lower stretcher**	Empty	18	41	46	47	32	1.0x	1.4x	High
	90 lb patient			103			2.2x	3.2x	High
	172 lb patient			145			3.1x	4.5x	High
	224 lb patient			170			3.6x	5.3x	High
Lift/carry clamshell with patient	90 lb patient	0	42	64	45	27	1.4x	2.4x	High
	172 lb patient			112			2.5x	4.1x	High
	224 lb patient			142			3.2x	5.3x	High
Manually lifting patient without equip	90 lb patient	11	50	62	45	27	1.4x	2.3x	High
	172 lb patient			118			2.6x	4.4x	High
	224 lb patient			154			3.4x	5.7x	High
Lifting/ carrying patient on chair cot	90 lb patient	16	39	73	45	27	1.6x	2.7x	High
	172 lb patient			119			2.6x	4.4x	High
	224 lb patient			147			3.3x	5.4x	High

*5th percentile female, 50th percentile male and 95th percentile male patients plus equipment weight.
**Where applicable, based on heaviest end (torso end), as it represents worst case scenario and is most protective
***Values based on 1 lift/lower every 30 minutes for 12 hours from Mital, Nicholson and Ayoub (1997), including 7% correction factor for two-person lifting, as recommended by Diffrient et al. (1981).
†Activities requiring greater than 1x the recommended weight limit (for 50th percentile female) is considered high risk for injury. Male data is shown for illustrative purposes only.
††Assuming Ferno 35X series stretcher.

Lateral Transfers from Stretcher to Bed (Push/Pull)

Lateral transfer technique was poor for all observed instances. Mechanical patient lifts, slider sheets and slider boards were not used. **Due to the observed awkward postures and tendency to lift and pull, the risk associated with observed lateral transfers is high**.

Ferno PowerFlexx Stretcher

Although not part of this assessment, a trial of the Ferno PowerFlexx stretcher is currently under way. The power stretcher uses a motor to raise and lower the stretcher, which is a frequent activity (for example, paramedics may transport a patient on the stretcher at a lower height, then raise the stretcher for loading into the ambulance, but pulling a lever and lifting it; the process is reversed at the hospital). Since the stretchers must still be loaded and unloaded into and out of ambulances manually, a brief analysis of the manual handling aspects of loading and unloading was conducted. During the power stretcher orientation, it was stated that all lifts, including loading and unloading of the stretcher (loaded and empty) were to be performed by two paramedics, thus halving the weights involved.

As indicated in the following table, although power stretchers would eliminate the risks associated with raising and lowering, they do not fully address risk associated with loading/unloading of stretcher in ambulance. With the power stretcher, the paramedics are still required to hold a large portion of the weight of the stretcher/patient while the wheels are lifted or lowered and while sliding the stretcher in or out of the ambulance. The length of time spent holding this weight is also increased (approximately seven seconds for loading the power stretcher compared to five seconds for loading a standard stretcher), due to the additional time it takes to lift/lower the wheels. Furthermore, not only does it not address lifting stretchers (e.g. over curbs or stairs), it actually increases the weight for these tasks, thus increasing risk associated with lifting activities. However, the overall frequency of heavy lifting would be reduced (since the raising and lowering the stretcher is mechanized).

Table 7. PowerFlexx Stretcher Force Measurements

Activity	Condition*	Lift Height		Heaviest Weight Lifted / Para-medic (lbs)**	Weight Limits (lbs) Mital et al.***		Number of Times of Weight Limit		Risk Level
		Min lift height (inches)	Max lift height (inches)		50th %ile Male	50th %ile Female	50th %ile Male	50th%ile Female	
Load/unload PowerFlexx power stretcher	Empty	27	38	36	45	27	0.8x	1.3x	High
	90 lb patient			54			1.2x	2.0x	High
	172 lb patient			74			1.6x	2.7x	High
	224 lb patient			85			1.9x	3.1x	High
Lift/ lower PowerFlexx power stretcher	Empty	18	41	73	47	32	1.6x	2.3x	High
	90 lb patient			125			2.7x	3.9x	High
	172 lb patient			172			3.7x	5.4x	High
	224 lb patient			200			4.3x	6.0	High

**5th percentile female, 50th percentile male and 95th percentile male patients plus equipment weight.
**Assumes all loading and unloading performed by 2 paramedics, including empty stretchers; and lifting/lowering the heaviest end of the stretcher (torso end) by one paramedic.
***Values based on 1 lift/lower every 30 minutes for 12 hours from Mital, Nicholson and Ayoub (1997), including 7% correction factor for two-person lifting, as recommended by Diffrient et al. (1981).
†Activities requiring greater than 1x the recommended weight limit (for 50th percentile female) is considered high risk for injury. Male data is shown for illustrative purposes only.

ERGONOMICS (MSI) RISK CONTROLS

Paramedics perform work with high physical demands that create significant risk of injury. The primary recommendations below aim to reduce those demands to make this a safer and lower risk job. Based on the current pre-employment screening requirements and that a third of paramedics are female, risk controls must be chosen to protect at least the 50th percentile female. **NB: Controls are listed in approximate order of expected injury reduction effectiveness**.

While this list is the required starting point, we will be working with BCAS on determining and finalizing all interventions.

Recommended Controls include:

- Implementation of powered and other on-ambulance equipment
- Use of lateral transfer aides, such as hospital lifts
- Examination of work practices
- Review and provision of education and training
- Policy and procedure review and development
- Preventative maintenance program
- Review of jump kits
- Health promotion initiatives
- Review of functional capacity testing
- Inclusion of ergonomics in ambulance design
- Review of dispatch communication

Table 7: Recommended Control Measures

**Control Priority Note: 1 = critical, high priority recommendation; 2 = recommended for implementation to reduce risk factors; 3 = not for immediate action but for future consideration.*

	Recommended Control	Risk Factors	High Risk Activity Addressed by Recommended Control	Control Priority*
CONTROLS	**Power Stretcher** Evaluate the impact of power stretchers. BC Ambulance has begun a trial of the Ferno Powerflexx stretcher in Kelowna and Vancouver. A PHSA Ergonomics Advisor is involved in these trials. The Stryker Powercot and Ferno IN/X cot should also be trialed (without purchasing), evaluated and compared to other stretchers including the Ferno Powerflexx. A trial of the Stryker products and follow-up employee survey was completed in North York, Ontario and is included in Appendix G. http://www.youtube.com/watch?v=nvpQGBt8a6I A power stretcher would eliminate force requirements for raising and lowering the stretcher (with wheels on ground), and reduce force requirements for loading and unloading stretchers (by virtue of two paramedics halving forces). Note that the power stretcher is heavier than standard stretchers resulting in increased injury risk when lifting (e.g. over curbs, stairs). Recommendations below regarding a mobility assessment protocol and an additional resources policy would reduce both frequency and force magnitude of such lifts.	High force combined with awkward postures	1 – Lift and lower patient on stretcher 4 – Unload and load stretcher with patient from ambulance	1
	Power Loading System Preferred option to reduce risk of injury: Investigate the use of a powered loading stretcher system which automatically lifts the stretcher into and out of the ambulance, eliminating the need for paramedics to manually do it. See the link below for a demonstration. A trial of this product and follow-up employee survey was completed in North York, Ontario and is included in Appendix G. http://www.youtube.com/watch?v=nvpQGBt8a6I Conduct an industry best practices search, including UK tail lift (see http://www.youtube.com/watch?v=gQhzEdG3PQQ) and the new Ferno iNx (self loading power cote)	High force combined with awkward postures	4 – Unload and load stretcher with patient from ambulance	1

	Recommended Control	Risk Factors	Risk Reduction Activity	Control Priority*
CONTROLS	**Evacuation HoverJack / Mangar Elk & Camel** Investigate the use of the Evacuation HoverJack, Mangar Elk and Camel for manual patient lifts from the ground. The HoverJack can also be used to take patients downstairs. A HoverMatt can be used to laterally transfer the patient from the HoverJack to the stretcher. HoverJack: Mangar: & Videos	High force combined with awkward postures	2 - Manually lift patient without equipment 3 - Lift and carry patient on clamshell	1
	Lateral Transfer Aides Investigate tools that can be used to assist in laterally transferring patients between horizontal surfaces (i.e. stretcher, hospital bed). Lateral Transfer Aides that should be investigated include the HoverMatt, Patient Lift, Slider board, Z-slider, Slipp and fabric slider sheets. Training is required (utilize online patient handling videos).	High force combined with awkward postures	5 – Lateral patient transfer	1
	Powered Chair Cot Investigate a powered chair cot that can go up and down stairs on the tracks. http://www.fernoems.com/powertraxx The EZ-Glide chair cot currently used by BC Ambulance can be upgraded with a PowerTraxx Retrofit Kit	High force combined with awkward postures	6 - Lift and carry patient on chair cot	1

	Recommended Control	Risk Factors	Risk Reduction Activity	Control Priority*
CONTROLS	**Reduce Frequency of Lifts** Look for ways to reduce the frequency of lifting or raising stretchers with patients on it. For example if the patient is ambulatory (see mobility assessment recommendation), ensure the brakes are engaged and have one paramedic hold the stretcher and have the patient use the step stool to get up onto the lifted stretcher. Investigate the practice of allowing ambulatory patients to walk into the ambulance. This requires investigation of potential legal consequences, coordination with policy/procedures review and patient assessment protocol development and training, as discussed below. Frequency of raising and lowering the stretcher would also be significantly reduced with implementation of a power stretcher.	Reduce frequency related to high force combined with awkward postures	1 – Lift and lower patient on stretcher 4 – Load and unload stretcher with patient from ambulance	2
	Education & Training Conduct a thorough evaluation of the current MSI and equipment training including content accuracy, course availability and facilitator competency and revise as necessary. The following should be considered: • Train all paramedics and supervisors on proper use of equipment, proper body mechanics corresponding to the use of each piece of equipment and MSI and risk factor reduction. Consistency in this knowledge will help to reduce risk of injuries. See Appendix H for further explanation as to why general body mechanics training is not considered to be useful. • Instructors must be trained and have their competency assessed before being able to teach others. Instructors should use a standardized curriculum when teaching so that information and knowledge is consistent across the province. Currently there are various methods of operating the chair cot being used and taught. There is also conflicting information on the use of the drop down handles. • Provide training to all staff on any new patient handling equipment that is deployed.	Organizational	All activities	2

CONTROLS	Recommended Control	Risk Factors	Risk Reduction Activity	Control Priority*
	Policy and Work Procedures Review Review, update and create new policies and procedures and ensure intranet is up-to-date. New and revised policies and procedures should be effectively communicated to paramedics. For example, new policies that should be addressed in future include but are not limited to: • Patient no lift policy (with exceptions, such as a patient who could be critically or fatally injured if not moved immediately) • Additional resources policy (e.g. use of fire fighters to assist with activities such as loading/unloading and lifting/lowering stretchers, carrying patients on the clam shell, and lifting patients without equipment)—not just for "larger" patients Examples of procedures that should be created include: • Using clamshell • Using stretcher (make one procedure for each type of stretcher)	Organizational High force combined with awkward postures	All activities Particularly: 5 – Lateral patient transfer 1 – Lift and lower patient on stretcher 4 – Unload and load stretcher with patient from ambulance 7 – Reposition patient on stretcher	2
	Mobility Assessment Protocol Develop and train paramedics on a mobility assessment protocol upon which paramedics make informed decisions about how to transfer a patient (i.e. to determine if a patient is safely ambulatory). Proper assessment will reduce the number of patient falls and associated patient and paramedic injuries. Example: http://fhpulse/workplace_health_safety/safety_and_prevention/safe_client_handling/Pages/AssessingClientMobility.aspx	Sudden high forces combined with awkward postures	8 – Prevent patient from falling 1 – Lift and lower patient on stretcher 4 – Unload and load stretcher with patient from ambulance	2
	Preventative Maintenance Develop and implement a preventative maintenance program for all equipment used by paramedics. This will reduce the forces required to move and use the equipment. Ensure information pertaining to maintenance requirements on the intranet is up-to-date and effectively communicated to paramedics.	Force	1 – Lift and lower patient on stretcher 4 – Unload and load stretcher with patient from ambulance 6 - Lift and carry patient on chair cot	2

CONTROLS	Recommended Control	Risk Factors	Risk Reduction Activity	Control Priority*
	Ensure Stretcher Wheel Locks Work Wheel locks on the silver stretches do not work. This is a safety issue that needs to be addressed even if the long-term plan is to remove the silver stretchers from service. The risk of injury for staff and patients significantly increases during patient transfer when one of the surfaces is not stable. Having one paramedic hold the stretchers during transfer is not an appropriate solution, as it adversely affects body mechanics.	Force	All stretcher related activities	2
	Jump Kits Look into alternative carrying devices for the jump kit and determine how to make the jump kits lighter and more user friendly. Note: Currently ACP jump kits are being investigated by the product procurement committee. Ensure ergonomics input into this process. 	High force	Manual handling of heavy equipment	2
	Health Promotion Initiatives Investigate ways of promoting physical and mental health for paramedics. The following are some of the services currently being rolled out by Health Promotions for BCEHS: • Healthy paramedics study • Discounted gym memberships • Mental health resources • Review of MSIP content at Institutions for Paramedic Programs • Sustained fitness research • Predisposing factors/health program determination • Education on specific topics (e.g. shiftwork)	Organizational	All activities and general worker health & efficiency	2

	Recommended Control	Risk Factors	Risk Reduction Activity	Control Priority*
CONTROLS	**Functional Capacity Testing** New JDAs for ALS and PCP have been completed and this information will help focus the review and update of pre-employment screening and recruiting processes. Next steps will include Workplace Health initiating a discussion with Human Resources and the contracted provider (Viewpoint) regarding updating the current pre-employment screening process. Investigate possibility of periodic functional capacity testing throughout paramedics' careers, such as annual testing or prior to moving from Rural to Metro (due to the increase in physical demands)	Organizational	All activities	2
	Ambulance Design Ensure ergonomics input into future ambulance designs, for example: ● Stretcher/ambulance loading system height ● Seat design	Awkward lifting	4 – Unload and load stretcher with patient from ambulance	2
	Transfer Belts Provide training and promote use of transfer belts for transferring semi-ambulatory patients to/ from seated position. Best practices involve using two paramedics to transfer such patients.	Awkward postures Force	8 – Prevent patient from falling	2
	Communication with Dispatch Investigate what additional information should be provided to paramedics (without affecting timeliness) for each call to better enable them to prepare (access and equipment required) and have better situational awareness when they arrive at the scene.	Systems issue	Overall system efficiency	3

NEXT STEPS

This assessment and its recommendations are intended to be a starting point. Additional investigation is required to determine the best solutions. Four of the eight activities are responsible 81% of the claims costs, and these four activities all involve manually lifting patients. To significantly reduce injuries, engineering controls which mechanize patient lifting and handling are required. The final products chosen will come from examination and trials of available products done jointly with Workplace Health and BC Ambulance.

Some of the observations stated in this report with respect to organizational factors require further investigation to determine appropriate steps forward. For example, the literature on shift work is clear; both on its relation to MSI reporting, and its effects on cognitive function and general health. Further examination of the current shift system, including how it was arrived at, would be prudent. Furthermore, workplace culture globally impacts the recommendations because of its influence on acceptance and perception of change. For example, there appears to be a perception that lifting “heavy” patients is the problem, when in fact lifting each and every patient contributes to injury and exceeds recommended weight limits. This is a perception that must be changed in order to improve understanding and acceptance of many of the solutions. For this reason, management of change becomes important, and must be addressed in a top down fashion to ensure success. This may require assistance from change management professionals in Human Resources.

The impact of extreme weather needs to be examined. As seen in Appendix B, claims costs associated with slips and trips amounted to $221,000 (as of May 2013), and warrants further investigation by Workplace Health and BC Ambulance. Furthermore, conditions in regions outside of Metro Vancouver need to be examined to understand their unique circumstances and impacts on MSI development.

Workplace Health is committed to working with BC Ambulance moving forward, helping with selection and evaluation of controls. Through a systematic approach to the evaluation and selection of controls, there is tremendous potential for MSI reduction in paramedics. Workplace Health is very optimistic and looks forward to working with BC Ambulance towards this goal.

APPENDIX A – RISK ASSESSMENT METHODOLOGY

Physical data, such as force requirements, joint angles, and stretcher heights were gathered at the mock-up sessions. The data was then used to calculate force requirements under different scenarios. For loading and unloading the stretcher, force measurements were taken for an empty stretcher, as well as a stretcher with a patient on it. Using this data, combined with published data on centres of mass of various percentile humans, a simple model was created which allowed an estimated (minimum) force requirement to load and unload patients of various size.

Force requirements for each paramedic to lift/lower a stretcher, chair cot, or clamshell with a patient were based on a calculation which included the centre of mass of a patient of each percentile. Force requirements to lift a patient without equipment was calculated based on a worst case of one paramedic lifting the entire torso with the other paramedic taking only the weight of the legs.

Lifting limits were based on Mital, Nicholson and Ayoub's (1997) published guidelines, with a 7% correction factor for 2-person lifts [as suggested by Diffrient et al. (1981)], where applicable. PHSA Ergonomics Advisors chose lifting limits for the 50th percentile female to compare against (with the aforementioned correction factor) since one third of paramedics are female, and protecting this population will also protect the vast majority of male paramedics. Lifting limits for the 50th percentile male are included in the table for illustrative purposes only. Pre-employment testing requires paramedics to lift 120 lbs. from floor to standing knuckle height. Comparing this requirement to comparable isometric strength data, this corresponds to the maximum lifting force of 50th percentile females (Chaffin & Andersson, 1991; Keyserling et al, as cited in NIOSH, 1981). This pre-employment strength requirement lends credence to the approach of comparing on the job force requirements to 50th percentile females and forms the basis for choosing the 50th percentile female for prescribing risk levels.

Frequency rates for lifting are based on a combination of ride along observation and interviews with paramedics and Duty Supervisors. When comparing required lifting forces to the weight limit tables, it is important to understand that the frequency of heavy lifting is the sum of the frequencies of all of the heavy lifting activities.

Lateral transfer minimum force requirements were measured directly with a 135 lb. subject on a standard flannel ambulance sheet being moved across a stretcher mattress. Using this data, a coefficient of friction was calculated and used to estimate force requirements for patients of various body weights. It is recognized, however, that the method likely contains error due to the deformation of the mattress, which likely results in an underestimation of force requirements as body weights increase. The method does provide a point of reference, however, for evaluating risk.

Minimum force requirements for repositioning a patient on a cot were assumed to be equal to the minimum force requirements for lateral transfers, and assume the stretcher is in a flat position. One important difference, however, is that the direction of force application is different: with lateral transfers paramedics push or pull patients across the surface; in repositioning, patient is pushed/pulled sideways, a biomechanically weaker position.

APPENDIX B – WSBC COSTS FOR THE 14 HIGHEST RISK ACTIVITIES

Activity	2012 WSBC Claims Costs	Number of incidents	WSBC Claims cost per incident (avg)	Days Lost	Days lost per incident (avg)
Lifting/raising stretcher with patient	$425,705	57	$7,469	2302	40.4
Manually lifting patients - without equipment	$318,428	40	$7,961	8494	212.4
Lifting / carrying patient on Clam Shell	$281,387	18	$15,633	1161	64.5
Unloading stretcher with patient from ambulance	$173,056	25	$6,922	910	36.4
Lowering stretcher with patient	$169,498	12	$14,125	945	78.8
Slip / slip and fall	$163,207	20	$8,160	500	25.0
Lateral patient transfer	$144,246	18	$8,014	852	47.3
Lifting / carrying patient on Chair Cot	$135,237	26	$5,201	936	36.0
Motor vehicle accident	$91,312	20	$4,566	266	13.3
Loading stretcher with patient onto ambulance	$89,705	16	$5,607	992	62.0
Aggressive patients	$65,968	10	$6,597	308	30.8
Trip / trip and fall	$57,317	12	$4,776	204	17.0
Repositioning patient on stretcher	$36,910	6	$6,152	128	21.3
Preventing a patient from falling	$23,074	8	$2,884	171	21.4
TOTAL (May 2013)	**$2,175,051**	**288**	**$7,552**	**18,169**	**63.1**
Feb 2014 updated TOTAL estimate	**$2,805,816**	**288**	**$9,742**	**-**	**-**

APPENDIX C – ORGANIZATIONAL RISK FACTORS

Ergonomics is concerned with the interaction between humans and elements of the system in which they are situated, including organizational factors. Organizational risk factors are known to increase injuries and to influence MSI reporting. These risk factors were identified based on observations and conversations with BCAS. No formal tools were used in this portion of the evaluation. Further investigation and action may be warranted to more accurately and thoroughly understand the complex issues and to better inform organizational change initiatives. Workplace Health is happy to assist in the investigation and development of controls to reduce harmful effects of these risk factors.

SHIFT WORK

There are numerous shift schedule patterns. Paramedics typically work 11 or 12 hour shifts, with occasional overtime required to complete calls which comes in before the shift. Breaks are taken when workload allows. The 12 hour shift schedule is 2 days on, 2 nights on, and 4 days off. The 11 hour shift schedule is 2 days on, 2 afternoons on, and 4 days off.

The health issues related to shift work are well known. Disruptions to the body's natural circadian rhythms lead to disrupted sleep patterns (CSA, 2012; Kroemer, et al., 2010; Grandjean & Kroemer, 1997) , increased incidence of chronic health issues (Grandjean & Kroemer, 1997; Kodak, 2004), cumulative sleep deficits (CSA, 2012; Kodak, 2004), increased mental health problems (Grandjean & Kroemer, 1997; Hagberg et al., 1995; Muchinsky, 2006), gastrointestinal problems (Grandjean & Kroemer, 1997; Kroemer et al., 2010), poorer lifestyle habits [e.g. poor nutrition (Grandjean & Kroemer, 1997; Kodak, 2004); increased smoking in males (Kodak, 2004)], and increased reproductive health problems in females (CSA, 2012; Grandjean & Kroemer, 1997). In addition, disruptions in social life are seen (CSA, 2012; Grandjean & Kroemer, 1997), with greater family disturbances reported (Muchinsky, 2006; White & Keith, 1990), and higher divorce and separation rates (Smith et al., as cited in Muchinsky, 2006). Moreover, fatigue induced by long shifts, night shifts, and disrupted sleep patterns adversely affects decision-making ability (Costa, 1996), and leads to higher rates of human error (CSA, 2012). These have particular relevance to drivers, who see increased rates of motor vehicle accidents at night (Akerstedt et al, 1994; Suzuki et al, 2004), and paramedics in general, whose decisions can impact the patient safety. It is also important to note that as workers age, the body's ability to cope with the physiological stresses of shift work declines (Grandjean & Kroemer, 1997; Kroemer et al., 2010).

Many shift patterns are possible, each with pros and cons. Although shift scheduling is a complex topic, in general Grandjean and Kroemer (1997) report that fixed day & afternoon shifts are best from a physiological standpoint, as the body is better able to adjust its circadian rhythm; fixed evening and night shifts place greater stress on workers' social lives; and fixed night shifts are the worst from a physiological perspective, in addition to the negative consequences to social life. Rotating schedules (e.g., days, then evenings, then nights) are difficult from a physiological perspective (Costa, 1996; Santhi et al, 2005) as the body's circadian rhythms are in constant flux. Of rotating shift patterns, BCAS' fast forward rotating schedule[3] is better than backward rotating, or long rotation schedules from a physiological perspective (Grandjean & Kroemer, 1997; Kroemer et al., 2010), as circadian rhythms do not shift as much as others, and also provides good social benefits (Grandjean & Kroemer, 1997). For the balance between physiological and social facets, the fast forward rotating shift is the preferred schedule in most of Europe (Kroemer et al., 2010).

The standard 11 and 12 hour shifts also present problems, from both cognitive and physical performance standpoints (Kroemer et al., 2010), as well as the perspective of musculoskeletal disorders. On the physical side, longer shifts mean greater exposure to risk factors (i.e. lifting/lowering, bending, static sitting, etc.), resulting in increased risk of injury (Grandjean & Kroemer, 1997; Hagberg et al., 1995). Kroemer et al. (2010) generally recommend against shifts beyond 8 hours for physically demanding jobs or jobs

[3] Fast rotating schedules refers to short blocks of 1 or 2 days on a given shift before rotating to the next shift time. Forward rotation means days, followed by afternoons, followed by night; as opposed to days, followed by night, followed by afternoons.

requiring high attention (e.g. driving) or complex cognitive processing. The BCAS 11 or 12 hour shift scheduling is counter to this recommendation due to the physically demanding nature of the work, as well as the attention required during driving.

In short, the BCAS fast-rotating shift (i.e. 2 days, 2 nights, 4 days off) schedule, based on the collective agreement represents a reasonable compromise between the competing social and physiological demands. However, combined with the shift length of 11 or 12 hours, not to mention overtime extending shifts beyond 12 hours, results in increased risk of MSI and reduced physical and cognitive performance. Furthermore, these risk factors combined with driving at night increase the risk of motor vehicle accidents (Akerstedt et al, 1994; Suzuki et al, 2004).

WORK CULTURE

From both conversations with paramedics and observation, it appears paramedics do not fully understand the risks inherent in patient handling. As discussed above, the sheer weight and nature of lifting patients places very large loads on the low back, in particular. When asked, paramedics would frequently speak of bariatric patients and the strain placed on the back, but did not demonstrate an understanding that lifting even a small 95 lb. patient is a high risk activity. This lack of understanding appears to span at least paramedic and supervisory levels. This poor understanding of strain on the back was also consistently demonstrated by many paramedics during patient transfers, using techniques which result in very high compressive forces in the low back. An attitude of “just getting the job done” was expressed by some paramedics. These attitudes and poor techniques are reinforced as newer paramedics take the lead from the more experienced.

There also appears to be a desire among many paramedics to be self-sufficient and not to appear weak. This attitude encourages working beyond one’s physical capacity and endangers paramedics’ (and potentially patients’) safety. Some paramedics also report, however, having difficulty performing some of the more physically demanding aspects of the job, such as loading or unloading heavy patients and carrying patients on chair cots, and routinely ask for help. Perhaps in response to this desire to appear self sufficient it is likely some workers feel pressured to push themselves beyond their physical capabilities, increasing the cumulative micro damage done to the body, and the risk of acute injury. Again, these poor practices are reinforced as paramedics observe and emulate that which they see around themselves. There may be conflict between the “Patient First” focus, and the “Safety First” messaging paramedics are exposed to. Paramedics in general are very concerned with providing the best possible service to the patient and may place the patient’s needs above their own in the interest of patient safety. However, they may also be placing themselves at risk in doing so. Paramedics do not demonstrate an understanding that patient safety and staff safety are one in the same: one does not have to be given up for the other.

While it will be very unlikely to see large reductions in injuries without implementation of engineering controls, improved work and safety culture is critical. Components of a culture of safety include the following (Singer et al., 2003):

- Commitment to safety articulated at the highest levels of the organization and translated into shared values, beliefs and behavioral norms at all levels.
- Necessary resources, incentives provided by the organization to allow this commitment to occur.
- Safety is valued as the primary priority, even at the expense of efficiency if that is the case; personnel are rewarded for erring on the side of safety even if they turn out to be wrong.
- Communication between workers and across organizational levels is frequent and candid.
- Unsafe acts are rare despite high levels of production.
- There is openness about errors and problems; they are reported when they do occur.
- Organizational learning is valued; the response to a problem focuses on improving system performance rather than individual blame.

WORK PRACTICES

During the ride alongs, none of the paramedics were observed utilizing patient lifts for patient transfers in health care settings. Healthcare no lift patient handling policies require the availability of floor lifts or ceiling lifts. Paramedics do not receive training on patient lifts and are unable to utilize them unassisted. High nurse workloads present a barrier to receiving or asking for assistance and therefore currently patient lifts are typically not being used for transfers from ambulance stretcher to hospital beds.

The stretcher manufacturer, Ferno, recommends a "secondary lift", which was not observed in practice. The purpose of this secondary lift is reportedly to ensure the stretcher's height adjustment mechanism is locked, preventing the possibility of a stretcher collapsing with a patient on it. It is unclear whether this is BCAS policy or not, however. In fact, when asked, some paramedics had heard of the secondary lift, but openly admit to not using it in practice, while others were not aware of it at all. During the course of this project, its use was not observed in the field. In terms of cumulative stress on the low back, as well as muscle fatigue, the secondary lift increases overall exposure to high force, by nearly doubling the number of times stretchers would be lifted. From an ergonomics perspective, one approach to risk reduction is to reduce the exposure to a risk factor, in this case high lifting force. Whether the secondary lift is necessary or not is unclear, however its role in increasing risk of back injury is and therefore it would be counterproductive to introduce a system that requires secondary lifts. This is more support for the move to power stretchers. If the power stretcher is not implemented the necessity of the secondary lift must be investigated further.

As discussed below, under Training, there appears to be confusion surrounding procedures for chair cot use, leading to potentially unsafe procedures.

During the ride-alongs it was commented by paramedics that there was a new policy which forbids allowing ambulatory patients to step up into the ambulance. If a policy exists it would require all patients to be lifted into the ambulance on a stretcher, increasing overall exposure to high force and contributing to the high risk for back injuries. This practice of allowing ambulatory patients to step into the ambulance was reported to be used by some paramedics in the Lower Mainland area, although there was confusion as to whether the practice contradicted policy.

Some paramedics report frequently utilizing Fire Fighters as extra resources to carry out some of the more physically demanding aspects of the job (e.g. carrying patients on stretchers or chair cots, loading patients on stretchers into ambulances). There is a perception that this practice is forbidden and during a MSI prevention training session, trainers indicated that best practice is to only allow BC Ambulance employees to operate BC Ambulance equipment. If this practice is followed and fewer people are allowed to assist, paramedics are exposed to greater forces resulting in higher risk of injury.

Poor understanding of policy on the part of employees may suggest communication issues within BC Ambulance. The discrepancy between policy and practice also speaks to communication issues, and may suggest impractical or outdated policies.

TRAINING

Paramedics receive limited training on equipment. Training received includes that received during paramedic training (prior to becoming licensed), which may or may not include equipment used in the field by licensed paramedics (for example, one paramedic reported never having touched a stretcher during his training). Once hired by BCAS, paramedics receive a mandatory 3.5 hour equipment orientation (OHS 3) to cover all of the equipment paramedics use. An additional optional training course is the Musculoskeletal Injury Prevention course, which spends approximately 2 hours on selected equipment.

This level of training is insufficient and is likely responsible for the different methods observed and reported for carrying a patient up stairs on a chair cot, perceived safety concerns reported regarding the rear flip-up handles, and risky lateral transfer methods observed. Inconsistencies in information provided on how to use equipment were observed during the observation of two separate OHS 3 training sessions.

The Musculoskeletal Injury Prevention course is not mandatory and according to the Education Department attendance is low. This contributes to paramedics' lack of awareness regarding the stresses to the body when manually handling patients. Additionally, the course falls short in several respects: due to the length, the course is limited in scope and level of detail; it underemphasizes the inherent risk associated with manual handling of all patients, not just bariatric patients; it glosses over the issue of gender and the increased risk to females; and inconsistencies were noted between equipment knowledge of trainers, potentially de-emphasizing their potential in reducing risk of injury.

As mentioned above, paramedics are not using patient lifts at hospitals, which increases the physical demands of manual patient transfers in hospitals.

Access to training appears problematic, as some courses are offered only infrequently; shift work and part-time paramedics with other jobs may also represent barriers to training access.

PERSONNEL SELECTION

Paramedics undergo a pre-employment physical capacity assessment through Viewpoint. There is no further ongoing assessment of physical capacity as a paramedic's career progresses such as the move from rural to metro; and retired paramedics returning to service within 120 days. This has implications since a paramedic who does not have the physical capability may adopt less safe techniques to overcome their physical limitations, potentially endangering patient safety, as well as their own. It is important to note, however, that the scientific literature is mixed in terms of correlating physical capacity testing with risk of musculoskeletal injury (Hagberg, et al, 1995; Sanders & McCormick, 1993; Mital et al., 1997; NIOSH, 1981). Stronger evidence exists for predicting job ability provided the tests are well designed, closely simulating actual job activities, and is based on a detailed job analysis (Rice, 1999; Mital et al.; 1997, Chaffin & Andersson, 1991).

WORK DESIGN & WORKLOAD

During ride alongs it was observed that paramedics spend considerable time waiting in hospitals for a patient bed. During this time one paramedic must remain with the patient while the other completes paperwork. After 30 minutes the hospital can be billed for the paramedics' time, creating an expense for the hospital (and a revenue for BCAS), but tying up paramedics' time. Each 30 minutes the paperwork must be completed again. This duplication of paperwork creates more administrative work for both BCAS and the hospital. Although the sample size is quite small, in one case a holding time of 2.5 hours was observed.

Additionally, conversations with paramedics indicate a sense that workload is high, and that the holding time contributes to it. During holding, it may appear that little "work" is done, however paramedics are typically standing the entire time, and expend mental effort attending to the patient and other required tasks. Paramedics report feeling time pressure once a patient is signed off, knowing that as soon as they report to dispatch a call may come at any moment, without opportunity for a break. Perception of high workload, particularly with low decision latitude, is known to negatively affect worker health and well-being (Ganster et al., 2001). Long hold times reduce opportunity for breaks, both mental and physical, and may work to increase the perception of high workload.

APPENDIX D – ACTIVITY PHOTOGRAPHS & DEFINITIONS

Lift and lower patient on stretcher – Paramedics change the height of the stretcher by activating a lever and then manually lifting or lowering stretcher. Paramedics also lift stretchers over curbs, stairs, etc.

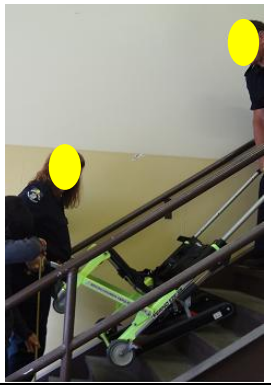
Manually lift patient without equipment – with various techniques, the paramedics lift the full weight of the patient from once surface (e.g. floor, couch) to another (e.g. stretcher, chair cot)

Lift and carry patient on clamshell – Paramedics lift the clamshell (spinal board) from ground level and place onto a stretcher.

Unload and load stretcher with patient from ambulance – One end of the stretcher rests in the ambulance and the other end is held by a paramedic while the other lifts the wheels up.

Lateral patient transfer – Paramedics move a patient from one horizontal surface to another using primarily manual methods (e.g. stretcher to hospital bed)

Lift and carry patient on chair cot – non-powered chair cots need to be carried up stairs. Cots can roll down stairs or on flat ground.



Reposition patient on stretcher – Paramedics may need to shift patient's position on stretcher.

Prevent patient from falling – patient falls or stumbles and paramedic(s) attempts to prevent it. Paramedics indicated that current policy is to not attempt to catch a falling patient, but rather to only protect the head.

APPENDIX E - FERNO STRETCHER GRIPPING HEIGHTS (INCHES)

(Measured from existing equipment during activity mock-ups)

Stretcher Model	Position	Head End	Foot End Upper Grip	Foot End Lower Grip
35A Version 12	1	8.25	11	5
	2	14.5	16.75	10.75
	3	19.25	20.5	14.5
	4	24	23.75	17.75
	5	28.75	26	20
	6	33	27.75	21.75
	7	36.75	28.75	22.25
	8	40.25	29.25	23.25
35P	1	12	8	2
	2	17.25	13.75	7.75
	3	21.5	18.75	12.75
	4	24.75	23.5	17.5
	5	27	28	22
	6	28.75	28.75	22.75
	7	29.75	36.25	30.25
	8	30.25	41.25	35.25
35X	1	7.75*	13.5	7.5
	2	13*	19	13
	3	18*	22.75	16.75
	4	22.5*	26	20
	5	27*	28.25	22.25
	6	31.5*	29.75	23.5
	7	35.5*	31	25
	8	39.75*	31.5	25.5
*5 position angle adjustability (of which only 3 can be used for lifting) allowing options of approximately 15” higher or 10” lower at each position.				

APPENDIX F - EQUIPMENT WEIGHTS

(Equipment weights were supplied by BCAS Stretcher Repair Program Technician, and from equipment manuals.)

Equipment Model	Weight
Ferno EXL Scoop Clamshell	18 lbs
Ferno Stretchers 35A	72 lbs
Ferno Stretcher 35P	81 lbs
Ferno Stretcher 35X	92 lbs
Ferno Power Stretcher PowerFlexx	133 lbs
Ferno Chair Cot	43 lbs

APPENDIX G – STRYKER POWERCOT AND POWERLOAD TRIAL REPORT NORTH YORK, ONTARIO

MEMORANDUM

TO: Norm Barrette, Chief/General Manager, EMS
FROM: Steve Darling, Deputy Chief Logistics
Nicki Lund, Return To Work Specialist
Fraser Hewitt, Health and Safety Consultant
DATE: August 20, 2013

RE: **Powerload/ Powercot operational impact**
Since deployment of the Stryker Powercot and subsequently Powerload in January 2013, the following has been observed (calculations have been adjusted to account for 2013 YTD comparison to the entire year of 2012:

- 71% Reduction in reported stretcher related incidents causing injuries (38 in 2012, 7 in 2013)
- 39% Reduction in repetitive task/motion incidents (18 in 2012, 7 in 2013)
- 11% Reduction in overexertion/strain incidents (133 in 2012, 76 in 2013)
- 49% Reduction in lost time hours (585 in 2013, 189 in 2013)
- Average lost days per lost time incident in 2012 1.8, in 2013 0.4

Employee Health and Safety Statistics – EMS

Stretcher Incidents		**Adjusted to Account for YTD**
2011	N/A attribute not tracked directly	
2012	38	24
2013 Year-to-Date (Aug 20)	7	7

Repetitive Task/Motion Incidents	
2011	24
2012	18/11.5
2013 Year-to-Date (Aug 20)	7

Overexertion/Strain Incidents	
2011	143/92
2012	133/85
2013 Year-to-Date (Aug 20)	76

Lost Time Incidents - EMS	
2011	93
2012	65/42
2013 Year-to-Date (Aug 20)	45

Lost Time Days – EMS	
2011	647
2012	585/374/1.8
2013 Year-to-Date (Aug 20)	189/.4

Stryker Orientation Survey Results						
Question Asked	**# Asked**	**Excellent**	**Good**	**Adequate**	**Less than adequate**	**Poor**
How would you rate the ease of loading and unloading the stretcher using the Power-Load.	171	161	8	2	0	0
How would you rate the general ease of use of the Power-Pro XT stretcher and Power-Load	171	153	16	2	0	0
How would you rate the ease of use of the foot end operator controls and handles?	171	143	25	3	0	0
How would you rate the foot controls for the steering and wheel locks?	171	135	29	7	0	0
How would you rate the Expandable Patient Surface (XPS)?	171	136	28	7	0	0
How would you rate the general functionality of all of the optional features (equipment hook, steer lock, knee gatch, retractable head and bottle holder)?	171	139	29	3	0	0
How would you rate the overall functionality of the Power-Pro XT stretcher?	171	151	18	2	0	0
How would you rate the overall functionality of the Power-Load Cot Fastener system?	171	144	25	2	0	0
Please enter your comments regarding the PowerPro XT Stretcher?	171	0	0	0	0	0
Please enter your comments regarding the Power-Load Cot Fastening system	171	0	0	0	0	0
Total	**1710**	**1162**	**178**	**28**	**0**	**0**

Feedback from York Paramedics

Stryker PowerPro XT Stretcher
This stretcher is easy to use and is another great step in injury prevention and prolonging a paramedics career, will save my back (46)
Excellent Stretcher, best one I have ever seen (63)
Seems good, need to try it in the field to judge (6)
Is there an extension head piece for tall sitting persons. There appears too be little to no support for the pt's head, if in the sitting position. There is quite a bit of time spent loading, especially if it is a dynamic call. What id CPR or ventilating is being done. The loading height in the stretcher is very high. With some medics, it will be above their eye level.
Great design...like the added options - (o2 tank holder etc). Not too heavy. Much smoother operation than that Ferno power stretcher. Quite comfortable too. GET THIS ASAP!!
At this time my only concern is the absence of the additional lifting points we currently have with the Ferno - they are often handy when pushing through snow etc. when assistance is available. It seems like a great product and I'm hopeful the field trial is favorable.
All the features on the stretcher will be a great benefit to all staff and pt's that will be using them. This item should definitely be strongly considered for NEMS.
Great item. The plastic side rails could become brittle and crack in very cold weather
By far the best stretcher I have seen in all my career. Easy to use, expandable for the LBS calls, the curved mattress and curved side rails are a definite need
Absolutely AMAZING!!! I can actually see me being able to retire. My only concern and it has already been mentioned, is the room for knees and feet between the stretcher and the medic seat. I believe the cot is being adjusted. (2)
Great stretcher, easy to use and no lifts required. Love all the extra features (e.g. the O2 bottle holder, equipment hook, retractable head, etc.) if other features are available please provide list.
It looks be been an amazing stretcher!! It is hard tell fully until we can use them in the field if we have any major issues but so far so good. The only question is if need be that we have to physically lift the stretcher (stairs, battery dies etc)
I found this stretcher to be easy to use, and I am certain it will make my work easier and less hazardous. It will also avoid making bariatric patients feel awkward because we may not need a lift assist from a full FIRE crew.
Awesome piece of equipment and long overdue. This will save many strain injuries as sadly our population expands (literally!!). I like all the extra mods on the cot. Will be fun to work with. Just need a hover (Jack) to get the patient from the floor to the cot!!
Some Concerns: overall heaviness of stretcher during traveling through cross country areas. i.e. grass, muddy parks, possible snow covered driveways…(2)
Much lighter and easier to carry than FERNO power cots, excellent product. Glad to see the service opening doors to other more superior companies!!
This has been on the market for 12 years and we're only looking at it now??? It's a far superior stretcher in comparison with the Ferno powercot. Faster, smoother. Prettier colour!!
Wow so much easier to use and without any effort, which will save on our backs, arms and legs....sweet. This will also be awesome for our pt for more comfort and able to adjust to the different types of body sizes and so much smoother
Need move head room/longer upper portion.

WONDERFUL WONDERFUL WONDERFUL!!! I had too many issues with using the last power stretcher due to functionality....this stretcher is much more user friendly. Would like to see 2 brakes on the wheels of the stretcher. Love the steering controls, will be easier for 1 medic to steer through halls or hospitals while another, once pt is offloaded. As well, with the steering, you won't feel the 'loss of control of the one end of the stretcher'. Being able to bend the 'knees' of the cot is great for long transport times, much more comfortable for the pt. The functionality of the head of the stretcher is much more user friendly, with only having to push the head in or out, instead of folding it...as well, it gives 2 better options for lifting (over a small bump or lip) while it is shortened. Being able to carry a oxygen cylinder at the head, strapped down would be a great option as well, not having to put it on the pt's legs, or moving it when folding the top end of the stretcher. The straps are much more pt friendly, and feel much more secure. Overall....FANTASTIC STRETCHER!!!
Really nice to use, moves well and easily. I like the side rails and the contoured mattress. The safety restraints actually feel like restraints now.
A very much improved stretcher over anything that has been trialed so far in both ease of use and functionality.
My main concern is how we keep the equipment and the patient dry when working in inclement weather. We must leave the stretcher out in the rain and snow while attempting to transfer a patient to it from a stair chair. A process needs to be developed to assist medics in managing these scenes.
Overall it seems wonderful. Love that there is no "lift" into and out of vehicle or to raise and lower the stretcher. It's difficult to assess the ease of use until using it in actual patient/emergency situations. It's a little scary at first- the thought of leaving a patient "suspended" in mid air. The actual mechanics are surprisingly smooth when raising and lowering the stretcher/carriage. The knee gatch is awkward as you have to hold the weight of the patient's legs in order to raise or lower the knee gatch. Also, the stretcher itself is VERY heavy if you do have to lift or carry it at all. It would have to be left outside a residence and the pt be brought to it. I know we have the stair chair but in inclement weather that means transferring the pt to the stretcher outside and then loading. This is a long time to get 'soaked' or frozen in a blizzard.
Pleased to know that NEMS is looking at other options other that FERNO. THIS A FAR SUPERIOR STRETCHER, CAN'T WAIT TO USE IT. MY BACK ALREADY FEELS BETTER
It's great. Will extend medic careers, and lower injuries. The steer locks and knee gatch are nice to have, not need to haves. In the Mercedes ambulance the seats are far too close. Both jumpseat and side seat. Knees right into stretcher.
Overall great system, not sure of the flexible side rails re. pt. girth but I love the ease of its functionality and capabilities.
The shoulder straps actually are placed on the pt.'s shoulders, much more comfortable and secure for the pt. Easy to use for the paramedic, with the added benefit of the telescoping head of the stretcher makes for greater maneuverability. As for the stretcher being the replacement for the LBS, the benefit for the LBS pt. is obvious. They will now have padding on the stretcher, the discomfort of the Ferno LBS stretcher was inhumane, think of the degree of pt.'s with pressure sores. That with the extended scene time required as you waited for the LBS unit to arrive, with the deployment of two vehicles for one call decreases resources.
The location of the monitor when attached to the support pole is very close to the face of the foot end medic when doing small lifts of the stretcher. The optional O2 (d tank) housing accessory at the head of the stretcher would be beneficial. A pou8ch to carry O2 supplies to accompany that would be great!
Only thing missing is a built in weight scale. You gotta get rid of the Boggie tube mount; it looks tacky and is not needed. Roll up the Boggie and put it in the bag or in the pouch behind the stretcher
The PowerPro XT is an amazingly simple, easy to use and safe unit and I look forward to using it in the field. I still need to see the final set-up with all of our routine equipment in place (monitor and pole, IV pole on the right side, etc.) however even without these items installed I would still highly recommend that NEMS purchase and deploy this stretcher system.

I am extremely excited about the possibility of getting this stretcher into use at NEMS. I think that this will greatly reduce injuries and go a long way in our effort to "road to zero". I am excited about all of the options on the stretcher. If it came down to eliminating an option(s) to make the process go through it might be the steering/locking wheel option. Even the knee gatch could be eliminated if necessary but I think that it would definitely be used.
It would be an excellent addition to have side handles mid way to help push the stretcher through snow and such. Overall excellent piece of equipment.
Absolutely love it; I wouldn't be on light duties if we had this stretcher now. I also love the mattress as well as the expandable side railings, I find that the majority of our pts seem to be getting larger and larger and it would be nice if every truck had the ability to have the LBS stretcher in it
This stretcher is excellent. It is far superior to Ferno. The shoulder straps secure the patient better, easy of use, the no lift benefit. It is a win-win for everyone, will definitely decrease injuries and prolong our careers! It is so well designed to accommodate all pt sizes and weights and moves easy. The knee lift component is so practical and beneficial for the patient as well, and I feel we have an obligation to provide the best service to our community and this is a great step in that direction. This stretcher is so much better then anything else out there it is a no-brainer not to get it. Please do it ASAP for all of us, medics, community everyone will benefit!
It's ok though not my first choice
Required to be mounted much further out from the wall, will make already cramped vehicles much worse
Due to weight of stretcher maneuverability through loose (snow, gravel) surfaces may be difficult. Regardless I really look forward to using this new piece of equipment.
This stretcher is easy to learn to use. It has many features that are user friendly. The controls are in the right position even for small hands.
All controls were extremely easy to use. The power mechanism of the stretcher was all extremely smooth. The placement of the expand/retract buttons is ergonomically correct as well. My back felt happy when loading this stretcher.
It would be great to possibly have a spare battery with a charging unit in the ambulance in any case the battery dies midcall. Also possibly a net on the bottom part of the stretcher where the wheels are so we can place bags and such when we move around as we are losing the side handles on the side of the stretcher.
I used a previous version of the power stretcher during my rideouts in York. I loved the functionality of it, and incurred no mechanical failure during the 5 months of use. I can already see this design is improved with XPS. The IV pole was on the Pt's left and never incurred any inconvenience with that position though it can pose a hazard in a moving vehicle. The power loader is very easy to use. I am curious to know how well it will function on inclines/declines, and how it would compare for ease of use against a unit without any loader system in similar circumstances. Is there an increased space requirement behind the vehicle? Overall, yes I without a doubt would like to see this system in Niagara.
The bariatric addition (wings), upgraded mattress and elevated knees seemed like a worthy upgrade (4)
The only issue was the yellow colour attracted bees when we were practicing outside

Stryker Power-Load Cot Fastening system
Excellent system (70)
This will reduce injuries significantly (30)
Very well built, and easy to use (26)
Pt's afraid of heights or who are contused or moving about, I can see being or having issues loading. Otherwise I do see this system as a professional career extender.
BY FAR the best piece of equipment I've seen in 16 yrs of EMS. Sad to know that it's been available since 2005 & has not been considered before now. Better late than never. Nice to see the fascination with Ferno being reconsidered. GET THIS ASAP!!!
OK, need to try it in the field to judge (2)
Top notch. The system seems solid and well secured. could be moved over 3-4 inches to accommodate the larger medics
Great system, will make pt feel safer and decrease lifts for medics. Best feature is how to prevents rolling if parked on uneven surface.
I felt more stable and secure in the back of the ambulance.
Seems fool proof. Have to trust the testing as to the fullest strength of it. (lots of weight on that pivot point where the horns pick up the stretcher)
Very impressive system and as stated above will save a lot of injury. Very fortunate to work for a service who would consider the expense and show such concern for staff.
It sounds like a good/ effective system. One small concern is not for the stretcher/ loading unit but with the new trucks and lack of width. There seems to be little leg room, operating room to perform on route emergence care (IV starts - getting proper body positioning...)
Very excited about this product, the thought of having 50% of lifts decreased makes me and my lower back very happy!! Thank you NEMS!!
Makes loading the pt in with ease and taking out with very little effort at all. This will definitely improve overall injuries that occur when lifting ....how about that stair chair any new modifications coming soon?
Same as above comments. It should be noted that the XPS, Steering, Knee Gatch, O2 holder, as well as something as simple as the storage hook, are valuable options that should be included in the purchase of this system.
The ease of which this stretcher is loaded is fantastic. not having to do any lifting will decrease on strain on our backs. it is wonderful to see something like this being brought to our service. For someone who is short, this stretcher is much more friendly to myself due to not having to lift it, or lift into the back end of vehicle.
I was quite amazed at the Power Load system and am very excited about it. I think it is necessary to NEMS in order to reduce injuries and extend the longevity of every paramedic's career. I feel that my career will be extended and without pain with this system and with the power cot. I can't imagine how excited our paramedics must be that have been here for several years and have performed many lifts will be to have this system installed. I think it is a very smart move for NEMS to go ahead and install this system.
Cool maybe a challenge to line up the locking pins at times
Great. Awesome to have with the Pro X. Maybe move it over, and the (head) jumpseat to accommodate medics?
A little confusing, need to work with it.
With this system the amount of lifts per shift for the paramedic crew will be cut in half. The resulting decrease in injuries will be quickly evident. Eliminating the need to steer pt. in and out of vehicle makes for a much smoother lift for the pt. This combined with the reduced chance of a dropped stretcher makes this stretcher the best choice for the pt.

Beautiful!!!!! The only problem that I can see (in our present Sprinter configuration) would be the limited space between the seat (jump seats beside and at the head) and the stretcher. This however can be adjusted to make more room and I myself would easily do with less leg room in exchange for a longer career and less lifting! Thanks for considering this stretcher no lift option for us at NEMS.
The pt will definitely be more secure, I found everything about this stretcher just easier
Great design. Excellent. Only issue is proximity to paramedic seat in rear at this time.
This stretcher is excellent. It is far superior to Ferno. The shoulder straps secure the patient better, easy of use, the no lift benefit. It is a win-win for everyone, will definitely decrease injuries and prolong our careers! It is so well designed to accommodate all pt sizes and weights and moves easy. The knee lift component is so practical and beneficial for the patient as well, and I feel we have an obligation to provide the best service to our community and this is a great step in that direction. This stretcher is so much better then anything else out there it is a no-brainer not to get it. Please do it ASAP for all of us, medics, community everyone will benefit!
Concern will be functionality in inclement weather, and cleaning of the unit when it becomes soiled with fluid, blood, vomit, etc. Also redundancy in the event of mechanical or electronic failure - ie ease of using system in backup manual mode.
This is a dream come true. With this system and the power stretcher we could never be closer to the road to zero than what you get with this system. Thank you for considering other systems and options out there. I look forward to using this system in the near future.
Some difficulty on angles but otherwise flawless
I have concern for the shoulder straps' lifetime as the rings the straps pass through do look as though they may wear the straps down over time. I heard there will be increased leg room at both the head and side. Ideally I would like to see this happens while maintaining seat adjustment if possible.
Glad it will eliminate difficult lifts into ambulance on uneven ground. Better, safer stretcher control
Power-Load cot fastening system requires no lift which will reduce spinal load and back injuries. It is safe for the patient also. Excellent system.

APPENDIX H – BODY MECHANICS TRAINING

Literature Review – Body Mechanics Training and Low Back Injury Prevention
Compiled by Lauren Doan (FHA Ergonomics), December 19, 2012

A body of literature from the past 25 years indicates that body mechanics education does not necessarily prevent back injuries. In a systematic review of workplace interventions to prevent low back pain, Maher (2000) found that body mechanics education was an ineffective intervention in the prevention of low back pain. Back braces were also found to be ineffective and the combination of workplace modifications and body mechanics education were found to be of unknown value. Workplace exercise (e.g., group calisthenics, strength and endurance training) was the only intervention found to be effective in low back pain prevention. A study by Tveito, Hysing and Eriksen (2004) revealed similar findings: only exercise interventions, multidisciplinary interventions and interventions aiming to treat employees with low back pain showed evidence of effect on low back pain. Educational interventions (e.g. body mechanics training) showed limited to no evidence of effect on new episodes of low back pain, sick leave, costs and level of pain.

Literature has also questioned the translation of body mechanics training from clinic to work environment and knowledge retention. Holmes, Lam, Elkind and Pitts (2000) reported that although employees showed increased ergonomic knowledge and proper lifting behaviours after safety training, the retention of this knowledge was only seen for a two week period of time. The researchers in this study were unable to show that body mechanics education had long-term, sustainable implications on proper lifting behaviours. The study also further determined that allowing employees to physically practice proper lifting/bending mechanics and ergonomic principles did not make a difference in training outcomes. Lieber, Rudy and Boston (2000) reported a need for greater evidence to support outcomes of the body mechanics education intervention, especially given the inherent complexity of lifting tasks that occur in the workplace. The authors questioned the validity of body mechanics training in a clinic setting and its ability to reliably translate over to the workplace where manual materials handling is multidimensional. Similarly, Carlton (1987) conducted a study to determine whether body mechanics instruction was effective in (a) teaching body mechanics principles and (b) improving lifting and lowering performance in the work environment. The outcome revealed that subjects who received body mechanics education performed better in the static laboratory environment, but did not perform better in the real work environment. Given these results, the question needs to be addressed: if there is little translation of skill from the clinic to the work environment and if there is question around the sustainability of body mechanics knowledge, why implement this intervention?

Comprehensive programs should involve reducing the physical demands of the particular job or task and empowering employees to develop and use strategies and equipment that reduce the strenuousness of their jobs. Tasks that involve handling heavy loads or sustaining awkward positions/movements (e.g., bending, stooping or twisting) should be modified (Myers et. al, 1999). To further this idea, Cheng and Chan (2009) found a statistically significant difference in knowledge and practical skills on manual materials handling after employees received job-specific assessment and training programs as opposed to receiving conventional body mechanics education. Results also revealed a significantly lesser number of first time reports of work related musculoskeletal back injuries in the experimental group that received job-specific training.

References

Akerstedt, T., Czeisler, C., Dinges, D., and Horne, J. (1994). Accidents and sleepiness: a consensus statement from the International Conference on Work Hours, Sleep and Accidents, Stockholm, 8–10 September, Journal of Sleep Research, 3(195).

Brown, S. (2009). *KIN-481 Musculoskeletal Disorders*. Custom Course Materials, Faculty of Science. Burnaby, Canada. SFU Document Solutions.

Canadian Standards Association. (2012). *Workplace Ergonomics – A management and implementation standard (Z1004-12)*. Retrieved from Shop CSA.

Carlton, R.S. (1987). The effects of body mechanics instruction on work performance. *The American Journal of Occupational Therapy,* 41(1), 16-20.

Chaffin, D., and Andersson, G. (1991). *Occupational Biomechanics* (2nd ed.). Toronto, Canada. John Wiley & Sons, Inc.

Cheng, A.S. & Chan, E.P. (2009). The effect of individual job coaching and use of health threat in a job-specific occupational health education program on prevention of work-related musculoskeletal back injury. *Journal of Occupational and Environmental Medicine,* 51(12), 1413-1421.

Costa, G. (1996). The impact of shift and night work on health. *Applied Ergonomics*, 27(1), 9-16.

Diffrient, N., Tilley, A. and Harman, D. (1981). *Humanscale*. Cambridge: The MIT Press.

Eastman Kodak Company (2004). *Kodak's Ergonomic Design for People at Work* (2nd ed.). New Jersey, USA. John Wiley & Sons, Inc.

ErgoRisk (2013). *Jobs Demand Analysis - Primary Care Paramedic*. Provincial Health Services Authority.

Ganster, D., Fox M., & Dwyer, D. (2001). Explaining employees' health care costs: a prospective examination of stressful job demands, personal control, and physiological reactivity. *Journal of Applied Psychology, 86*, 954-964.

Grandjean, E., and Kroemer, K. (1997). *Fitting the Task to the Human* (5th ed.). Padstow, UK. Taylor & Francis.

Hagberg, M. Silverstein, B., Wells, R., Smith, M., Hendrick, H., Carayon, P., and Perusse, M. (1995). *Work Related Musculoskeletal Disorders (WMSDs): A Reference Book for Prevention.* London, UK. Taylor & Francis.

Holmes, W., Lam, P.Y., Elkind, P & Pitts, K. (2008). The effect of body mechanics education on the work performance of fruit warehouse workers. *Work,* 31(1), 461-471.

Konz, S., Johnson, S. (2000). *Work Design: Industrial Ergonomics*. Scottsdale, AZ. Holcomb Hathway, Publishers Inc.

Kroemer, K, Kroemer, H., and Kroemer-Elbert, K. (2010). *Engineering Physiology: Bases of Human Factors Engineering/Ergonomics* (4th ed.). New York, USA. Springer.

Lieber, S.J., Rudy, T.E. & Boston, R. (2000). Effects of body mechanics training on performance of repetitive lifting. *American Journal of Occupational Therapy,* 54 (2), 166-175.

Maher, C.G. (2000). A systematic review of workplace interventions to prevent low back pain. *Australian Journal of Physiotherapy*, 46 (1), 259-269.
Mital, A., Nicholson, A., and Ayoub, M. (1997). *A Guide to Manual Materials Handling*. London, UK. Taylor & Francis.

Muchinsky, P. (2006). *Psychology Applied to Work* (8th ed.). Belmont, USA. Thomson Wadsworth.

Myers, A.H., Baker, S.P., Li, G., Smith, G.S., Wilker, S., Liang, K.Y. & Johnson, J.V. (1999). Back injury in Municipal Workers: A case-control study. *American Journal of Public Health,* 89 (7), 1036-1041.

National Institute for Occupational Safety and Health. (1981). *A Work Practices Guide for Manual Lifting*. Technical Report 81-122. USA, Cincinnati, US Department of Health and Human Services.

Pheasant, S., Haslegrave, C. (2006). *Bodyspace: Anthropometry, Ergonomics and the Design of Work* (3rd ed.). Boca Raton, USA. Taylor & Francis Ltd.

Rice, V. (1999). Preplacement strength screening. In Karwowski, W., and Marras, W. (Eds.). (2006). *The Occupational Ergonomics Handbook* (2nd ed.). Boca Raton, USA. CRC Press LLC.

Sanders, M., and McCormick, E. (1993). *Human Factors in Engineering and Design* (7th ed.). USA. McGraw-Hill, Inc.

Santhi, N., Duffy, J., Horowitz, T., and Czeisler, C. (2005). Scheduling of sleep/darkness affects the circadian phase of night shift workers. *Neuroscience Letters*, 384, 316-320.

Singer, S.J., Gaba, D.M., Geppert, J.J., Sinaiko, A.D., Howard, S.K., Park, K.C. (2003). The culture of safety: results of an organization-wide survey in 15 California hospitals. *Qual. Saf. Health Care*, 12, 112-118.

Smith, C., Folkard, S. & Fuller, J. (2003). Shiftwork and working hours. In Quick, J. & Tetrick, L. (Eds.) Handbook of organizational health psychology. Washington, DC. American Psychological Association.

Suzuki, K., Ohida, T., Kaneita, Y., Yokoyama, E., Miyake, T., Harano, S., Yagi, Y., Ibuka, E., Kaneko, A., Tsutsui, T., and Uchiyama, M. (2004). Mental health status, shift work, and occupational accidents among hospital nurses in Japan. *Journal of Occupational Health*, 46, 448–454.

Tveito, T.H., Hysing, M. & Eriksen, H.R. (2004). Low back pain interventions at the workplace: A systematic literature review. *Occupational Medicine,* 54(1), 3-13.

Vagg, P.R. & Spielberger, C.D. (1998). Occupational Stress: Measuring Job Performance and Organizational Support in the Workplace. *Journal of Occupational Health Psychology*, 3(4), 294-305.

White, L., and Keith, B. (1990). The effect of shift work on the quality and stability of marital relations. *Journal of Marriage and the Family*, 52, 453-462.