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EMS Safety, Stretchers, and Stretcher Handling

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SP16 EMS 201 “EMS Professional Development” Study

Abstract

What has the greatest impact on EMS crew safety in the area of patient handling? In this study, EMS safety – crew safety for loading and unloading the stretcher either with or without a patient, and the stretcher – primarily powered lift stretchers, and their interface to the ambulance – either the traditional hook and antlers or the powered stretcher lift will be examined. The author, serving in agencies purchasing new ambulances and refurbishing a number of older ambulances and having precepted in agencies with both power lifts and rail mounting systems, became curious as to why new ambulances or refurbishments would be purchased specifically avoiding the newer powered lift even with its incipient cost? What are both national and state level standards and design requirements for ambulances? This study will use current standards at both national and state levels for ambulances, current manufacturer documentation, and authoritative peer reviewed documents on EMS safety. This study finds there are few available studies in the area of EMS lifting safety and injury, and those areas supported by studies have found a large savings over a short period converting their equipment to power stretchers with power lift systems. The costs have generally been recouped within one to two years vice the potential lifetime impact of knee or lower back injury.

Keywords: Stretcher, Cot, Lift, Power-Cot, Stretcher-Lift, musculoskeletal, EMS, Safety,

EMS Safety, Stretchers, and Stretcher Handling

EMS Crews are at risk, standards and practice recommend equipment capable of improving patient handling. Agencies are looking at short-term cost reduction for ambulance purchase or renovation ignoring the potential long term impact to the EMT. Cases of a musculoskeletal incident possibly requiring hospitalization, long term care and/or rehabilitation, and payments from/to legal or insurance are increasing. Agencies could experience loss of reputation through resultant bad press or media reactions. Agency fiscal near-sightedness could result in costs considerably greater to the human resource than the cost of ergonomic improvements to EMS vehicles.

Emergency Medical Service (EMS) crews risk injury due to the lack of proper patient movement and handling ergonomics or supporting equipment on both older and newer ambulances. Our patient population, are becoming larger and in general very heavy (ne obese). Agencies used manual lift stretchers or cots in the past but now almost all use some form of electrically operated, powered stretchers to raise and lower the stretcher wheels or stretcher itself.

Modern powered stretchers are stronger enabling heavier/larger patients. Adding mechanical lift mechanisms, batteries, and motors to incorporate the lift capability add weight to the stretcher before adding the potentially larger patient. EMS personnel, starting younger, are perhaps not as physically fit having lived relatively sedentary lives in our current computer and video entertainment oriented society vice previous labor and agrarian lifestyles. This EMS lifestyle possibly leading to less physical strength capacity. (This is an area for possible future study.) Injuries or strains from improper lifting can lead to a minimum of temporary disability, permanent disability, or a life of pain. EMS agencies incorporate more training in proper lift techniques and require more personal physical fitness.

First discussed in 1997, manufacturers are answering the call for increased EMS crew and patient safety by the developing power lifts. The power lift is an electro-mechanical means of taking control of the stretcher, stabilizing and moving the stretcher into or out of the ambulance, with or

without a patient on board. Power lifts have taken two forms – adding the mechanism to the ambulance, or adding a form of ambulation to the stretcher.

Literature available for the subject was plentiful from stretcher and stretcher lift manufacturers, standards for ambulance construction are now coming to the forefront. However, statistics and studies on EMS hazards, patient handling risk, and EMS injury are limited.

EMS personnel like many professional trades don't like to admit they can't "do it all". "An injury, pain, or strain will go away... I can take a few days' vacation and rest up; I'll feel better then." "It's my job and I have a family to take care of." Therefore, studies and statistics are often hard to find and track. As many studies are performed by EMS personnel, authors typically don't shed light on our own internal problems. (EMS 201 and 211 discussions)

EMS Back Safety and Lifting

EMS Back Safety

EMS personnel are required to handle the EMS stretcher either with or without the patients a minimum of nine times:

1. Removal of the stretcher from the ambulance.
2. Movement of the stretcher to the location where the patient is found.
3. Movement to their own location, to the stretcher, or to temporary carry i.e. stair chair, reeves sleeve or stokes type baskets, or onto full length back board.
4. Movement of the stretcher to the Ambulance, possibly over numerous steps, across rough, uneven, smooth, firm, or not so firm terrain.
5. Movement of the stretcher into the back of the ambulance.
6. Movement of the patient out of the ambulance at the health care facility.
7. Movement of the patient into the health care facility to the assigned room or waiting area.

8. Movement of the patient from the stretcher to the health care bed or waiting area seating (whether a chair or wheel chair).
9. And finally return of the stretcher to the ambulance once turnover is accomplished.

Two studies evaluated the biomechanical impact on emergency response personnel. (Fredericks, Butt, Harms, & Burns, 2013) (Goodlow, Crowder, Arthur, & Thomas, 2012) Both pointed out the paucity of EMS stretcher and lifting injury analysis, referring to articles published in 2000, 2006, and 2007. Both referred to the lack of national injury tracking preventing additional study, and the lack of any movement toward such tracking even in the presence of EMS advocacy groups.

One study abstract discussed a power cot implementation. Austin/Travis County Texas EMS evaluated their safety records over the pre-hydraulic stretcher period of 1999 through 2006 (a total of 2087 man-years) and the post implementation period of 2007 through April of 2008 (approximately 706 man-years). Their pre-hydraulic injury rate was 61.1 per 100 full time employee (FTE), and 28.8 per 100 FTE post implementation. The authors and the EMS system found this to be significantly worthwhile implementation investment. (Studnek, Crawford, & Fernandez, 2012) Studnek is often quoted in other studies.

Studies related to ergonomics of EMS personnel crews while assessing and treating their patients inside the ambulance compartments were not considered in this paper.

Patient and stretcher movements 1, 5, 6, and 9 described above were studied using kinetic and biomechanical failure analysis to determine levels of biomechanical stress as relate to EMS personnel injury creating lower back stresses. (Cooper & Ghassemieh, 2007) Oklahoma City/Tulsa EMS agency was studied for adverse events from July 2009 through June of 2010. Studying 129,100 patient transports, finding 23 adverse stretcher events. No patient injuries

occurred, however, 15 events were during unloading, five loading, and three during surface movement. Of contributing factors, 14 of 23 were due to stretcher/ambulance safety latch issues and only two due to uncooperative patients. Reported EMS injuries included two knee and two back injuries. (Goodlow, Crowder, Arthur, & Thomas, 2012)

Definitive numbers based on experimental findings rather than experiential data from EMS agencies, examined the perceived effort of experienced EMS provider teams using four different combinations of cot/loading mechanisms. The three combinations studies consisted of a manual cot (41.5 kg + 75 kg manikin) and antler based retention system (similar to that of Studnek prior to 2007), a power cot (63.5 kg + 75 kg manikin) with both power lift antler and non-power lift antler retention systems (essentially the system used in Studnek post 2007, however with addition of the powered lift mechanism), and a European cot rail system (59 kg + 75 kg manikin) requiring action from two personnel to retract the legs but using a manual rail system to guide and then secure the cot once fully inside the ambulance. (The author personally used this system with an upgraded electric leg retraction system cot and personally found this system extremely heavy and quite challenging to align even while inside the station.) The two North American style systems were used on an ambulance deck approximately 815 mm high, while the European was 700 mm (very similar to newer American ambulances capable of kneeling during patient loading.) The study results compared time to load, load cell measurements, and perceived exertion ratings. The powered cot on the powered lift took approximately one-third more time than the shortest time combination (29 seconds vice 19 seconds for the European system). Most significant though was the perceived effort results: powered cot with powered lift – 6.3, powered cot with manual antlers – 8.45, manual cot with manual antlers – 9.65, and European manual cot with rail – 13.10. Final results demonstrated the

benefit of the minimal lower back stress of the power cot/power lift combination vice even the power cot with its manual antler system. (Fredericks, Butt, Harms, & Burns, 2013)

EMS Stretcher Training

EMS personnel are trained and tested on proper lift methods during entry level courses. Precepting agencies demonstrate and review stretcher systems during initial ambulance orientation. EMS cognitive exams at all levels include questions on patient handling and safety. High levels of emphasis on teamwork, keeping hands in, palms up, close to the body position and use of knees vice lower back are emphasized in numerous EMT texts. (Pollak, 2011) (Beebe & Myers, 2012) (Caroline, 2012)

EMS Back Injury and Costs

While the studies examined ((Goodlow, Crowder, Arthur, & Thomas, 2012) (Fredericks, Butt, Harms, & Burns, 2013) anecdotally pointed out the relatively low incidence of EMS injury, the extent of study is quite small (two larger EMS systems), both emphasized the benefits of powered stretchers and of powered stretcher/power lift systems with education highlighting specific events and conditions exacerbating possible injury.

Internet searches failed to identify back injury costs to EMS personnel perhaps due to HIPPA considerations as well as the minimal availability of EMS injury data. Readers wishing to further study lower back injury should consult the McGill Study on “The Biomechanics of Low Back Injury: Implications on Current Practice in Industry and the Clinic” 1997.

One article, with possible corporate interest, alluded to the work related injuries sustained by responders relating to physical aspects of lifting and loading patients but did not provide data or justification. (Whooley, 2015)

One manufacturer article provided statistics from the commercial EMSStat system in Oklahoma. In the one-year period 2011-2012, EMSStat had 10 provider injury claims directly relating to cot handling, totaling over \$251,000. EMSStat's solution to their increasing claim losses, was implementing the Stryker powered cot/cot lift system in their 14 vehicles reducing their incidents to zero within 2 years. (Stryker Mkt Lit-983 09 JUL 2014 Rev B.2, 2014)

The subcommittee meeting slide deck from The National Academies Transportation Research Board (TRB) provided the best EMS numbers impact for lifting injuries. During the January 2013 EMS Safety Meeting, the most notable presentation included graphs portraying EMS work impact. During 2010, of 8,360 cases tracking days away from work among EMS, 56% were due to overexertion and 38% directly related to lifting. The median number of days away was six days, with 24% of the 8,360 cases being greater than 31 days. (National Academies TRB 92nd Annual Meeting Various Authors, 2013)

EMS Stretchers and Manufacturers

Two primary manufacturers of Ambulance stretchers are Stryker and Ferno. Both companies continue to advance their capabilities (but also the weight). The manufacturers goal seems consistent – improve provider safety while accounting for the increasing weight of both patients and equipment. A third type (not examined in this study) provides a lift similar to a delivery truck lift platform lifting the stretcher to the ambulance deck. (Whooley, 2015)

Stryker

Stryker, a large medical device manufacturer, developed the Stryker Power-PRO Cot and Power-LOAD system capable of lifting and supporting patients weighing up to 700 lbs. This system uses of a pair of antlers interfacing with the cot upon alignment of the cot with the loading device. Web searches provided a public price of \$20K for the Power-LOAD, and \$27K

for a combination of Power-PRO cot with the Power-LOAD. (Medical Equipment Inc, 2016).
(Stryker, 2016)

FERNO

iN/X Integrated Patient Transport & Loading System has a web base price of \$33.7K. (FERNO, 2016) The iN/X takes a different approach, using independent front and rear legs, greater height ability, and uses the typical fixed antler/peg clamp retention system within the ambulance. The iN/X eliminates the stretcher lift by lowering the rear legs as they clear the back of the ambulance. While this system allows usage in current antler fastening systems, it's cost is greater than other powercot/power lift type systems.

Ambulance Standards, Best Practices, Guidelines, and Regulations

The most used and national required purchasing specification, KKK-A-1822 (A-F) referred to as "Triple K" has been the guideline since 1974 for federal agencies and grant recipient agencies in order to purchase a ground vehicle ambulance. (Busch, 2015) The Triple K scheduled to be retired in 2015 was extended to October 2016, with the advent of the NFPA standard 1917 2nd ed. Two other competing standards, the Commission on Accreditation of Ambulance Services (CAAS) and National Fire Protection Association (NFPA). NFPA based their standard, NFPA 1917 Standard for Automotive Ambulance, on the existing NFPA 1901 used by fire agencies in combination with the Triple K. The CAAS Ground Vehicle Standard (GVS-2015) examined the minimum requirements for new purchase of limited forms of OEM Chassis based ambulances. (Green, 2015)

Further complicating the standards and specifications requirements are the Society of Automotive Engineers (SAE) Crash Safety Standards and J standards for component and system testing. These standards impact internal driver compartment as well as the EMS treatment

compartment even to the types of cabinets used to store EMS supplies and equipment. (Busch, 2015) SAE 3027 specifically addresses litter fasteners and anchors with a primary concern being that of high speed and rollover crashes ensuring the patient and the litter stay in place vice patient/litter handling. SAE 3027 compliant systems cost an average of \$1-4K with power loading systems potentially adding \$40K per ambulance. All current standards fail to address older ambulance retrofit and remounting. Olson recommended we “take a walk out in the apparatus bay. Look at the mechanism by which your cot is affixed to the floor of the module. Look around and see where portable equipment is or is not appropriately mounted.” (Olson, 2015) Many current manufacturers’ also have outstanding recalls on the traditional mounting systems. Has your agency corrected those recalled systems?

The second edition of NFPA 1917, published in early 2016, was to incorporate the Triple K and the CAAS standards, becoming an all-encompassing standard. NFPA 1917 section 6.22 addresses Patient Cot Retention, leaving most of the requirements to the manufactures as long as the SAE J3027 Ambulance Litter Integrity, Retention, and Patient Restraint standards are met. NFPA 1917 is written using “shall” as many NFPA documents become adopted as regulation. (NFPA, 2016)

Virginia EMS Regulation 12VAC-31-810 incorporated the SAE standards effecting ambulances manufactured after July 1, 2015. (Davis & Berg, 2015) (Virginia State Board of Health, 2016) EMS regulations require ground ambulances to meet USGSA KKK-A-1822 standards as of the date of vehicle construction. 12VAC5-31-710 describes the patient restraint but not stretcher retention. Paragraph 860 and others related to patient transport require a cot with minimum of 350 lb. capabilities with manufacturer retention system. (Virginia State Board of Health, 2016) During the RCC Operations Course (EMS 211), one guest speaker discussed

potential changes to regulations. When queried, he did mention possible requirements for stretcher lift devices would be forthcoming.

Results, Conclusions, and Recommendation

The EMS safety related to stretchers, and stretcher handling remains a problem. EMS provider training, practice, and personal fitness are still the primary form of protection from musculoskeletal injury. Recordkeeping needs to improve before adequate study will enable changes to equipment. Current agency budgets are typically considered prior to the EMS providers' future livelihood or life style.

Considerable anecdotal studies demonstrate the savings to agencies but more importantly the reduction to zero for back and knee related injuries. Agencies should desire reducing injuries due to overexertion and reduce missed work through short term investment in equipment.

Recommend Virginia consider require improved patient handling equipment, not only on new but also reconditioned or refitted, ambulances. Further recommend agencies consider the long term impact on their EMS career and volunteer members, as well as possible reductions in insurance costs and the potential image improvement related to better patient handling capabilities on their patient transport fleet.

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Glossary/Definitions

As an engineer working with standards, practices, and regulations or codes on a daily basis, allow the author to define many of these terms first.

A regulation is considered law, and typically uses the word “shall”.

Codes are commonly part of regulation and law once adopted, i.e. NFPA 70, the National Electrical Code.

Standards are established by groups (the standards body or board) of concerned people, companies, manufacturers, possibly academia, and both private and government users. Standards are considered by all as the “MINIMUM” capability or function to be upheld if brought before a court and meet the Regulations.

Best Practices often supersede or exceed the standards and meet regulation. Best practices by accepted definition are dependent on the group or organization determining the best practice. Best practices can be quite defined and are typically addressed if legal issues arise.

Guidelines can tend to be arbitrary, established by the user or purchaser, agency or operation, must meet the regulation, but can be anywhere within the spectrum of regulation through best practices.

Specifications are sets of defined limits either at the minimum or maximum or a combination of both set by the purchaser, user, or stakeholder for a given item to meet. Specifications must meet regulation, but are defined somewhere based on the standards, best practices, or guidelines.