Proceedings of the XXIst Annual International
Occupational Ergonomics and Safety Conference
Dallas, Texas, USA
11-12 June 2009

THE IMPACT OF GURNEY DESIGN ON EMS PERSONNEL

Tycho K. Fredericks, Steven E. Butt, and Ashley Hovenkamp

Human Performance Institute
Department of Industrial and Manufacturing Engineering
College of Engineering and Applied Sciences
Western Michigan University
Kalamazoo, MI 49008-5336 USA
Corresponding author's e-mail: tycho.fredericks@wmich.edu

Abstract: There are many studies describing the ergonomic benefits of various product interventions, but it is rare to learn about the financial impact of an ergonomic intervention on a company. The objective of this study was to determine the financial impact of two different gurney designs on an emergency medical service. Claims data over a four-year period was obtained for a service in Northern California through a partnership with a large US emergency medical service provider. Throughout the first two years, the EMS service used gurneys which required EMS professionals to lift and lower patients manually. During the subsequent two-year period, the service replaced the manual gurneys with a fleet of battery powered gurneys capable of being raised and lowered using an activation switch. Results of the pre/post powered gurney installation revealed a 41% decrease in claims paid due to gurney related incidents. Additionally, claims paid associated exclusively with raising and lower gurneys decreased 96% and 69%, respectively.

1. INTRODUCTION

Emergency medical service (EMS) personnel have to carry patients and equipment over long distances and transfer them between ambulances and the hospital environment on a regular basis. The physical exertion required to move patients during pre-hospital care causes high injury rates within this profession (Crill & Hostler, 2005). The US Bureau of Labor Statistics (BLS) reports an incidence rate of 13.9 thousand recordable cases of nonfatal occupational injuries and illnesses for ambulance personnel in 2007, with approximately 6.4 thousand of these resulting in lost days at work, job transfers or job restrictions (BLS, 2007a). They also report that musculoskeletal disorders account for approximately 2.2 thousand of these injuries and result in a median 6 days away from work (BLS, 2007b). These injuries can result in high workers compensation costs in addition to lost work days and possible job reassignments.

Biomechanical and postural analysis of frequently performed work tasks for paramedics have been performed in order to aid in redesigning EMS equipment (Cooper & Ghassemieh, 2007; Fredericks, et al., 2002a; Fredericks, et al., 2002b; Lavender, et al., 2000a; Lavender, et al., 2000b). Recent studies have shown that these types of ergonomic interventions reduce the physical exertion needed for EMS personnel to move and transfer patients. In particular, Lavender, et al (2007a; 2007b; 2007c) have shown that ergonomic interventions in stairchairs, gurneys, and lateral transfer methods can decrease trunk muscle loading, directional spine movements, and perceived physical exertion. Fredericks, et al. (2002a) showed that stairchairs, in which the stairwell itself was used to partially support the weight of the patient, significantly reduced the biomechanical stresses on the body. Comparisons have also been made to determine the ergonomic differences between currently used EMS stairchairs using both subjective physical exertion data and quantitative sheer and compression measures (Butt, et al., 2002; Fredericks, et al., 2006). Although in trials these ergonomic improvements have shown reduced stress and physical exertion on EMS personnel, no research has been done to determine the impact of these interventions on compensation claims and lost and restricted work days in actual practice. With that said, it is the objective of this endeavor to determine the financial impact of two different gurney designs on an EMS service.

2. METHODS AND PROCEDURES

In order to determine the financial impact of two different gurney designs, a partnership was formed with a large US emergency medical service provider. Following HSIRB approval, claims data from a service in Northern California was obtained for a four year period (March 2004 to February 2008). In the middle of this study period the type of gurney used by the service was updated to an ergonomically improved model. From March 2004 to February 2006 the Stryker MX-PRO™ manual gurneys were used exclusively to provide services. This type of gurney required EMS personnel to lift and

ISBN # 97809652558-4-4

lower the patients manually on the gurney every time it was used. In March 2006, this model was updated to the Stryker Power-PRO™ XT powered ambulance gurney for the entire service. The Power-PRO™ XT is a battery powered gurney capable of raising and lowering itself and the patient hydraulically using a switch on the handle. The subsequent two years of data were collected while the new gurney was in service.

Claims data received from the ambulance service were sorted to remove non-equipment related injuries such as needle sticks, inhalation, and illness. All event descriptions in which a gurney was identified as in use were separated and then re-evaluated to be sure that the gurney was involved in the incident. Throughout the re-evaluation process the ambulance company was consulted in order to clarify claim entries in their databases. Occasionally discrepancies existed between databases, including the exact figures for claim totals and lost or restricted work days. All discrepancies were channeled back to the emergency medical service provider for clarification.

Once all event descriptions were deciphered they were then coded as per the type of activity being performed when the injury occurred. Several activities in particular were of interest since they were the most frequently identified in the event descriptions. These were loading and unloading the gurney from the ambulance, raising and lowering the gurney, moving the gurney, and transferring the patient to and from the gurney. Follow-up interviews were also necessary to explain specific data entries where the cause of the incident was unclear in the description. For example an entry may read, “While lifting patient on gurney EMS personnel strained lower back.” Follow-up information was gathered to determine if this entry referred to the gurney being lifted with the patient already on the gurney or the patient being lifted *onto* the gurney. It was also noted if other equipment was in use, for example “Pulling gurney with patient out of ambulance, seatbelt stuck in wheel, EMS personnel felt back pain.” Environmental factors affecting the accident were also noted such as, “Lifting patient to gurney on dirt track, ankle rolled and gurney fell on EMS personnel.”

Upon completion of data coding, analyses were performed to compare the injury types, claim totals incurred, and lost and restricted work days for the 24 months in which each gurney model was used. For analysis, the total claims incurred included all expenses, indemnity and medical costs. The analysis did not include an assessment of cost for lost or restricted workdays. Since the hydraulic lift mechanism in the new gurney model was designed to reduce the physical exertion of EMS personnel while the gurney is raised or lowered, types of injuries related to these activities were further studied.

3. RESULTS

When reviewing the financial impact of the two gurney designs on the ambulance service, the claim total incurred was thought to be a good surrogate measure for both the severity and frequency of injuries. In addition, the number of lost and restricted work days was used to further study the frequency of gurney related incidents pre- and post- installation. During the 24 months before the installation of the new gurney design incidents related to gurneys resulted in claims totaling $88,453, with 208 lost work days and 478 restricted work days. After the installation of the new gurney design, claims fell to $51,870, a decrease of 41%. Lost work days fell to 66 and restricted days to 278, a 68% decrease and 42% decrease, respectively. Figure 1 displays graphically the claim totals and lost and restricted workdays. In those same time periods the company had an overall decrease of 50% in all claims and a 63% and 70% decrease in lost work days and restricted workdays, respectively, as shown in Table 1.

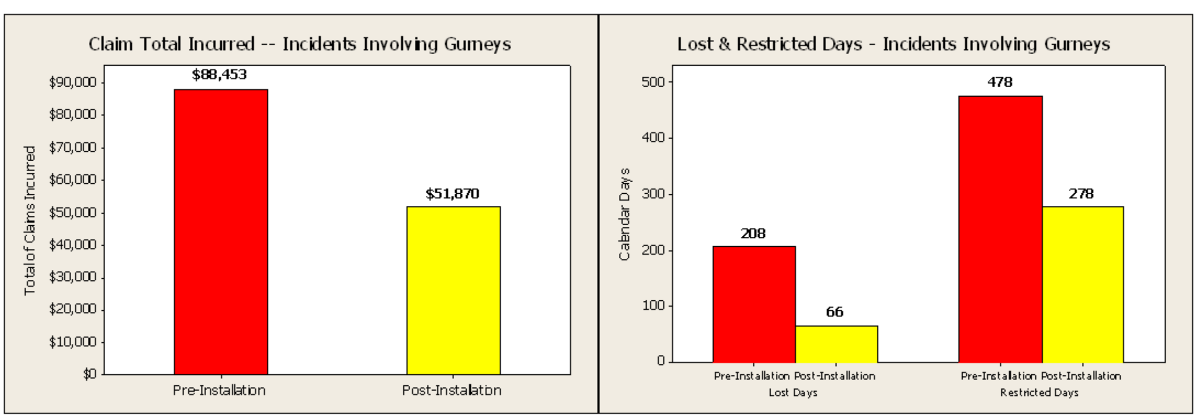

Figure 1. Graphical Displays of the Claim Totals and Lost and Restricted Calendar Days Pre- and Post- Installation

Table 1. Claim Totals for Gurney Incidents and All Incidents Pre- and Post- Installation of New Gurney Design

Gurney Incidents	**Pre-Installation**	**Post-Installation**	***Percent Decrease***
Claim Total	$88,453	$51,870	41%
Lost Days (days)	208	66	68%
Restricted Days (days)	478	278	42%
All Incidents	**Pre-Installation**	**Post-Installation**	***Percent Decrease***
Claim Total	$351,966	$177,295	49%
Lost Days (days)	1300	480	63%
Restricted Days (days)	1360	408	70%

Gurney related claims prior to the ergonomic intervention represented 25% of all claims, however the nature of this service's business changed over the study period. This included an overall increase in transports of 55%, and an increase in emergency transports of 70% (Table 2) after the installation of the powered gurneys. To compensate for this increase, the data were analyzed on a per-transport basis. This showed a 62% decrease in claim dollars per transport, and an 80% and 62% decrease in lost work days per transport and restricted work days per transport, respectively. Figure 2 and Table 3 presents these findings.

Table 2. Number of Transports Pre- and Post- Installation of New Gurney Design

	Pre-Installation	**Post-Installation**	***Percent Increase***
Emergency Transports	42,604	72,593	70%
Non-Emergency Transports	31,417	42,041	34%
All Unit Transports	74,021	114,634	55%
Unit Hours	287,309	418,700	46%

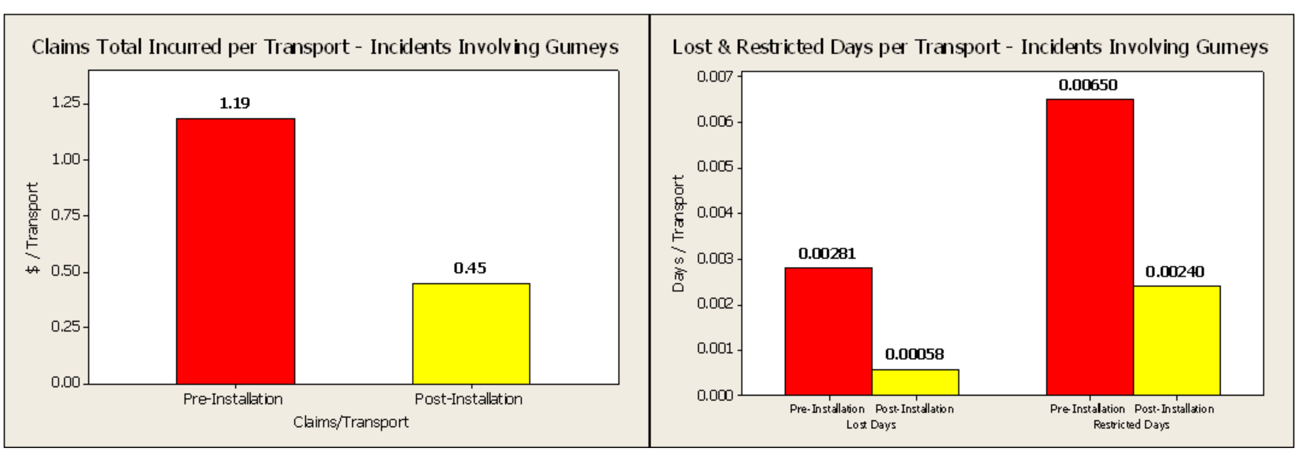

Figure 2. Graphical Displays of the Claim Totals and Lost and Restricted Calendar Days Per Transport

Table 3. Comparison between Total and Per Transport Claims, Lost Days, and Restricted Days for Gurney Related Incidents

Total	**Pre-Installation**	**Post-Installation**	***Percent Decrease***
Claims ($)	88,453	51,870	41%
Lost Days (days)	208	66	68%
Restricted Days (days)	478	278	42%
Per Transport	**Pre-Installation**	**Post-Installation**	***Percent Decrease***
Claims ($/transport)	1.19	0.45	62%
Lost Days (days/transport)	0.00281	0.00058	80%
Restricted Days (days/transport)	0.0065	0.0024	62%

It was also of interest to understand if the activities surrounding injuries and their financial consequences changed with the installation of the powered equipment. To investigate the surrounding activities, the data were divided and studied by specific incident types. Most incident types decreased after installation of the new gurney design as shown in Figure 3. An increased frequency in incidents related to loading the gurney into the ambulance occurred post-installation, specifically during the first month of use. In fact, 52% of the cost associated with loading incidents occurred in that first month after installation. Follow up interviews revealed that the new gurney was not being loaded as per manufacturer's guidelines. Guidelines required a loading process involving two EMS personnel, but in most cases the gurney was being loaded by only one. Incidents related to specific equipment challenges also increased after installation, however these incidents had no connection to the gurney being power or manually operated. An example of this type of incidence included an EMS worker being struck by an external object while pushing the gurney.

A decrease was specifically noted in raising and lowering the gurney, as anticipated due to the new hydraulic mechanism to raise and lower the gurney. Total claims associated with raising or lowering the gurney decreased from $42,114 to $3,412 as shown in Table 4. Although injuries were more frequently associated with raising the gurney, most of the claims paid were for incidents while lowering the gurney. At this point it is not known if this was due to sudden load bearing or the body postures assumed during a manual lowering operation. Further studies are underway to provide insight into these questions. Claims when lowering the gurney decreased a total of 96%, from $36,111 to $1,562, as shown in Figure 4. The ergonomic improvement to the raising and lowering mechanism of the gurney resulted in an overall claims savings of 92% in the two years after installation as compared to the two years prior to installation.

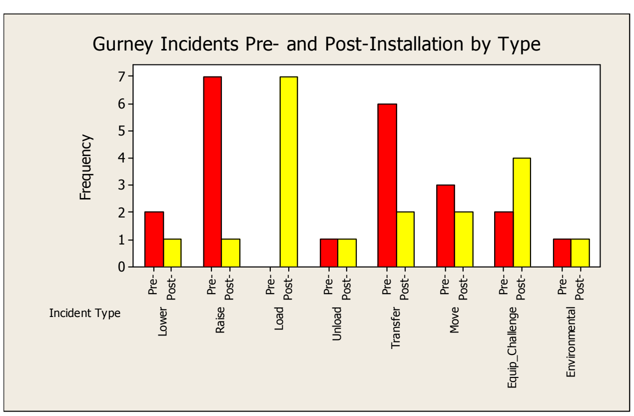

Figure 3. Frequency of Specific Types of Injuries Associated with Gurney Incidents

Table 4. Total Claims Paid and Frequency of Claims by Type of Incident

		Pre-Installation	Post-Installation	*Percent Decrease*
Claims Paid	Raising Gurney	$6,003	$1,850	69%
	Lowering Gurney	$36,111	$1,562	96%
Incidence Count	Raising Gurney	7	1	86%
	Lowering Gurney	2	1	50%

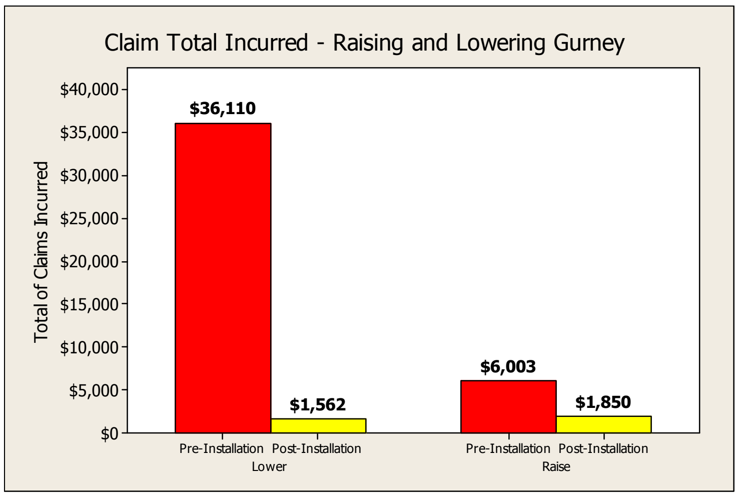

Figure 4. Claim Totals Associated with Raising and Lowering a Gurney

4. CONCLUSIONS

This study highlights the positive financial impact realized by an EMS service after installing equipment that reduced the task demands on employees. More specifically, after installation of the battery powered gurney, which would raise and lower the gurney and patient hydraulically, a 41% decrease in claims paid and a 62% decrease in the amount of claims paid per transport for incidents involving gurneys were realized. Additionally, claims paid associated with raising and lowering gurneys decreased 69% and 96%, respectively. Overall, the installation of the ergonomically improved gurney design resulted in significant savings while the frequency of calls for the studied service increased. This ergonomic intervention demonstrates that appropriately designed equipment may not only be good for the employee but makes sound financial sense.

5. REFERENCES

Butt, S. E., Fredericks, T. K., Choi, S. D. and Kumar, A. R. (2002). Comparison of Commercial Stairchairs Using Data Envelopment Analysis. *Proceedings of the XVI Annual International Occupational Ergonomics and Safety Conference*, International Society for Occupational Ergonomics & Safety, Available in CD-ROM Format.

Cooper, G. and Ghassemieh, E. (2007). Risk assessment of patient handling with ambulance stretcher systems (ramp/(winch), easi-loader, tail-lift) using biomechanical failure criteria. *Medical Engineering and Physics*, *29*, 775-787.

Fredericks, T.K., Butt, S.E., Kumar, A.R., and Amin, S.G. (2006). Biomechanical Analysis of EMS Personnel using Stair Chairs with Track Systems. *Proceedings of the 11th Annual International Journal of Industrial Engineering Conference*, Available in CD-ROM Format.

Fredericks, T. K., Choi, S. D., Butt, S. E. and Kumar, A. R. (2002a). Biomechanical Analyses of Paramedics Using Stairchairs. *Proceedings of the XVI Annual International Occupational Ergonomics and Safety Conference*, International Society for Occupational Ergonomics & Safety, Available in CD-ROM Format.

Fredericks, T. K., Choi, S. D., Butt, S. E. and Kumar, A. R. (2002b). Postural Analysis of Paramedics Using Stairchairs. *Proceedings of the XVI Annual International Occupational Ergonomics and Safety Conference*, International Society for Occupational Ergonomics & Safety, Available in CD-ROM Format.

Hostler, D. and Crill, M. T. (2005). Back strength and flexibility of EMS providers in practicing prehospital providers. *Journal of Occupational Rehabilitation*, 15(2), 105-111.

Lavender, S. A., Conrad, K. M., Reichelt, P. A., Gacki-Smith, J., and Kohok, A. K. (2007a). Designing ergonomic interventions for emergency medical services workers – part I: Transporting patients down the stairs. *Applied Ergonomics*, *38*, 71-81.

Lavender, S. A., Conrad, K. M., Reichelt, P. A., Johnson, P. W., and Meyer, F. T. (2000a). Biomechanical analysis of paramedics simulating frequently performed strenuous work tasks. *Applied Ergonomics*, *31*, 167-177.

Lavender, S. A., Conrad, K. M., Reichelt, P. A., Kohok, A. K. and Gacki-Smith, J. (2007b). Designing ergonomic interventions for emergency medical services workers – part II: Lateral transfers. *Applied Ergonomics*, *38*, 227-236.

Lavender, S. A., Conrad, K. M., Reichelt, P. A., Kohok, A. K. and Gacki-Smith, J. (2007c). Designing ergonomic interventions for emergency medical services workers – part III: Bed to stairchair transfers. *Applied Ergonomics*, *38*, 581-589.

Lavender, S. A., Conrad, K. M., Reichelt, P. A., Meyer, F. T., and Johnson, P. W. (2000b). Postural analysis of paramedics simulating frequently performed strenuous work tasks. *Applied Ergonomics, 31*, 45-57.

United States Bureau of Labor Statistics. (2007a). Cases and demographic characteristics for work related injuries and illnesses involving days away from work. *Table 2: Numbers of nonfatal occupational injuries and illnesses by industry and case types, 2007*. Retrieved on March 26, 2009 from http://www.bls.gov/iif/oshcdnew.htm.

United States Bureau of Labor Statistics. (2007b). Cases and demographic characteristics for work related injuries and illnesses involving days away from work. *Table 11: Number, incidence rate, and median days away from work of occupational injuries and illnesses involving days away from work by selected occupations with musculoskeletal disorders in private industry for all United States, 2007*.Retrieved March 26, 2009 from http://www.bls.gov/iif/oshcdnew.htm.