SAFETY EVALUATION OF A MEDIC'S WORK ENVIRONMENT DURING RURAL EMERGENCY RESPONSE

by

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ABSTRACT

The purpose of this study was to gain a better understanding of emergency medical service working conditions, and to develop recommendations to aid in minimizing harmful actions and behaviors inherent in EMS work. The naturalistic data collected in this study allowed researchers to perform analysis in a rural emergency driving environment to identify contributing factors to attending medic behavior, severity of biomechanical forces experienced in the driver and patient compartment, and an evaluation of emergency medical response safety culture. Based upon research findings, the project includes development of a series of environmental, ergonomic, policy, or training recommendations to mitigate circumstances that cause potentially unsafe operations in the driver's and patient's compartment of the ambulance. This study used naturalistic data and video, survey responses, focus groups, and agency patient care records to analyze the rural medics' working environment during emergency patient transportation. Accelerometer data was analyzed for 102 separate emergency transports to provide descriptive statistics relevant to whole-body vibration experienced by the medics during patient care. Five years of patient care records were analyzed to identify specific patient illnesses and medical procedures associated with traveling in emergency response mode. Restraint compliance rates were collected for both self-reported (21.5% restrained) and observed (2.6% restrained) data collection methods. Focus groups identified factors influencing medics' choice to be unrestrained, characterized by a reduced ability to provide patient care, the belief that restraint devices will cause harm to the medics, and the belief that the restraint devices are ineffective in a crash situation. Finally, reach analysis was conducted to highlight the procedures and equipment retrieval which require the medics to assume positions resulting in awkward and unstable postures during transport. The results of this study will add to the growing body of knowledge surrounding the behaviors of EMS workers in a real work setting, will aid in understanding the complexities of EMS safety culture, and can be applied toward different aspects of EMS work such as driver or medic training.

CHAPTER 1

INTRODUCTION

Every year, approximately 6,500 ambulance collisions occur that injure an estimated ten people per day, and result in two fatalities per week. Injured parties include emergency medical service (EMS) personnel, non-EMS affiliated ambulance occupants, and other persons involved in the incident, such as pedestrians, other vehicle occupants, etc. EMS personnel maintain an occupational fatality rate almost five times higher than the general public, and similar fatality rates to other emergency-response workers. EMS workers have a fatality rate of 12.7 deaths per 100,000 workers overall, over 75% of which are related to transportation [1]. Compared to other emergency services, ambulance occupants are more likely to be injured and killed during transportation (9.6 deaths per 100,000 workers) than occupants of fire (5.7 deaths per 100,000 workers) or police (6.1 deaths per 100,000 workers) service vehicles [1].

The prevalent cause of transportation-related EMS deaths is attributed to the lack of EMS restraint use in the rear patient compartment of the ambulance. Gilad and Byran [2] conducted a brief survey in Israel with EMS workers, and found that only three percent of medics surveyed reported wearing their seatbelts at *all* times. A survey of approximately 900 EMS workers responded to a survey, and indicated that the lack of seatbelt use was due to inhibited patient care, restricted movement, inconvenience, and lack of efficacy [3]

The naturalistic data collected in this study allowed researchers to perform analysis in a rural emergency driving environment to identify contributing factors to attending medic behavior, severity of biomechanical forces experienced in the driver and patient compartment, and a safety culture evaluation to identify underlying causes for medic behaviors. Based upon research findings, the project included development of a series of environmental, ergonomic, policy, or training recommendations to mitigate circumstances that cause potentially unsafe operations in the patient's compartment of the ambulance.

This study presents a discussion and literature review of:

- Prehospital emergency care provider environments
- Safety culture involved in emergency medical care
- Rural ambulance crashes
- Emergency medical service worker injury sources and mitigation
- Naturalistic data collection

Research Objectives and Hypotheses

The objective of this project was to observe activities and behaviors exhibited by emergency medical personnel along with the conditions that they are subjected to during emergency vehicle transportations. The naturalistic data collected allowed researchers to perform analysis in a rural emergency driving environment to identify contributing factors to attending medic behavior as well as the severity of biomechanical forces

experienced in the driver and patient compartment. The specific objectives and their hypotheses include:

1. Determine biomechanical forces experienced by medics during transport.

Hypothesis 1.1

Whole-body vibration exposure for prehospital care providers during emergency transportation is significantly higher than the vibration exposure threshold for health designated in ISO 2361-1.

$$H_0: \mu < a_w \frac{m}{s^2}$$

$$H_0: \mu \geq a_w \frac{m}{s^2}$$

Where:

μ represents the most severe axis vibration; and

a_w represents the threshold for health associated with the specific exposure experienced by EMS workers in this ambulance.

Hypothesis 1.2

Whole-body vibration exposure for prehospital care providers during emergency transportation is significantly higher than the vibration exposure threshold for comfort designated in ISO 2361-1 C.2.3.

$$H_0: \mu < 0.315 \frac{m}{s^2}$$

$$H_0: \mu \geq 0.315 \frac{m}{s^2}$$

Where:

μ represents average weighted vibration magnitude.

Hypothesis 1.3

Whole-body vibration exposure for prehospital care providers during emergency transportation is significantly higher than the vibration exposure threshold for perception designated in ISO 2361-1 C.3.

$$H_0: \mu < 0.02 \frac{m}{s^2}$$

$$H_0: \mu \geq 0.02 \frac{m}{s^2}$$

Where:

μ represents the most severe axis vibration.

Additionally, crest factors (and vibration dose values, if crest factors are greater than 9), average force values, and peak force values will be presented for the x, y, and z-axes.

2. Identify which factors influence vehicle operators to travel in emergency mode.

Hypothesis 2.1

Patient Care Records (PCRs) analysis identifies significant predictors toward emergency mode travel status by analyzing occurrence of different types of responsive

medical care procedures performed by the medic (IV administration, intubation, medicine administration, etc) during transportation.

Model: $y_{ij} = \tau_i + \beta_j + (\tau\beta)_{ij} + \in_{ij}$

Where:

y_{ij} represents the i[th], j[th] response variable for emergency mode travel status;

τ_i represents the i[th] factor of patient care response;

β_j represents the j[th] factor of patient injury type;

$(\tau\beta)_{ij}$ represents the effect of the interaction between τ_i and β_j; and

$\in_{ij}$ represents the i[th], j[th] random error component.

$$H_0: \tau_1 = \tau_2 = \cdots = \tau_i$$

$$H_1: at\ least\ one\ \tau_i \neq 0$$

Hypothesis 2.2

Patient Care Records (PCRs) analysis identifies significant predictors for different types of *patient injury type* toward emergency mode travel status.

Model: $y_{ij} = \tau_i + \beta_j + (\tau\beta)_{ij} + \in_{ij}$

Where:

y_{ij} represents the i^{th}, j^{th} response variable for emergency mode travel status;

τ_i represents the i^{th} factor of patient care response;

β_j represents the j^{th} factor of patient injury type;

$(\tau\beta)_{ij}$ represents the effect of the interaction between τ_i and β_j; and

$\in_{ij}$ represents the i^{th}, j^{th} random error component.

$$H_1: \beta_1 = \beta_2 = \cdots = \beta_j$$

$$H_1: at\ least\ one\ \beta_j \neq 0$$

3. Determine the rate of restraint use by emergency medical personnel in various conditions.

Hypothesis 3.1

Observed medic restraint usage while providing patient care in the rear patient compartment of an ambulance on emergency response is significantly lower than 100% compliance.

H_0: $\mu = 100$ percent rear compartment restraint compliance

H_1: $\mu < 100$ percent rear compartment restraint compliance

Where:

μ represents the average percentage of time medics are restrained in the rear patient compartment, from video data.

Hypothesis 3.2

Self-reported medic restraint usage while providing patient care in the rear patient compartment of an ambulance on emergency response is significantly lower than 100% compliance.

H_0: $\mu = 100$ percent rear compartment restraint compliance

H_1: $\mu \leq 100$ percent rear compartment restraint compliance

Where:

μ represents the average percentage of time medics are restrained in the rear patient compartment, from self-reported survey data.

Hypothesis 3.3

Self-reported medic restraint usage while providing patient care in the front patient compartment of an ambulance on emergency response is significantly lower than 100% compliance

H_0: $\mu = 100$ percent front compartment restraint compliance

H_1: $\mu \leq 100$ percent front compartment restraint compliance

Where:

μ represents the average percentage of time medics are restrained in the front driver compartment, from self-reported survey data

4. Determine significant causes that lead to medics being unrestrained.

Hypothesis 4.1

Safety culture is a contributing factor toward low restraint usage rates by medics, evaluated by comparing SAQ scores for Montana EMS workers.

$$H_0: \mu \geq 75 \text{ SAQ units}$$

$$H_1: \mu < 75 \text{ SAQ units}$$

Where:

μ represents the average SAQ score for Montana EMS workers who responded to an online safety culture survey.

Hypothesis 4.2

One contributing factor toward low restraint usage rates by medics is due to poor ambulance layout regarding efficacy of patient care. This information was collected from focus group responses and naturalistic observation.

5. Identify medic activities and any physical hardships imposed by their equipment or procedures.

Hypothesis 5.1

Inside the patient compartment, medic equipment and storage locations for providing patient care from encountered from up to three seated reach origin points to up to nine unique reach termination points (only origin and termination combinations observed in the visual data reduction were evaluated) are located outside maximum reach envelopes for a 95% male restrained medic (a 43.5 in. reach radius).

For each observed origin and termination point combination i:

$$H_0: y_i < 43.5 \text{ in}$$

$$H_1: y_i \geq 43.5 \text{ in}$$

Where:

i represents the unique origin and termination points associated with each observed reach; and

y_i represents the distance from the medic's shoulder to the reach termination point, from a seated and restrained position.

Hypothesis 5.2

While inside the patient compartment, providing patient care, medical procedures carried out by medics necessitate postures which exceed Rapid Entire Body Assessment (REBA) Medium Risk threshold (necessary action level).

For each observed origin and termination point combination i:

H_0: $y_i < 4$ units

H_1: $y_i \geq 4$ units

Where:

i represents the unique origin and termination points associated with each observed reach; and

y_i represents the i^{th} REBA score for analyzed postures.

Based upon research findings, the project additionally includes a series of environmental, ergonomic, policy, or training recommendations to mitigate circumstances that cause potentially unsafe operations in the driver's and patient's compartment of the ambulance.

Study Justification

Emergency medical service workers are a high-risk group, and while some of this risk is inherent in the type of work that they perform, much of it may be avoidable. This study examined medical professionals administering patient care during transportation to highlight and define previously overlooked safety issues in an ambulance. Many EMS workers volunteer their service to their communities, and it is the responsibility of that community to ensure that EMS workers are able to effectively mitigate safety problems. Identification of high-risk elements in an ambulance may lead to behavioral or policy

changes prompting a significant reduction in the number and severity of on-the-job injuries to this population.

CHAPTER 2

LITERATURE REVIEW

Prehospital care providers are a unique occupational group. The first section of this literature review will discuss prehospital emergency care, emergency medical service (EMS) care providers, the vehicles used during prehospital care, and the processes involved in emergency medical response. The second section details trends and findings associated with rural ambulance crashes. The third section examines safety culture within EMS groups and a tool used to measure that culture, the safety attitudes questionnaire. The fourth section discusses contributing factors toward care provider injury, focusing on whole-body vibration, ambulance structure, ambulance layout, awkward postures, and care provider restraint compliance. The last section discusses naturalistic data collection, and the advantage of using naturalistic data collection compared to a similar study performed using direct observation.

Prehospital Emergency Care

Prehospital emergency care is the care provided to patients prior to arrival at a hospital, provided in an ambulance by emergency medical service (EMS) care providers.

EMS Care Providers

Through training, EMS providers can acquire different levels of licensure to provide care, detailed in

Table 1. The categories differ in both the training requirements for attainment as well as the level of emergency care the EMT is able to provide. In accordance with Montana law, EMS workers can only use the equipment and skills for which they are licensed.

Table 1. EMT Licensure Categories

License	Training Requirements	Duties
EMT-First Responder (EMT-FR)	44 hours	Life-saving medical techniques at the scene of an injury or accident
EMT-Basic (EMT-B)	160 hours	Life-saving techniques plus ability to safely transport a patient in an ambulance
EMT-Intermediate (EMT-I)	Basic-level training + 350 hours	Life-saving techniques plus endorsement in other advanced techniques
EMT-Paramedic (EMT-P)	Basic-level training + 2000-3000 hours	Life-saving techniques plus advanced training to undertake many emergency medical procedures

Source: Board of Medical Examiners, January 2010 [4]

Licensed EMS care providers have staffing requirements to support the level of care they are licensed to provide (ALS, BLS, BLS with ALS capability).

Table 2 shows the personnel requirements involved with the different levels of service in ground transport service providers.

Table 2. Level of Service Personnel Requirements – Ground Transport

Level of Service	Personnel Requirements
Basic Life Support (BLS) – Ground	2 Certified EMTs, one EMT-B or higher, and one EMT-FR or higher
Advanced Life Support (ALS) – Ground	2 Certified EMTs, one EMT-FR or higher, and one EMT-P with 24/7 coverage availability
BLS with ALS Capability	BLS Requirements, with ALS requirements as personnel availability permits

Source: Montana Department of Public Health and Human Services – EMS and Trauma Systems, February 2010 [5] **Total**

EMS units capable of providing 24/7 ALS capability are located primarily around areas with higher populations in western and southwestern areas of Montana. The EMS coverage provided in the less populated eastern and northern portions of Montana is composed of units providing BLS, BLS with some ALS capability, and non-transporting emergency response units. In addition to EMS transport units, there are 102 licensed EMS groups that are non-transporting units, who will respond to 911 calls and tend to patients on-scene.

Ambulance Specifications

The traditional vehicles for prehospital care are emergency response vehicles. The General Services Administration (GSA) standard KKK-A-1822E [6] describes standards which ambulances must meet in order to meet nationally recognized standards for maintenance, construction, and reliability. GSA defines an ambulance as (p1):

"a vehicle for emergency medical care which provides: a driver's compartment; a patient compartment to accommodate an emergency medical technician (EMT)/paramedic and two liter patients (one patient located on the primary cot and a secondary patient on a folding litter located on the squad bench) so positioned that the primary patient can be given intensive life-support during transit; equipment and supplies for emergency care at the scene as well as transport; two-way radio communication; and, when necessary, equipment for light rescue/extrication procedures. The ambulance shall be designed and constructed to afford safety, comfort, and avoid aggravation of the patient's injury or illness."

There are three main types of ambulances, described in Table 3. The ambulance focused on in this thesis is a Type III ambulance, which is further specified to be a (p8) "Type III … shall be a 'cutaway' van with a transferable, modular, ambulance body or unitized cab-body mounted on a chassis." Type III ambulances equipped for Advanced Life Support (ALS) response have no standard equipment storage locations. GSA instructs that equipment locations should be designated according to importance, with equipment necessary for airway maintenance present near the head of the litter and monitoring equipment, IV supplies, and medications readily available to the EMT. All

other supplies need to be fastened to the vehicle or stored in closed compartments to avoid injury from moving equipment in the event of a crash or sudden vehicle movement. The bench seats in an ambulance are equipped with three sets of lap belts, to be used by the EMT providing care, or as a restraint for a second on-board patient. Side-facing seats in the ambulance are equipped with a lap belt, and all seats have rear padding and a padded area at the head area.

Table 3. Ambulance Types

Ambulance Type	**Vehicle Description***
Type I	Conventional cab-chassis with modular ambulance body
Type II	Standard van with integral cab-body ambulance
Type III	Cutaway van, cab-chassis with integrated modular ambulance body

*Source: GSA STD KKK-A-1822E [6]

EMS Response

The time from when the EMS group receives a call prompting an emergency trip until the patient is transported to the hospital has several components: EMS preparation time, time spent travelling to the scene, time administering treatment on-scene, and time involved in the subsequent transport to the hospital. An internal audit conducted by the Montana Legislative Audit Division [7] found that these blocks of time are different for rural and urban responses, shown in Table 4.

Table 4. Urban and Rural Call Times in Montana

Actions during Time Segments	**Time for Rural EMS Calls (min.)**	**Time for Urban EMS Calls (min.)**
EMS Preparation Time	5:33	1:17

Time en Route to Scene	8:10	6:30
Treatment Time On-Scene	15:33	14:56
Transport to Hospital	28:22	9:19
Total Incident Time:	57:38	32:05

*Source: Department of Health and Human Services, Board of Medical Examiners, [7]

One metric commonly used to evaluate EMS groups on their quality of provided care is the time from the EMS group receiving a call until arrival on-scene, which includes "EMS Preparation Time" (time to get ready to leave; time between receiving the call for assistance and departing in an ambulance) and "Time en Route to Scene" (time to travel to the scene requesting assistance), from Table 4. A recent criterion that many EMS agencies are being required to meet is to achieve response times of eight minutes or less—a standard developed around a study of cardiac arrest patient outcomes dependent on response time [8]. This eight-minute goal has received mixed responses from subsequent studies. Supporting researchers have recommended that this standard response time be shortened to five minutes to raise survival rates from 8% to 10% [9]. Alternatively, Pons and Markovchick [10] found no difference in survival when comparing a group of nearly 3,500 patients with response times either greater than or less than eight minutes. This encouragement for quick response times may be related to use of lights and sirens when they are not needed. Lacher and Bausher [11] found that EMS workers with lower levels of training were more likely to inappropriately engage EU (operate the ambulance in EU when the patient is stable) than more highly certified and trained paramedic personnel were. Overall, almost 40 percent of ambulance transports demonstrated inappropriate use of lights and sirens [11]. The specific cause for crashes

involving ambulances using lights and sirens are unknown, only that there is an association between increased crash rate and lights and sirens.

Once the EMS workers arrive to the injury scene, they provide care for the patient as needed, specific care procedures vary depending on the nature of the injury. The patient is moved to the emergency vehicle, and additional care is provided during the transport as needed.

Rural Ambulance Crashes

Weiss, Ellis, Ernst, Land, and Garza [12] studied all ambulance crashes reported to the Tennessee State EMS bureau between 1993 and 1997, focusing on urban and rural crashes as characterized by injury, vehicle condition, weather, time of day, and road conditions. The rurality of the crash location was designated by the population of the county containing the crash site, with counties of greater than 250,000 people designated as urban. Although urban areas were characterized by higher crash rates (19 ambulance crashes per million people per year) than rural areas (8 ambulance crashes per million people per year), the study found that rural areas showed significantly more crashes with any type of injury (Rural: 40%, Urban: 24%; $p=0.03$), and significantly more crashes with severe injury (Rural: 9%, Urban: 0%; $p<0.01$). Rural areas showed significantly higher rates of the ambulance being damaged, disabled, and towed. Urban areas showed significantly more rear-impact crashes, and rural areas showed significantly more front-impact crashes. Rural ambulances were significantly more likely to crash in areas with high posted speeds than urban ambulances.

Lower populations found in rural areas result in fewer instances of crashes than in urban areas, but rural settings account for a significantly higher percentage of crashes resulting in injury. The injuries sustained in rural collisions are more severe than those sustained in urban areas [12, 13]. Rural collisions are more likely than urban collisions to involve single vehicles striking a fixed object. In both rural and urban ambulance collisions, data gathered from U.S DOT's Fatality Analysis Reporting System (FARS) revealed that many EMS drivers involved in fatality collisions were more likely to have had previous crashes.

The majority of incidents resulting in injury occur while the ambulance is in an emergency state and with the injured parties unrestrained prior to the critical event [14, 15]. Ambulances experience most crashes during weekday daylight hours and early evening [16], corresponding to two peak ambulance operational times. Collisions involving ambulances involve more people and injuries among all vehicles involved in the collision than collisions involving non-ambulance vehicles of similar size. However, the number of vehicles involved in the collisions was not found to be significantly different when comparing the two types [17]. Within an ambulance involved in a collision, individuals in the rear of the vehicle show higher fatality and injury rates than those driving and riding in the front [14]. The higher injury and fatality rate in the rear cabin is related to the greater number of people in the rear of the cabin as well as lower rates of restraint use.

Safety Culture in EMS

While prehospital care is known to be hazardous to the care providers, there is also a risk to patients. Safety culture evaluations to date have primarily focused on care providers in hospitals (nurses and surgeons) and have found associations with higher safety culture at an organization and lower employee turnover, lower risk adjusted patient mortality rates [18], shorter lengths of stay in a hospital, fewer medication errors, lower ventilator associated pneumonia rates, and lower bloodstream infection rates [18]. Patterson et al. [19] expanded the study of safety culture to show that the same safety culture evaluations could be given to prehospital care providers of different training certification levels (EMT-P and EMT-B), although associations between high safety cultures and patient outcome and employee turnover was not studied. A separate study by Chapman et al. [20] using an alternative survey to study job satisfaction found correlations between low job satisfaction and high employee turnover in emergency medical service groups. Turnover has separately been associated with the staffing type of EMS agencies (paid or volunteer groups). Patterson et al. [21] examined employee turnover within EMS groups, and found higher annual turnover rates in EMS groups staffing volunteer personnel.

The concept of safety culture is largely abstract. Several different definitions have been published in the literature; many of those definitions identify safety culture as the idea of a collective set of ideas or beliefs, shared throughout an organization, relative to safety [22]. Until the 1970s and 1980s, human error was largely identified as the cause

for many investigated industrial failures. Although human action can be a catalyst for hazardous events, the root causes often multiply over time, are qualitatively diverse, and interact with each other [23]

Evaluating safety culture measures and behaviors began in high-risk fields like aviation and nuclear facilities before it became prevalent in the healthcare industry. Gundermuld [22] promotes the study and evaluation of safety culture to promote effective risk management and mitigation strategies within organizations. One validated method for evaluating safety culture in healthcare-related fields is the Safety Attitudes Questionnaire (SAQ), which measures worker attitudes about six areas of safety culture: teamwork climate, safety climate, perception of management, job satisfaction, working conditions, and stress recognition [19]. Applied to prehospital emergency care, this shared set of beliefs may influence an organization's behaviors regarding restraint compliance, patient care, or ambulance operation, which could then be evaluated using the SAQ.

Safety Attitudes Questionnaire

The SAQ is a survey analyzed based on answers using a five-point Likert scale (Disagree Strongly, Disagree Slightly, Neutral, Agree Slightly, and Agree Strongly). Participants use this 5-point scale to state whether or not they agree with an item that indicates positive safety culture at that participant's workplace. Negatively worded items, like "EMS personnel frequently disregard rules or guidelines," are scored negatively. The SAQ responses are then adjusted to a numeric scale of 0-100. Scores

below 25 indicate disagreement with the safety attitude questionnaire item, scores between 25 and 75 represent neutral responses, and scores greater than 75 represent positive safety culture at each participant's workplace. Responses from studies in different healthcare environments and jobs are shown in Table 5 [18, 19].

Table 5 SAQ Mean Scores in Different Fields

	Mean scores					
Questionnaire	Teamwork Climate	Safety Climate	Perception of Management	Job Satisfaction	Working Conditions	Stress Recognition
SAQ: Inpatient Hospital*	64.3	60.5	38.3	59.6	49.2	74.4
SAQ: Ambulatory Care*	69.7	69.9	55.3	70.6	61.6	66.7
EMS-SAQ: EMT**	73.7	70.0	72.9	76.7	69.4	54.0
SAQ: Paramedic**	69.4	66.4	66.2	71.3	63.9	65.4

Abbreviations: EMS-SAQ, Safety Attitudes Questionnaire; EMS, emergency medical services; EMT, emergency medical technician
*Source: Sexton et al., 2006 [24]
**Source: Patterson, Huang, Fairbanks, & Wang, 2010 [19]

The SAQ evolved from the aviation industry's Flight Management Attitudes Questionnaire (FMAQ), and the shorter Flight Management Attitudes Short Survey (FMASS). These surveys were used to identify different areas of safety culture in aviation—morale, job satisfaction, safety culture, stress recognition, and human attitudes.

Within the aviation industry, Sexton and Klinect [25] observed flights with crews who had participated in the FMASS, and found that flight crews with positive attitudes about safety culture showed better crew performance rates, fewer errors and violations, and corrected from error situations better than crews with negative attitudes about safety culture. Similar beneficial results have been associated with positive SAQ scores in hospital workers (nurses and surgeons): favorable SAQ scores have been associated with lower employee turnover, lower risk adjusted patient mortality rates [26], shorter lengths of stay in a hospital, fewer medication errors, lower ventilator associated pneumonia rates, and lower bloodstream infection rates [18].

Factors Contributing to Care Provider Injury

In a collision, there are factors present that may influence whether or not the occupants are injured, and the scope of those injuries. Prolonged exposure to vibration, awkward reaches for equipment, medic/patient positioning, abnormal forces on the medics, and restraint usage can all contribute to the medics' overall physical stress.

Whole-Body Vibration

Prolonged exposure to vibration has a negative effect on humans. Vibration is calculated using root mean squared (R.M.S) values, which take into consideration the duration of vibration exposure as well as frequency of the vibration. Exposure duration will be referenced against

Figure 1, shown below, to identify the threshold level of weighted acceleration (a_w) for

the calculated exposure length [27]. This threshold level of acceleration has been explored in many types of moving vehicles to quantify the effect of whole-body vibration on vehicle passengers.

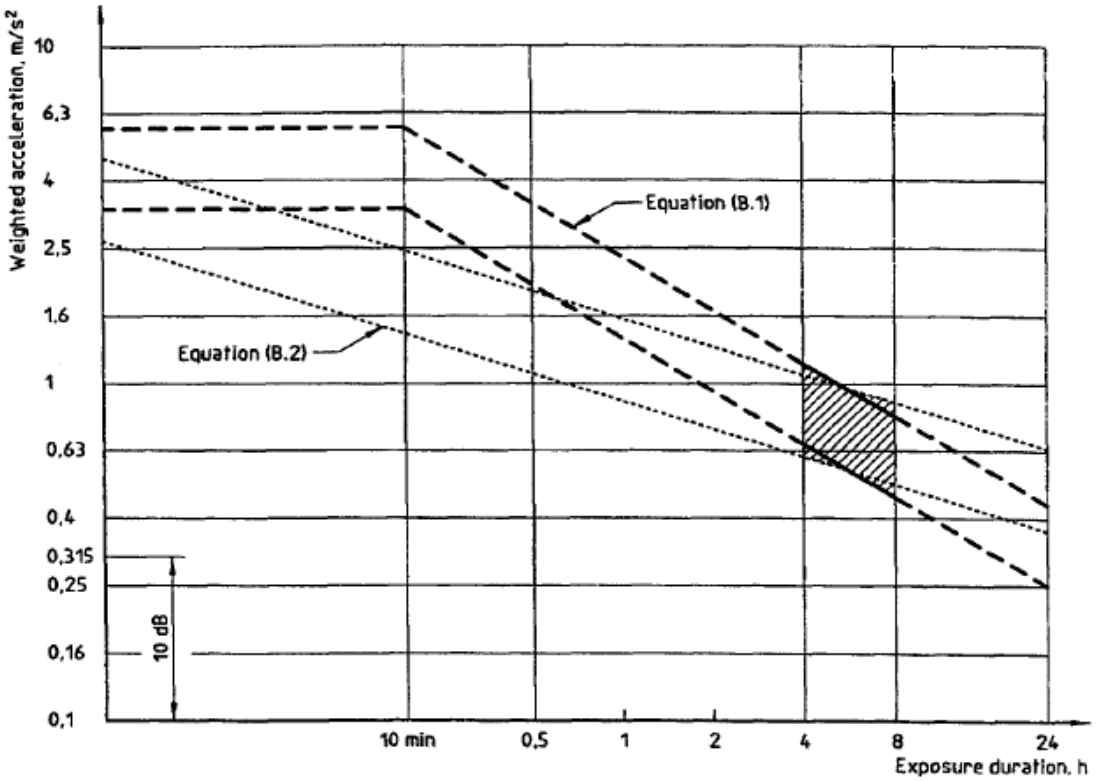


Figure 1. Health Guidance Caution Zones (Source: ISO 2361-1, Figure B.3)

Although vibration on EMS workers has not been extensively studied, there have been several studies looking at the effects of vibration on bus and truck drivers who operate vehicles of similar size and handling as EMS workers. Paddan and Griffin [28] found vibration levels between 0.17 and 3.03 m/s^2 R.M.S. while examining large trucks and vans, while Shenai, Johnson, and Varney [29] found vibration levels of between 2 and 6 m/s^2 R.M.S. in the rear ambulance cabin. These values are all greater than the

equivalent upper-limit of vibration provided by ISO Standard 2361, where an eight-hour exposure would result in a R.M.S value of 0.82 m/s^2. Table 6 shows a summary of reported vibration values for several different types of light and heavy vehicles from past literature.

Table 6. Summary of Vibration Acceleration Values from Light and Heavy Vehicles

Vehicle Type	**Vertical Acceleration (m/s^2 r.m.s) median (min, max)**	**Acceleration for most severe axis (m/s^2 r.m.s) median (min, max)**
Car*	0.37 (0.25, 0.61)	0.39 (0.26, 0.75)
Lift Truck*	0.71 (0.47, 0.91)	0.74 (0.53, 1.0)
Tractor*	0.56 (0.32, 0.80)	0.73 (0.54, 1.0)
Van*	0.42 (0.34, 0.53)	0.45 (0.36, 0.57)
Bus*	0.48 (0.34, 0.79)	0.56 (0.38, 0.89)
Excavator*	0.91 (0.08, 3.27)	0.91 (0.17, 3.03)
Ambulance**	0.091-0.135 (NR)	NR
Ambulance***	2.0-6.0 (NR)	NR
Van (good road)****	4.8 (NR)	4.8 (NR)
Van (poor road)****	5.1 (NR)	5.1 (NR)
Van (cobblestone)****	10.3 (NR)	10.3 (NR)

* Source: Paddan & Griffin, 2002 [28]
**Source: Snook, 1972 [30]
***Source: Shenal, Johnson, & Varney, 1981 [29]
****Source: Okunribido, Magnusson, & Pope, 2006 [31]

The effect of whole body vibration (WBV) on the human body has been studied substantially in recent years. While the focus has traditionally revolved around heavy equipment operators (workers with exposure to locomotives, heavy trucks, or farm equipment), there has recently been more research into the magnitude of WBV on humans operating in nontraditional vehicles, like motorcycles [32]. Long-term exposure

to WBV has been conclusively linked to lower back pain by a large group of researchers [33, 34]. Vibration magnitude found during emergency prehospital care has not been extensively studied. Shenai, Johnson, and Varney [29] examined vibration in neonatal land transportation vehicles, finding potentially dangerous acceleration magnitudes applied to infants. Neonatal transportation and vibration mitigation measures were also analyzed by Sherwood, Donze, and Giebe [35], finding reduction in vibration experienced by newborns through several proposed mitigation techniques. Snook [30] focused on the ambulance as a whole, measuring vertical acceleration rates directly over the rear axle while trying to identify vibration exposure to patients. Snook found rates of root mean square acceleration between 0.091 and 0.104g in different load and speed vehicle conditions, and found that the vibration levels to the patient "were shown to be of clinical importance." The concerns of vibration studies have traditionally been used to evaluate the effects of exposure to patients, due to their diminished physical condition [36, 37]. As a result, the care providers who find themselves repeatedly subjected to these vibration forces have been largely ignored.

A similar vehicle style to ambulances that has been studied to a greater degree is drivers of light trucks and other commercial vehicles. In an 11-year study Boshuizen, Bongers, and Hulshof [38] examined the amount of sick leave due to back injuries in two groups: a group of tractor drivers, and a group not exposed to the ISO 2631 fatigue-decreased WBV limit. They found that tractor drivers had more long-term sick leave due to back disorders than the control group, tended toward being disabled at a younger

age than the control group, and also left the company before reaching the end of their working life than the control group.

A review conducted by NIOSH in 1997 found evidence associating awkward work postures with low-back pain, and strong evidence that work-related lifting and WBV was associated with low-back pain, but found inconclusive results when examining neck pain and vibration. NIOSH goes on to suggest that WBV acting in concert with other injury risk factors (prolonged sitting, lifting, and awkward postures) may result in a higher back injury risk than pure WBV in the absence of those risk factors [34]. One population subjected to all of these risk factors includes the EMS workers providing prehospital emergency care during transport. A meta-analysis by Bovenzi and Hulshof [33] showed that occupations with higher WBV exposure are at increased risk for lower back pain, sciatic pain, and herniated lumbar discs, and that lower back pain disorders are associated with driving occupations.

EMS worker exposure to WBV associated with transport in heavy vehicles is limited to the time spent in the vehicle in transit toward a patient in need of care and the subsequent travel toward a treatment center. The length of travel time and frequency of travel does not always occur at predictable intervals. By example, rurality plays a role in travel time: a study by the Department of Public Health and Human Services [7] auditing Montana EMS groups found that average transport time for a rural EMS response to be longer than an urban EMS response (rural: 36.5 minutes; urban: 15.82 minutes). The exposure to WBV during transit is irregular and not constant, so understanding the

magnitude of WBV is important due to the presence of additional risk factors that can lead to increased risk of low back injury.

Ambulance Structure

Ambulance structure can have an impact on the severity of injury to the occupants. Vehicles used in EMS are subject to only minimal impact testing: a static load test for the ambulance body structure, and a body door retention component test [6]. Rural collisions tend to involve front-end ambulance impact, and the standards that ambulances are required to meet are unrealistic in recreating actual forces encountered by the vehicles during these types of impacts. Analysis of the three main body types used in the United States show "poor vehicle structural integrity and crashworthiness" [39].

Ambulance Layout

Ambulances have no fully standardized layout. The standards that exist for ambulances in the United States come from Star-of-Life and the Ambulance Manufacturer's Division (AMD) standards. The National Highway Transportation and Safety Administration (NHTSA) give Star-of-Life certification to ambulances that meet a set of requirements stated in GSA Standard KKK-1822 E [6]. Star-of-Life ambulances layouts have some restrictions: an ambulance must be built so that it can accommodate one EMT and two patients on litters in the rear (with the primary patient in the central litter anchor, and another on a squad bench). Litters must be loaded with the patients head forward in the vehicle, two IV hangars, one at the patient's head and one near his lower extremities, a CPR seat at the left side of the patient's body, patient compartment

controls located near the seated EMT's position, a door on the right forward side of the patient compartment, rear doors for patient loading, and a fastener or anchor for the patient stretcher (GSA KKK-1822 E, 2002). The Ambulance Manufacturer's Division (AMD) has several standards in effect regarding ambulance manufacture. The standard relevant to ambulance layout is AMD Standard 004: Litter Retention System. This standard requires that all ambulances have a method to fasten the stretcher to the floor in order to avoid patient movement during vehicle crashes or sudden vehicle maneuvers.

Within the rear of the ambulance, poor ergonomic design inhibits consistently safe operation. Patient and medic location relationships lead many medics to sit alongside stretchers, resulting in increased reaching distances to required equipment [40]. Equipment location necessitates movement around the rear of the vehicle during transportation, which contributes to the amount of time medics are unrestrained. The post-production modification procedure and general cab layout also may subject the occupants of the ambulance cab to abnormal biomechanical forces. Boocock et al. [41] found an 18% risk of musculoskeletal injury due to various actions including heavy lifting, a stooped working posture, whole body vibration, and prolonged sedentary work punctuated by intense physical exertion. Few studies have been done to identify activities within a medic's work environment that promote poor ergonomic behaviors.

Awkward Posture

Awkward postures in EMS are an artifact of the interior ambulance organization and structure. Gilad and Byron [42] found the interior of ALS ambulances to be

insufficient to promote safe and adequate patient care. The layout of the preferred EMS worker seats resulted in deep back flexion during treating, and the distance between the equipment and the EMS worker required the EMT to leave his seat to retrieve supplies, resulting in extreme postures and reaches. Gilad and Byron found that paramedics display several non-neutral back postures, twisted back postures (greater than 20°), and sitting with back flexion between 20° and 45°. In addition to awkward postures, heavy lifting is part of EMS work and can be found in the lifting and moving of the patient from a scene to the ambulance on a stretcher. In a survey administered to over 2000 EMTs in Japan, EMTs reported the top four causes of physical stress to be "Heavy lifting with stretchers," "Heavy lifting without stretchers," "Loading ambulance," and "Unloading ambulance" [43].

One valuable tool for postural analysis is Rapid Entire Body Assessment (REBA) was developed specifically for analyses occurring in dynamic and active fields, such as those in health care or service industries [44]. REBA analysis examines the different segments of the body separately, and considers the effects unstable or rapidly changing postures to present an action level that indicates the level of urgency for intervention [44].

Restraint Compliance

The use of restraints by prehospital care providers is a topic which has been examined in past literature. Restraint usage in EMS has varied widely in reported data. Weiss et. al [12] found over 85% of workers involved in rural and urban ambulance

crashes were using restraints, but did not examine restraint rates in the front and rear compartments of the ambulance separately due to a trend of high overall restraint use. Ray and Kupas [13] examined ambulance crash records reported to the Pennsylvania Department of Transportation between 1997 and 2001 and found passive restraint usage rates between 56.5% (urban) and 71.5% (rural), although their data identifying restraint systems was unknown for a substantial portion of their urban crash data. Restraint data was not reported separately for occupants in the front and rear of the ambulance. Kahn, Pirrallo, and Kuhn [15] found an overall restraint use in ambulance crashes across the US to be 40%, although no differentiation was studied between urban and rural crashes. Restraint use is typically found to be lower in the rear patient-compartment of the ambulance than the driver compartment due to movement requirements associated with patient care (Weiss et. al, 2001). A study by Larmon, LeGassick, and Shriger [3] found that during emergency runs, the median restraint rate in the front cabin was 100%, and the median restraint usage rate in the patient compartment was 0%. The 900 prehospital emergency care providers that were surveyed submitted reasons for low usage in the rear of the ambulance – inhibited patient care (67.9%), restricted movement (34.7%), inconvenience (15.1%), and lack of effective restraints (5.3%). These low self-reported rear restraint rates have been contrasted against the periods of time in which medics can be restrained, but still do not engage their seatbelts. Hoyt, Stanley, and Sanddal [45] studied procedures involved in emergency care collected from ambulance records, and filmed mockups of the activities which account for 80% of total EMS actions. The mockups were studied, and the percentage of time which the EMS workers in the rear

patient compartment could feasibly be restrained was found to be 42% of the time that the medic spends engaged in patient care. This figure does not include the amount of time the medic spends idle, completing paperwork, or monitoring the patient, all of which can be performed from a restrained position.

Whether or not a medic is restrained significantly affects fatality rate and injury severity. Auerbach, Morris, Phillips, Redlinger, and Vaughn [46] found a restraint use rate of less than 50% for both the medics in the rear cabin as well as the EMS personnel working in the front cab. Restraint usage is typically lower in the rear of the vehicle than the front due to inhibited patient care, restricted movement, inconvenience, and lack of efficacy [12]. Becker et al. [14] found that 71 percent of all reported fatalities within the vehicle occurred to those in the rear of the vehicle, even though only 40 percent of total ambulance occupants in fatal crashes were traveling in the rear patient compartment.

Naturalistic Data Collection

Contributing factors to high transportation injury and fatality rates within the EMS field are not clearly understood. One obstacle to this understanding is the lack of central database detailing information specific to ambulance crashes, occupants, or workers. The data sets that have been gathered from past studies are from several different sources: State EMS bureaus [12], state department of transportation records [13], popular press reports [47] and survey data [19] have been studied—which do not parallel each other in terms of the data variables collected or data record completion.

Data Completion

One disadvantage of past studies is that the studied data typically involves only data associated with critical events—crashes involving injury or fatality. The data recorded on-scene is often incomplete, and difficult to find comparable data sets between different states and ambulance response agencies. Gilad and Byron [42] conducted a study measuring work postures of EMS workers in transport by having data analysts ride along in the ambulance on calls. The analyst recorded observed postures throughout the trip—while this provided useful data, there are limitations associated with direct observation. At times the observers' viewing angle may have been obstructed, vigilance to detect accurate postures may have been reduced over the 8-hour observation shifts, and detailed analysis of posture duration is not available because the observational data was collected only as frequency count data.

Data Accuracy

Priestman [48] conducted a study interviewing EMS personnel that indicates that the number of injuries received during EMS work may be much larger than reported. The potential discrepancies in reported data and actual events may be due to under-reporting near misses or solely internal reporting of minor vehicle damages [14]. The data in the majority of studies on EMS crash behavior is taken from databases which extract information from official records and crash reports. Because naturalistic data collection collects a constant stream of data, this study will result in a more accurate assessment of medic safety and injury contributors.

CHAPTER 3

METHODS

Participants

Demographics

Research participants were emergency medical personnel working with the American Medical Response (AMR) ambulance service in Bozeman, Montana. Project materials were presented to AMR Bozeman's staff of 20 medics and compensation of $50 was offered to consenting participants. Ten male and two female participants chose to participate. Detailed participant information is shown in Table 7. Age was not included in the analysis, as a minimum of personally identifying data was requested to try to increase participation among AMR staff.

Table 7. Participant Demographic Data

Variable	No. Medics	Average (years)	SD
Gender	12	-	-
Male	10	-	-
Female	2	-	-
EMT Experience (years)*			
EMT-Basic**	5	4.9	3.06
EMT-Paramedic**	6	7.8	3.59

*Note: One medic joined the project late, and his licensure date is not listed in the MT EMT database, so is not included in the experience database or the licensure type count in Table 7

**EMT-Basic and EMT-Paramedic definitions can be seen in greater detail in Table 1

EMS Care Facility

The emergency medical care provider, AMR, is located in an urban area in Southwest Montana. The group responds to calls involving local emergency care as well as trips involving non-emergency transports to cities in Montana. Bozeman AMR is a paid, advanced life support (ALS) emergency care provider. This facility provides care to a population of almost 100,000 people, and responds to an average of 219 calls per month. The participating medics work in twelve-hour shifts during the day (8:00AM – 8:00PM).

Ambulance

One Type III "Star of Life" ambulance was outfitted with data collection equipment, with a 2002 Ford E350 chassis, and a rear box was manufactured by American Emergency Vehicles in 2002. Figures 2 and 3 show the driver and passenger side views of the ambulance interior, respectively. The driver-side wall is populated with storage spaces, a convertible medic seat, oxygen supply, and electrical controls for climate control, interior lighting, and suction for a vacuum pump. The passenger-side interior contains a bench seat, restraints, and additional storage beneath the bench seat.

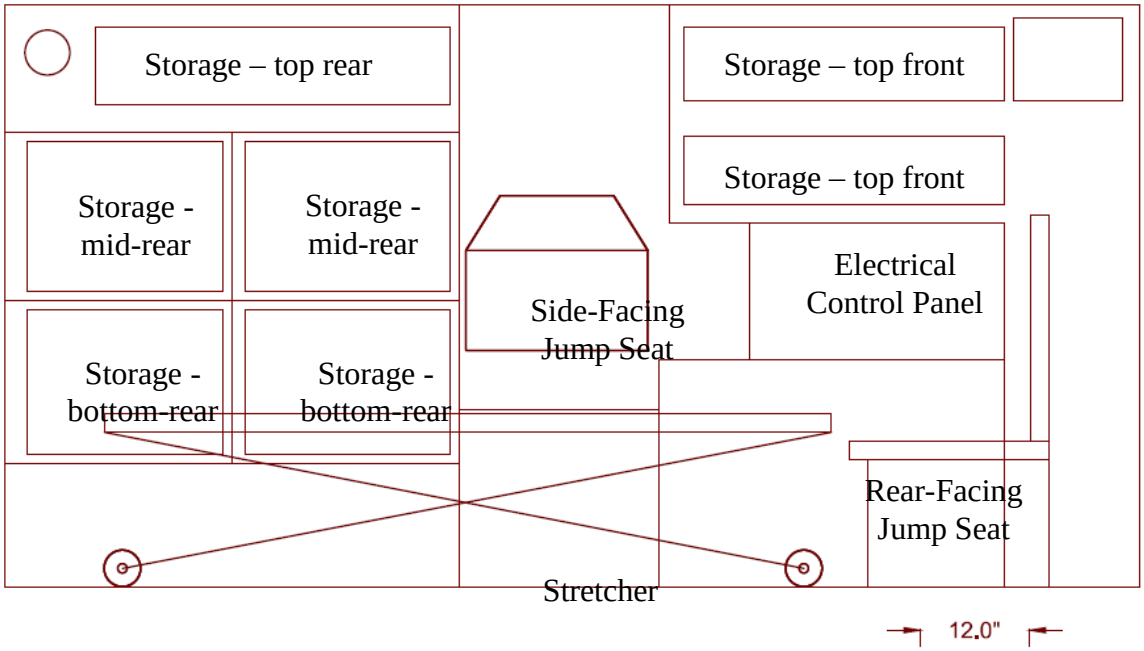


Figure 2. Side View: Driver's Side Wall

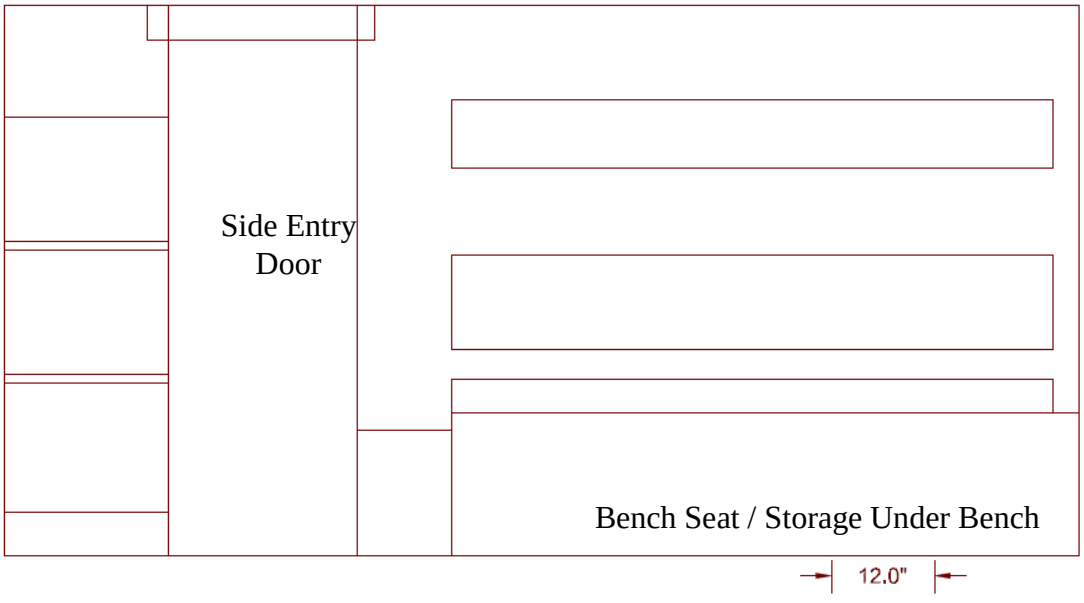


Figure 3. Side View: Passenger Side Wall

The front wall of the patient compartment houses a rear-facing seat, additional storage, and a one-foot square window that opens for communication between the medics and the driver. Vehicle electrical access is in a panel above the rear-facing seat. The front wall can be seen in Figure 4.

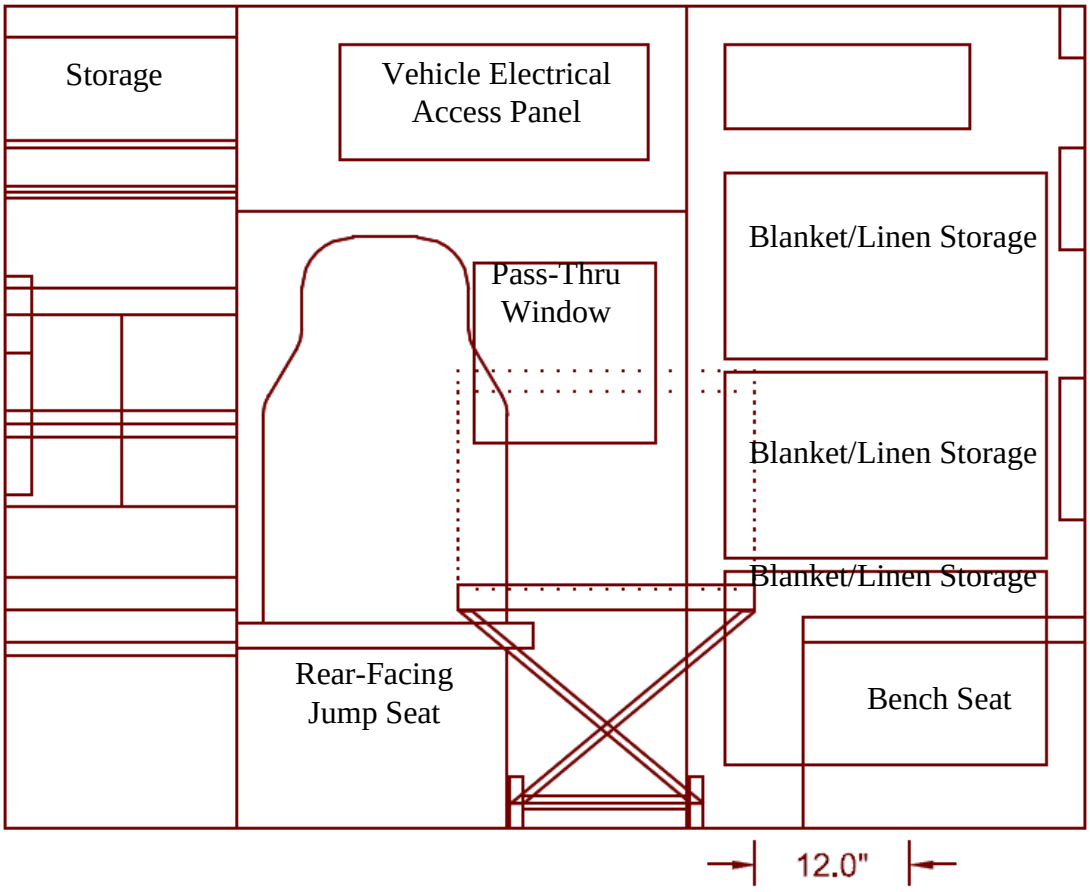


Figure 4. View of Front Wall in Rear Ambulance Cabin

IRB Approval

Institutional Review Board approval was granted for this study, the approved consent form and IRB application materials are shown in Appendix A. All participants signed consent forms prior to all data collection activities.

Data Collection Tools and Instruments

Data Acquisition System

The Data Acquisition System (DAS) used for this study collected visual, vehicle, and accelerometer data during periods when the ambulance is in motion for the duration of the study. The locations of the data collection equipment are shown in Figure 5.

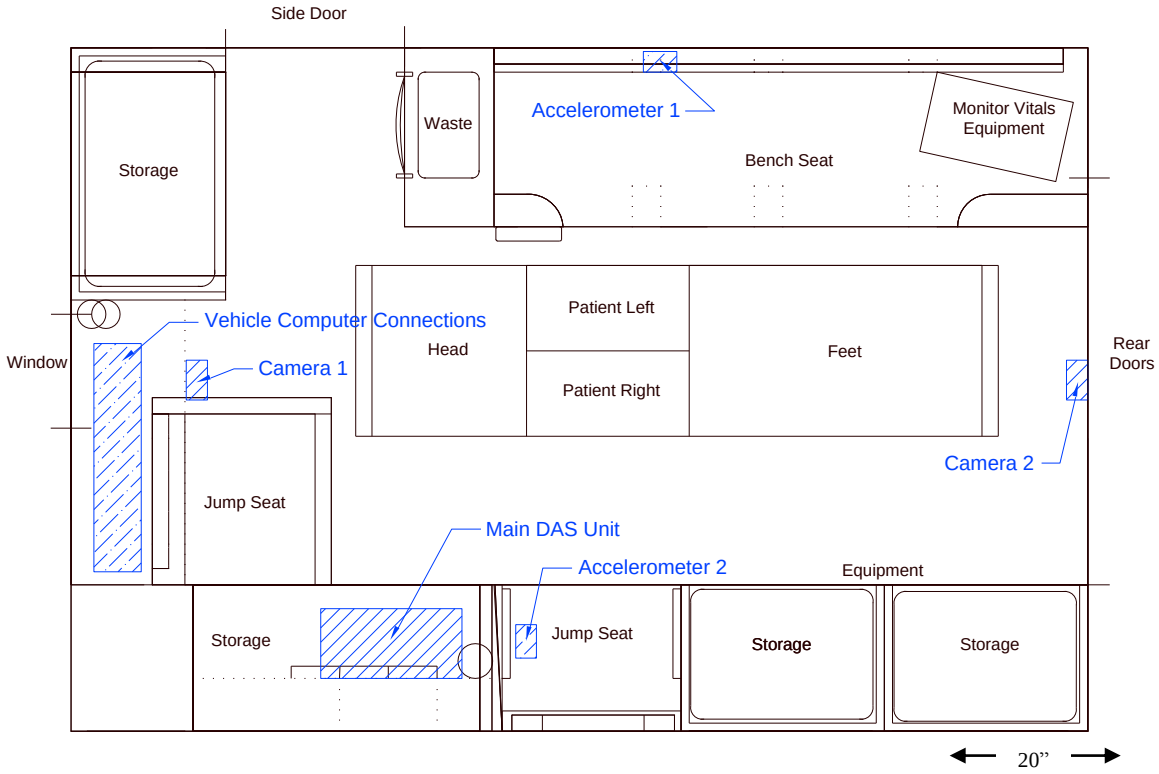


Figure 5. Overhead View of Ambulance and DAS Components

The DAS began collecting data immediately upon starting the vehicle. Data was collected until vehicle shutdown, when the ignition of the ambulance was turned to “OFF.” Equipment installation and maintenance was performed by Transecurity.

Visual Data

The visual data collected was composed of two separate cameras recording events both in and around the ambulance rear cabin. Visual data was collected at 30 Hz, and combined into a dual-pane image with H.264 video compression. The cameras were positioned so that they did not interfere with ambulance duties, as seen above in Figure 5. The cameras were 2” wide and 1.5” tall, mounted with brackets and industrial double-

sided tape to ensure no damage to the ambulance box during equipment removal. The cameras used infrared light, so they were able to capture data all lighting conditions. One of the cameras used is shown in Figure 6. All cables were routed under upholstered panels and concealed under cord covers to be as unobtrusive as possible.

Figure 6. Rear-Facing Camera

To preserve patient confidentiality, the video feed which most commonly feature patients were hidden with static black polygon masks. The polygon mask's shape and size was edited before recording, but once the video was captured, nothing behind the black mask was able to be recovered. The rear-facing view had a mask which covered the patient stretcher, as well as the entry door. The forward view had a mask covering the stretcher, which hid the patient on the stretcher in both elevated and prone postures. The visual data and masks were arranged on a single screen, segmented by the different fields of view, as shown in Figure 7.

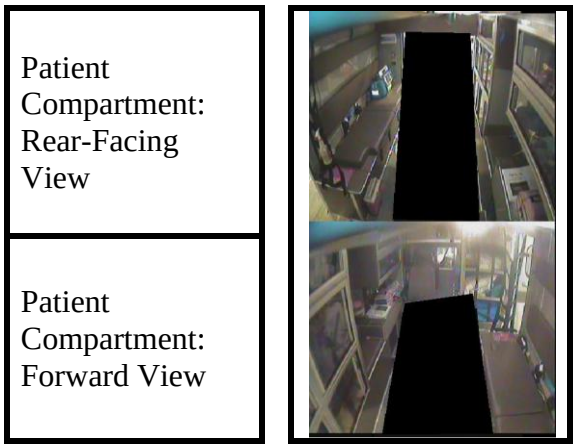


Figure 7. Recorded Visual Data Format

Vehicle Data

The DAS additionally collected streaming data from the onboard vehicle computer. The vehicle data was then synced with the video data. Vehicle data was collected from two areas: connections near the fuse box in the driver compartment and connections above the rear-facing seat in the ambulance compartment.

Accessory Data

Additional data was collected through three accelerometers, a head unit housing several general data collectors integrated with the main DAS unit and synced with all video and vehicle data. Three tri-axial accelerometers were installed in the vehicle; one in the driver's cab of the ambulance, and two in the ambulance cabin beneath the two most commonly used medic seats. The accelerometers measured vibration and forces that the medics and cab occupants are subjected to throughout ambulance operation. The captured data was stored at a frequency of up to 30 Hz; this was chosen based on data

storage constraints and to sync with other streaming DAS data. The medic bench accelerometer is shown in Figure 8 and the accelerometer positions in the ambulance are shown above in Figure 5.

Figure 8. Medic Bench Accelerometer

Vehicle Instrumentation

Transecurity, LLC. was the entity responsible for installation, integration, calibration, and testing of the DAS system. Installation was performed on-site at AMR. Installation and initial testing took approximately two days. The equipment was placed in the ambulance to be as unobtrusive as possible, and hardware was not placed in any positions that impacted the daily operations and needs of the emergency medical personnel.

Patient Care Record Data

Patient Care Records (PCR) records were used to identify patterns in patient injury and medic responses. PCRs were available in a limited form, and censored to preserve patient anonymity. These records were provided by AMR Bozeman, and include all entered data from July 1, 2005 until July 1, 2010, and include all medical response trips taken during this time period. These records detailed 13,253 individual ambulance calls. PCRs were analyzed to find common medical procedures that have high representation in emergency ambulance responses, and were analyzed specifically for the transports observed with the DAS to identify common body postures used in different types of response situations. A blank sample Patient Care Report can be found in Appendix B. The parameters collected from these summaries are shown in Table 8.

Table 8. Patient Care Record Data Description

Data Collected	Description
Transportation Mode	Whether or not the trip was an emergency, urgent, or scheduled transport
Basic Life Support (BLS) Procedures	The BLS medical procedures which the attending EMS workers used during the transport
Advanced Life Support (ALS) Procedures	The ALS medical procedures which the attending EMS worker used during the transport
Possible Impacting Factors	Factors which affected the patient's condition
Transportation Outcome	Definitive care destination the patient was transported to

EMS Survey Data Collection

A confidential online survey was created and activated that collected SAQ-EMS scores, open-ended answers to questions regarding the EMS agency which employed the

participant, their certification level (EMS-First Responder, Basic, Intermediate, or Paramedic), the number of years of experience the participant has spent working as an EMS care provider, the number of years of experience working at their current EMS agency, the number of shifts worked per week, the average shift length, their staffing payment status (paid, volunteer), their self-assessed skill level at EMS work, the percent of time the participant drives an ambulance while working, and the percent of time the participant spends belted while in the front of the ambulance, the rear of the ambulance, and while in a personal vehicle unrelated to work. Survey items unrelated to the SAQ-EMS items were designed to have open-ended responses, and no question was required to be completed in order to submit the survey. SAQ-EMS items on the survey were answered by selecting from one of 5 options for each item (Strongly disagree, slightly disagree, neutral, slightly agree, strongly agree). The individuals who participated in the EMS survey were licensed EMS workers from multiple agencies across Montana.

Experimental Variables

Variable selection was made based on the variables collected in past literature, and was further influenced by the amount of data reduction which could be performed in the time frame established before the videos were deleted, in accordance with IRB protocol.

Patient Transport State

The EMS agency trip logs were examined to identify portions of trips where a patient was definitively being transported. *Patient transport state* was a binary variable (patient present, patient not present) collected through examination of timestamps where patient transport occurred after arriving on a scene to a location of definitive care (hospital or air transport).

Weighted Acceleration

Force data was collected by accelerometers located near medic seats. This acceleration was then weighted in accordance with ISO standard 2361-1 prior to data analysis (m/s^2).

Maximum Force

For each trip examined, the longitudinal data stream for acceleration was analyzed in each axis (X, Y, and Z) to identify the maximum force encountered during transport (m/s^2).

Crest Factors

Crest factors are a measure of shock severity in a vibrating system, relative to root mean squared vibration level. Crest factors are the result of a calculation using acceleration data, and are used to describe the relationship between the maximum force and the average vibration exposure over time. This variable is reported for all three axes (X, Y, and Z).

Transportation Mode

Transportation mode was collected from patient care records (PCRs) associated with each medical transport conducted by the EMS group. *Transportation Mode* is a categorical variable, indicating the emergency status of the ambulance during travel. There are three outcomes for *transportation mode*: scheduled, urgent, and emergency. A scheduled trip is a non-urgent request for transport, arranged ahead of time. An urgent trip is an immediate request for aid where lights and sirens are not used. Emergency trips are immediate requests for aid where lights and sirens are used. Analysis in this examined *transportation mode* as a binary variable (emergency | non-emergency), combining scheduled and urgent calls as "non-emergency" trips.

Primary Patient Illness

Patient illness was collected from patient care records (PCRs) associated with each medical transport conducted by the EMS group. *Primary patient illness* is the primary injury that resulted in the need for EMS care or transportation. Each trip is associated with only one primary illness.

Medic Response Activity

Medic response activity was collected from patient care records (PCRs) associated with each medical transport conducted by the EMS group. *Medical Response* includes the activity or set of activities performed by EMS workers either on-scene or in the ambulance during transport. There are 42 separate actions that could have been performed, and each trip is associated with at least one *medical response*.

Several variables were collected during visual data reduction of video collected while the ambulance was in use. The first variable measured was patient care, for aid in identification of behaviors displayed while providing direct patient care as opposed to general postures assumed while idle, cell-phone communication, and discussion with the patient. The second variable collected was restraint state, to identify behaviors performed while restrained and general restraint usage statistics.

Medic working postures were collected from several variables in the visual data: seated or standing posture and trunk angle. These variables were collected to be reflective of literature defining working postures described by Neumann et al. [49] as well as to aid in performing Rapid Entire Body Assessment (REBA) analysis.

The medic behavior within the rear patient compartment was also described by physical location within the ambulance, along with any reaches for equipment or controls performed.

Procedures

Data Acquisition System

The DAS required little additional effort by the EMS workers. Consenting medics were instructed to turn the DAS on when beginning a shift, and off at the end of their shift. The DAS operated in the background, collecting data during all periods when both the DAS and the vehicle ignition were turned on. This process mitigated risk of recording EMS workers who were not actively participating in the project. Data was collected weekly from the ambulance by a researcher, and delivered to a data reduction

lab at Western Transportation Institute for analysis. The DAS yielded video data, accelerometer data, and time stamp data for this project. Compensation of $50.00 per medic was offered for three-month periods of participation, with two separate three-month collection periods occurring.

Whole-body vibration data was collected from an accelerometer which was located at the position where the primary attending medic sits. A single DAT file was generated each time the ignition was turned on, however this did not necessarily indicate a patient transport as the ambulance was also driven to alternative locations (to refuel, collect supplies, and for automotive repairs). Between May 5, 2010 and October 18, 2010 there were 744 unique trips. These trips were cross-referenced against AMR's trip logs to identify specifically which portion of each of the 744 trips involved a patient transport, and additionally to indicate at what point during the trip the medic would be positioned in the rear with the patient. Each data file was cleaned so it only included data from the time that the ambulance left the scene with a patient until the time that the ambulance arrived at the hospital or other destination location. This process resulted in 102 trips, which consisted solely of data describing vibration during times which an attending medic was known to be in the rear patient compartment with a patient, during a transport. Data manipulation was performed using SAS 9.2. Because two researchers were responsible for visual data reduction, inter-rater reliability statistics were calculated by having both researches score a random 5% of all videos. Results showed consistent scoring across the videos (Rho = 0.98, kappa = 0.69), so further rater training was not needed.

Patient Care Records

American Medical Response (AMR) (Bozeman, MT) assisted with providing data displayed on Patient Care Records. After looking at a blank Patient Care Record (PCR) form, an AMR agency manager was supplied with a list of categories from the form that were of interest to the study of EMS behaviors (date, EMS responsive actions, type of transport, and outcome). As the data was filed with AMR, the researchers contacted the AMR manager for an Excel spreadsheet summarizing this data. This data yielded information regarding patient illnesses, responsive medic activities, and emergency transportation mode for each trip.

Call Logs

Bozeman AMR assisted by providing call logs detailing each call to which they responded. Nearly six months of data were provided, detailing calls from 1 January 2010 until 15 June 2010. Each call had data surrounding the date, which crew attended the call, time of day call was received, time of day team arrived on scene, time of day team left the scene, and the time that the team cleared the hospital. This data was analyzed to identify the average number of calls per day each EMS crew responded to, as well as the average length of time in which the crew was in a moving vehicle.

EMS Safety Culture Surveys

The Critical Illness & Trauma Foundation (CIT) (Bozeman, MT) assisted with providing contacts for survey participation. CIT contacted EMS agency managers at different agencies in Montana who had previously shown interest in university-related

projects, and provided those managers with researcher contact information. Upon contact, researchers supplied the managers with an internet link to the web-based survey. Interested agency managers informed their colleagues in alternative agencies within Montana about the survey, and researcher contact information to participate in the survey was also posted in the Montana Emergency Medical Services Association (MEMSA) mailing list. Participating EMS agency managers contacted the project researcher, and were provided access information for the project survey. Compensation of $10.00 was offered to each survey participant for their time completing the survey.

Focus Groups

Focus groups were conducted with EMS professionals working with AMR Bozeman. The participants in the focus group were not restricted to the EMS workers who participated in the ambulance trip data collection effort. Five medics agreed to participate, and answered neutral questions designed to collect information regarding EMS worker expectations for ambulance design changes, hazard perception of different activities in the rear patient compartment, EMS ideology regarding restraint use patterns, contributing factors toward the decision to travel in Emergency Mode, and to observe EMS reactions to different ideas designed to improve safety in the rear patient compartment.

Focus group discussions took one hour. The focus group was led by one moderator, working from a script to ensure identical questions in the event of future focus group with alternative populations. The discussion was recorded by two audio recorders

placed around the room where the discussion was held. The verbal transcript is provided in Appendix C.

Statistical Analysis

All data was managed and analyzed using Microsoft Excel, SPSS 18, MINITAB 15, SAS 9.2, and Noldus ObserverXT software. Analysis was conducted on the results of observational video data from inside the rear patient compartment, patient care record data, agency call logs, survey data, and focus groups. All results are reported when significant with an alpha equal to 0.05.

Objective 1 – Vibration Assessment

Vibration data was generated during any time the vehicle was in motion, including time where there is nobody occupying the rear patient compartment. To identify periods of human occupation of the rear compartment, data file time stamps and durations were compared to trip logs associated with patient transports. AMR Bozeman reports the time that the ambulance leaves the scene with a patient, and the time that the ambulance arrives at their destination. The duration and time of day of this trip was compared to the duration and times of the data files. Data files which were identified as containing this "transporting" segment of the ambulance transport were kept for vibration analysis, which reduced the full set of 744 data files to 106 data files. To account for files which include extraneous travel (if the ignition was not turned off between multiple segments of travel), each of the 106 transport files were then manually reduced to include

only the portion of the trip from the scene of injury to the hospital, using timestamps. This manual reduction was based on the reported duration and time of day of each transport. The reduction was not based on video comparison, as the video data was not reliably available for comparison due to frozen video due to equipment failure as well as videos which were deleted due to privacy concerns.

The reduced data files resulted in three data streams of force data, for the x-, y-, and z-axes. The acceleration data was converted from g's to m/s^2, and then root mean square (RMS) calculations were performed to calculate significant parameters to test against standardized thresholds for health risk, comfort, and perception. All available data for each reduced transport file was included in this analysis, no sampling strategy was used within the larger data set. SAS code to analyze vibration data can be found in Appendix D, and the complete output tables are provided in Appendix E.

All data which was used to test hypotheses was first tested for normality using an Anderson-Darling test. This test was used because the Anderson-Darling test gives heavier weights to the tails of the distribution, which ensured that the data had no extreme outliers due to malfunctioning data collection equipment. Data which was found to be non-normal was transformed using a Box-Cox transformation followed by a Johnson transformation if no suitable Box-Cox transform existed. The transformed data was again tested for normality with the Anderson Darling test, and then the hypothesis testing was performed using a one-sample t-test to compare means against threshold values specified in each section.

Hypothesis 1.1 – Whole-Body-Vibration Peak Acceleration: The maximum force measured over a period of data collection is referenced to as the peak acceleration. These values are representative of the maximum forces the occupants of the ambulance are subjected to while transporting patients, and are used in conjunction with root mean squared acceleration values to calculate crest factors. Peak acceleration was examined for each axis, for each trip.

Hypothesis 1.2 – Whole-Body-Vibration Crest Factors: Crest factor is a statistic associated with vibration that is used to assess the relationship between the peak acceleration and the root mean squared acceleration. This statistic is used as an identifier for whether or not shock events were present during the period of acceleration data collection. While not a definitive threshold, ISO standard 2361-1 6.3 recommends that for crest factors greater than 9.0, fourth power vibration dose analysis should be conducted and reported to provide analysis that is more sensitive to multiple shocks. Crest factors were calculated for all three axes for each of the transport observations. Descriptive statistics summarizing crest factors encountered in the transports were reported.

Hypothesis 1.3 – Whole-Body-Vibration Health Thresholds: This analysis explored call data and agency records to find the average exposure duration to the EMS worker while in the rear of the ambulance, providing patient care en route to a target destination until the patient is discharged from the EMS workers' care. Exposure

duration was referenced against Figure 9 (below), from ISO 2361-1 B 3.1 to identify the threshold level of weighted acceleration (a_w) for the calculated exposure length.

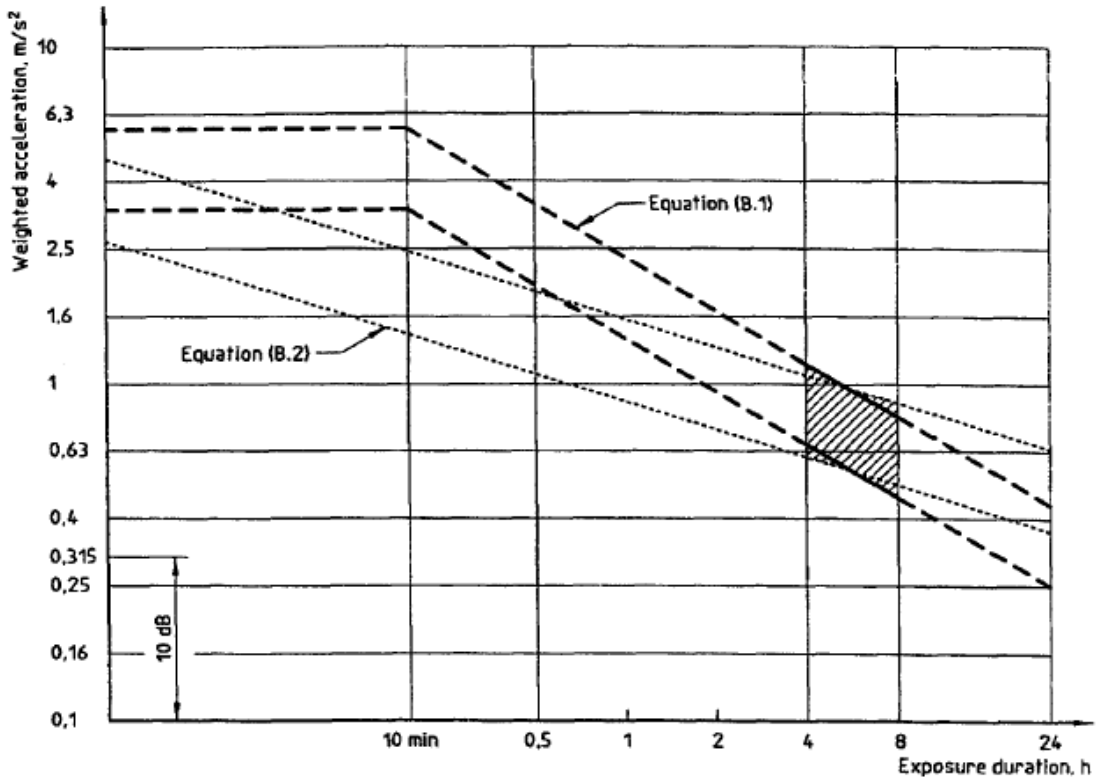


Figure 9. Health Guidance Caution Zones (Source: ISO 2361-1 Figure B.1)

The identified weighted acceleration value were compared to the values found using the seat-mounted accelerometers in the ambulance to see if EMS workers were at risk for negative health impacts due to whole-body vibration exposure in the rear patient compartment. Whole-body vibration is associated with increased health risks leading to lower back injury, which is discussed in more detail in the whole-body vibration section of Chapter 2.

To identify the average trip length, six months of call logs from Bozeman AMR were examined, providing trip details from January 2010 until June 2010. These logs listed the time the EMS crew arrived at the scene, the time they left the scene, and the time they got to the hospital. Total time in a moving vehicle per trip was calculated using the time to travel to the scene plus the time to travel from the scene to the hospital. The real value for time in transit is slightly larger, as these records do not include time to travel from the hospital back to the agency or deployment point. The only records which were analyzed were those with all four fields completed. The average amount of time in travel is reported with an average of 21.09 minutes spent traveling per trip. The same trip logs yielded data about the average number of trips taken per day, which showed an average of 10.66 trips per day. This number was split up between two to three crews consisting of two people. Analysis of the average number of trips taken per day *per crew* showed that the each of the two main EMS crews responded to an average of 4.56 trips per day. At 21.09 minutes of exposure per trip, EMS exposure was calculated to be 96.2 minutes per day.

With this daily exposure, ISO 2361-1 B 3.1 gives us a health caution guidance zone threshold upper and lower limits. At an exposure duration of 96 minutes, vibration exposure below 0.75 m/s^2 have not been shown to produce measurable health effects, vibration exposure in the health guidance caution zone (between 0.75 and 2.0 m/s^2) indicates that caution should be taken, and vibration exposure above the 2.0 m/s^2 indicates likely health risks. The measured vibration exposure within the ambulance was compared to these thresholds.

Hypothesis 1.4 – Whole-Body-Vibration Comfort: The effects of vibration on human comfort is possible to be evaluated in some environments, but that comfort level is affected by different factors including the vehicle, activities being performed while subjected to vibration (drinking, reading, and writing), and human "annoyance tolerances." If a crest factor is above 9, frequency-weighted root mean squared acceleration cannot be used to evaluate human response to vibration because humans discomfort is significantly influenced by peak values. Table 14 shows approximate indications of reactions to different magnitudes of overall vibration values in public transport (ISO 2631-1 C.2.3, 1997).

The weighted vibration magnitude was be calculated for each patient transport data file, averaged across the 106 transport observations where data was collected, and compared against the values in ISO 2631-1 C.2.3 using a test on means.

Hypothesis 1.5 – Whole-Body-Vibration Perception: According to ISO STD 2361.C.3 (p26), 50-percent of alert fit people can detect weighted vibration with a peak magnitude of 0.015 meters per second squared, but this perception may be noticeable for peak magnitudes of between 0.01 to 0.02 meters per second squared for different people. Most severe axis vibration was compared to this threshold using a one-sample t-test.

Objective 1: Additional Analyses: Because some crest factors were calculated that were greater than 9.0, descriptive statistics summarizing vibration dose values were calculated and reported alongside VDV values found for vehicles of similar size and weight from past literature.

Additionally, VDV health guidance caution zones found in ISO standard 2361were compared to conditions prevalent in the ambulance. The exposure time was adjusted, and comparisons were made between health guidance caution threshold limits and the VDV values shown in the ambulance.

Hypothesis 2.1 –Patient Injury in Emergency Mode: Data used in this analysis was collected from Patient Care Records provided by Bozeman AMR. A PCR is filled out as part of standard protocol for every patient transport, and details specific information pertaining to patient illness and medic responsive activities while under the care of an EMS worker. The record set used for analysis includes all PCRs submitted by AMR between July 2, 2005 and July 1, 2010. This data set consists of 13,253 individual calls, and the variables, descriptions, and example data entry values from the PCRs are listed below in Table 9.

Table 9. Patient Care Report Variable Descriptions

Variable	**Description**	**Example PCR Entries**
Transportation Mode: From Scene (Initial)	Whether or not the transportation was previously scheduled, an immediate request but no lights and sirens, or a request with lights and sirens	Scheduled, Urgent (no lights and sirens), Emergency (lights and sirens)
Transportation Mode: From Scene (Last)	Whether or not the transportation was previously scheduled, an immediate request but no lights and sirens, or a request with lights and sirens	Scheduled, Urgent (no lights and sirens), Emergency (lights and sirens)
Primary Illness/Symptom	Primary patient injury or illness recorded by EMT	Trauma, pain, seizure, breathing problem, bleeding, etc. (62 unique primary illnesses)
Administered Care	Specific procedures performed by the EMS worker providing care during the transportation	CPR, 12-lead EKG, Peripheral IV, intubation, bandaging, etc (47 unique procedures)
Outcome	Whether or not the patient was successfully transported. If patient was not transported, specific reason is detailed.	Transported, Cancelled en route, no treatment required, no patient found, dead on arrival, etc (13 unique outcomes)

Of the 13,253 PCRs provided by, the only records included in this analysis were those with an outcome of "Transported," which excluded 3,802 records. Excluded patient outcomes include "Patient Refused AMA (2345 records excluded)," "Cancelled FD/PD (702)," "Cancelled ENR (386)," "Dead On Arrival (97)," "No Patient Found (84)," "No Treatment Req'd (53)," "Lift Assist (48)," "Inter-Facility (29)," "Treated and Pronounced (26)," "Police Custody (17)," "Treat/No Trans. (14)," and "Helicopter (1),"

An inflated model was built consisting of all levels of the predictor *patient illness*, but a definitive model could not be built due to quasi-complete separation of data. Quasi-

complete separation of data occurs when any cell in an outcome table has a zero events. By way of example, this was evident in the data for "Nausea." There were 229 instances where nausea was the primary patient illness, but there were zero instances where nausea was the primary *patient illnes*s and the ambulance traveled in emergency transportation mode. All *patient illnesses* that had zero events in either emergency or non emergency mode were dropped from the model.

The Proc Logistic procedure was applied in SAS to build a binary logistic regression model using the remaining variables. Significant and marginally significant *patient illnesses* were reported. Patient illnesses which were not evaluated in the regression model due to under-representation of events were analyzed separately to determine if that illness was overrepresented in emergency or nonemergency transports. Because the contingency table cells have both very small (event) and very large (non-event) values, neither Chi-Square nor Fishers' Exact test was possible, and the percent associated with emergency transportation mode was reported.

Hypothesis 2.2 –Medical Response Activity in Emergency Mode: An inflated model was built consisting of all levels of the predictor *medical response*, but a definitive model could not be built due to quasi-complete separation of data. All *medical responses* that had zero events in either emergency or non emergency mode were dropped from the model.

The Proc Logistic procedure was applied in SAS to build a binary logistic regression model using the remaining variables. Significant and marginally significant

medical responses were reported. *Medic response activities* which were not evaluated in the regression model due to under-representation of events were analyzed separately to determine if each *response* was overrepresented in emergency or nonemergency transports. And the percent association with emergency transportation mode was reported.

Objective 2 - Additional Analysis: Reducing the predictor variables to achieve a data set that is not characterized by separation of data has the unfortunate effect of eliminating what may be some of the more useful predictive measures. For example, behavioral and psychological illnesses are characterized solely by nonemergency transportation mode (229 of 229 transports), but are not analyzed in the logistic regression model due to the absence of events occurring during emergency travel. As part of exploratory data analysis, a classification tree for categorical data was developed in R using *transportation mode* as a response variable, with *patient illness* and *medical response action* as predictor variables.

Hypothesis 3.1 – Observed Restraint Usage in Rear of Ambulance: Video data from the ambulance was collected in the rear patient compartment during emergency response trips. One of the variables that was analyzed was *restraint usage*, which was reduced as a binary variable (restrained | not restrained) any time that the attending medic was visible on the camera during a transport. In total, 67 unique trips were analyzed. When multiple medics were active in the cabin during a trip, the medics were analyzed separately, yielding an additional 12 observations. The total time belted is reported as a

percentage of the total time the medic is present in the video. Because the represented restrained medics are so infrequent, they are presented as a case-by-case basis along with trip duration, total time belted, percent of time belted, and the number of separate belted periods present in each trip. The trip duration indicates the entire period of time in which the medic is visible in the rear patient compartment. Total time belted indicates the total amount of time during which the medic is observed to be belted. The number of belted periods indicates the number of separate periods in which the medic is restrained; a medic who repeatedly engages and disengages his restraint during the ambulance transport will have a higher number of belted periods than a medic who remains belted throughout, or disengages his restraint and does not re-engage it at a later point in the trip. Descriptive statistics and a histogram showing restraint rates were reported. Wilcoxon signed-rank tests were performed, but the power was not large enough to make reliable conclusions. As an alternative method of analysis, the restraint usage data was analyzed as a proportion, testing a one-sided confidence limit against a hypothesized value of 0.0 which represents 0.0% restraint use in the rear of the ambulance. This should be interpreted such that if the lower limit to the confidence interval includes 0.0, then the proportion will not be significantly different to 0.0% restraint use in the ambulance.

Hypothesis 3.2 – Self-Reported Restraint Usage in Rear of Ambulance: Survey data was collected from Montana EMS workers. One question asked was "When you are in the rear patient cabin, providing patient care, what percentage of the time do you wear a seatbelt?" Participants then provided self-reported restraint usage rates as a numeric

response. If the participant provided a definite categorical response ("never" or "always"), the corresponding numeric response was used for data analysis (0 percent or 100 percent). No subjective categorical responses provided by participants ("mostly" or "sometimes") were used. This question was answered by 191 people, or 95%. To test the hypothesis, a One-Sample Wilcoxon Signed Rank Test was used to compare median values against a null value of 0% restraint use.

Hypothesis 3.3 – Self-Reported Restraint Usage in Front of Ambulance: Survey data was collected from Montana EMS workers. One question asked was "When you are in the front driver cabin, as a driver or passenger, what percentage of the time do you wear a seatbelt?" Participants then provided self-reported restraint usage rates as a numeric response. If the participant provided a definite categorical response ("never" or "always"), the corresponding numeric response was used for data analysis (0 percent or 100 percent). No subjective categorical responses provided by participants ("mostly" or "sometimes") were used. This question was answered by 196 people (98% response rate) of the 201 total survey participants. Descriptive statistics were reported.

Due to the large number of ties in the data, the Wilcoxon signed-rank test was only able to use 27 of 196 observations. Because standard nonparametric testing methods lost power due to ties, the restraint usage data was analyzed as a proportion, testing against a hypothesized value of 1.0 which represents 100% restraint use in the front of the ambulance. This should be interpreted such that if the upper limit to the confidence

interval includes 1.0, then the proportion will not be significantly different to 100% restraint use in the ambulance.

Hypothesis 4.1 – Safety Culture as a Predictor of Restraint Compliance: Survey data provided both restraint and safety culture SAQ scores for each participant. Of the 201 survey participants, 19 completed surveys contained missing values in one or more of the following categories: adjusted SAQ-EMS scores for teamwork climate, job satisfaction, stress recognition, perception of management, working conditions, and self-reported restraint rates in the rear patient compartment. *Restraint rate* is a self-reported variable regarding the percentage of time the EMT is restrained in the rear of the ambulance, while providing patient care. The SAQ-EMS scores are averages of responses to multiple questions involving each category, adjusted to a scale of 1-100. SAQ-EMS scores higher than 75 indicate agreement with positive attitudes about each category, and high restraint rates indicate that the EMS worker spends a higher percentage of time restrained in the rear of the ambulance. A regression model was built using the SAQ-EMS score categories as predictor variables for the response variable of *restraint rate* in the rear patient compartment. Significant predictors were reported.

Hypothesis 4.2 – Focus Group Findings for Low Restraint Compliance: Focus groups were conducted on-site at the EMS agency participating in this study, with a group of 5 EMS professionals. The focus groups were used to gather information about the EMS workers' opinions and behaviors of ambulance working conditions, including questions regarding EMS worker ideology regarding restraint use patterns.

The focus groups were conducted by a moderator working from a script. All discussion was recorded using an audio sound recording device, and was transcribed for analysis. Ideas and opinions exhibited by the medics regarding restraint usage and options were presented, and the complete transcript can be found in Appendix C.

Hypothesis 5.1 – Reach Envelopes for Seated Medics: Inside the patient compartment, medic equipment and storage locations for providing patient care from encountered from up to three seated reach origin points to up to nine unique reach termination points (only origin and termination combinations observed in the visual data reduction were evaluated) are located outside maximum reach envelopes for a 95% male restrained medic (a 43.5 in. reach radius).

Video data from the ambulance was collected in the rear patient compartment during emergency response trips. One of the variables that was analyzed was reaches, which was characterized by the medic's position at the initiation of the reach, the duration of the reach (seconds), and the termination point of the reach describing what the medic was reaching for. In total, 67 unique trips were analyzed. When multiple medics were active in the cabin during a trip, the medics were analyzed separately, yielding an additional 12 observations. The number and frequency of unique reaches were observed, reported in Table 22, along with average reach duration and the origin and termination points of each reach. The reach duration indicates the entire period of time in which the medic is visible in the rear patient compartment. Reach duration is the length of time in seconds from the beginning of the reach until the medic resumed a

neutral posture, or began a second reach. The reach termination is the location within the ambulance that the medic was reaching for. The total number of reaches is the observed event count for each unique reach.

Hypothesis 5.2 – REBA Reach Analysis: Reach data from video within the ambulance was characterized the medic's position at the initiation of the reach and the termination point of the reach describing what the medic was reaching for. Each individual reach was analyzed using Rapid Entire Body Assessment (REBA) analysis to assess ergonomic risk during the various reaches. These REBA scores are presented, along with the scoring metrics used to analyze REBA analyses.

CHAPTER 4

RESULTS

Hypothesis 1.1 – Whole-Body-Vibration Peak Acceleration

The values calculated for the ambulance in this study are presented in Table 10, and are compared to peak acceleration values calculated for vehicles of similar size in past literature below in

Table 11.

Table 10. Descriptive Statistics for Whole-Body Vibration Maximum Forces

Descriptive Statistics for Whole-Body Vibration Maximum Forces (m/s^2)			
	X-axis	**Y-axis**	**Z-axis**
Mean	4.579	3.188	5.621
Median	4.280	3.029	5.278
Max	9.086	6.542	11.306
Min	1.938	1.858	2.942
Standard Deviation	1.543	0.815	1.445

Table 11. Mean Peak Acceleration in Ambulance Compared to Similar Vehicles

Comparisons of Peak Acceleration in Ambulance to Similar Vehicles			
	X-axis	**Y-axis**	**Z-axis**
	Mean (standard deviation) (m/s^2)		
Ambulance	4.6 (1.54)	3.2 (0.82)	5.6 (1.45)
Van (good road)*	2.4 (1.58)	2.3 (1.61)	4.8 (1.28)
Van (poor road)*	2.2 (0.29)	1.9 (0.40)	5.1 (2.95)
Van (cobblestone)*	6.7 (0.35)	7.6 (0.78)	10.3 (0.59)
Ambulance (incubator)**	-	-	5 to 13 (unknown)
Minibus (asphalt)***	1.168 (NR)	1.107 (NR)	2.733 (NR)
Single Decker Bus (asphalt)***	1.064 (NR)	4.799 (NR)	7.024 (NR)
Double Decker Bus (asphalt)***	0.644 (NR)	0.652 (NR)	0.593 (NR)

*Source: Okunribido, Magnusson, & Pope, 2006 [31]
**Shenal, Johnson, & Varney, 1981 [29]
***Okunribido, 2007 [50]

The ambulance was found to have peak acceleration levels slightly higher than vans on non-cobblestone roads, but smaller than those identified as vans on cobblestone and single-decker busses on asphalt.

Hypothesis 1.2 – Whole-Body-Vibration Crest Factors

Crest factors were calculated for all three axes for each of the 106 transport observations. Descriptive statistics summarizing crest factors encountered in the transports are reported in Table 12 below. These values are shown to be lower than CF values reported for vehicles of similar size and weight from past literature, shown below in Table 13.

Table 12. Descriptive Statistics for Whole-Body Vibration Crest Factors

Descriptive Statistics for Whole-Body Vibration in Ambulance to Crest Factors (m/s^2)			
	X-axis	**Y-axis**	**Z-axis**
Mean	5.691	4.556	7.921
Median	5.214	4.312	7.058
Max	12.493	7.058	13.582
Min	2.936	2.618	5.047
Standard Deviation	1.723	1.057	1.796

Table 13. Mean Crest Factors in Ambulance Compared to Similar Vehicles

Comparison of Crest Factors in Ambulance to Similar Vehicles			
	X-axis	**Y-axis**	**Z-axis**
	Mean (standard deviation) (m/s^2)		
Ambulance	5.7 (1.72)	4.6 (1.06)	7.9 (1.80)
Van (good road)*	10.4 (6.07)	10.5 (6.28)	15.6 (3.07)
Van (poor road)*	9.3 (0.60)	8.1 (1.82)	13.7 (4.64)
Van (cobblestone)*	13.6 (0.17)	17.4 (2.25)	18.1 (0.29)
Auto (city road)**	NR	NR	4.8 (NR)
Van (country road)**	NR	NR	5.7 (NR)
Truck (rough road)**	NR	NR	3.9 (NR)
Heavy Truck***	NR	NR	7.8 to 18.8 (NR)
Light Truck***	NR	NR	7.4 to 17.5 (NR)
Minibus (asphalt)***	7.274 (NR)	7.119 (NR)	11.752 (NR)

Single Decker Bus (asphalt)****	9.050 (NR)	16.983 (NR)	16.128 (NR)
Double Decker Bus (asphalt)****	2.499 (NR)	2.499 (NR)	3.887 (NR)

*Source: Okunribido, Magnusson, & Pope, 2006 [31]; **Griffen, 1990 [51]; ***Robinson & Martin, 1997 [52]; ****Okunribido, 2007 [50]

The ambulance crest factors were found to be higher than those found for some automobiles, vans, and trucks, but smaller than the general levels found for heavy trucks, light trucks, minibus, and single-decker buses.

Hypothesis 1.3– Whole-Body-Vibration Health

With this daily exposure, ISO 2361-1 B 3.1 gives us a health caution guidance zone threshold upper and lower limits. At an exposure duration of 96 minutes, vibration exposure below 0.75 m/s^2 have not been shown to produce measurable health effects, vibration exposure in the health guidance caution zone (between 0.75 and 2.0 m/s^2) indicates that caution should be taken, and vibration exposure above the 2.0 m/s^2 indicates likely health risks.

$$H_0: a_w < 2.0 \frac{m}{s^2}$$

$$H_0: a_w \geq 2.0 \frac{m}{s^2}$$

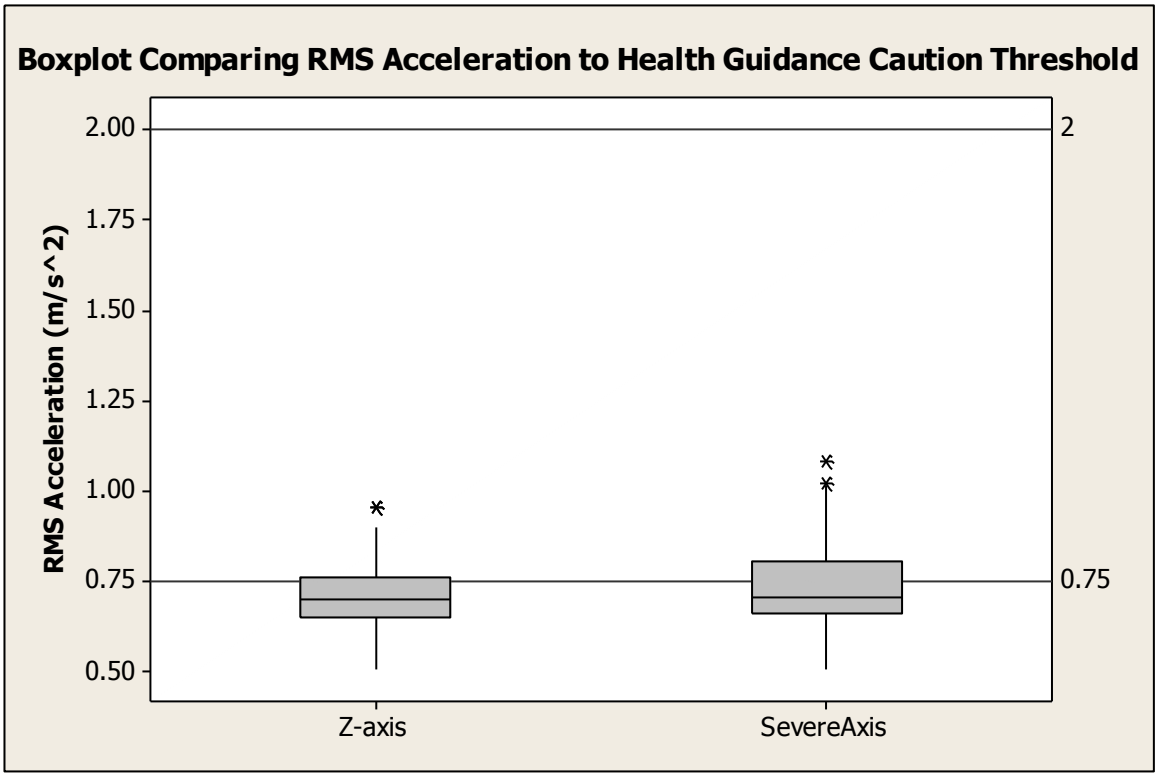
Where:

a_w represents the most root mean squared vibration for the most severe axis.

The most severe vibration axis is generally known to be the vertical axis. Of the 106 trips examined, 82 had the vertical axis (the Z-axis) as their most severe vibration axis. $a_{wz}$was compared to the lower health guidance caution zone threshold value of 0.75 m/s^2 using a one sample test on means, and a_{wz} was found to be significantly lower ($t = -4.41$, $p < 0.001$).

Because the z-axis was not always the most severe axis, this data was also analyzed looking at the weighted root mean squared acceleration for the most severe axis in every trip. Weighted root mean squared acceleration was not found to be significantly lower than the lower limit for health guidance caution zones, but was significantly lower than the upper limit for the caution zone ($t=-13.49$, $p<0.001$). A box plot for the severe axis root mean squared acceleration compared to the thresholds is shown below in Figure 10.

Figure 10. RMS Acceleration and Health Threshold Boxplot



Hypothesis 1.4 – Whole-Body-Vibration Comfort

The effects of vibration on human comfort is possible to be evaluated in some environments, but that comfort level is affected by different factors including the vehicle, activities being performed while subjected to vibration (drinking, reading, and writing), and human "annoyance tolerances." If a crest factor (a unit-less measurement) is above 9.0, frequency-weighted root mean squared acceleration cannot be used to evaluate human response to vibration because humans discomfort is significantly influenced by peak values. Table 14 shows approximate indications of reactions to different magnitudes of overall vibration values in public transport [27].

Table 14. Comfort Reactions to WBV Magnitudes (ISO 2361-1 C.2.3)

Weighted Vibration Magnitude	Comfort Reaction
$a_{w\,total} < 0.315\ \frac{m}{s^2}$	Not uncomfortable
$0.315\ \frac{m}{s^2} < a_{w\,total} < 0.63\ \frac{m}{s^2}$	A little uncomfortable
$0.5\ \frac{m}{s^2} < a_{w\,total} < 1.0\ \frac{m}{s^2}$	Fairly uncomfortable
$0.8\ \frac{m}{s^2} < a_{w\,total} < 1.6\ \frac{m}{s^2}$	Uncomfortable
$1.25\ \frac{m}{s^2} < a_{w\,total} < 2.5\ \frac{m}{s^2}$	Very uncomfortable
$2.0\ \frac{m}{s^2} < a_{w\,total}$	Extremely uncomfortable

The weighted vibration magnitude was calculated for each patient transport data file, averaged across the 106 transport observations where data was collected, and compared against the values in ISO 2631-1 C.2.3 using a test on means with the following hypothesis:

$$H_0: a_w < 0.315\ \frac{m}{s^2}$$

$$H_0: a_w \geq 0.315\ \frac{m}{s^2}$$

Where:

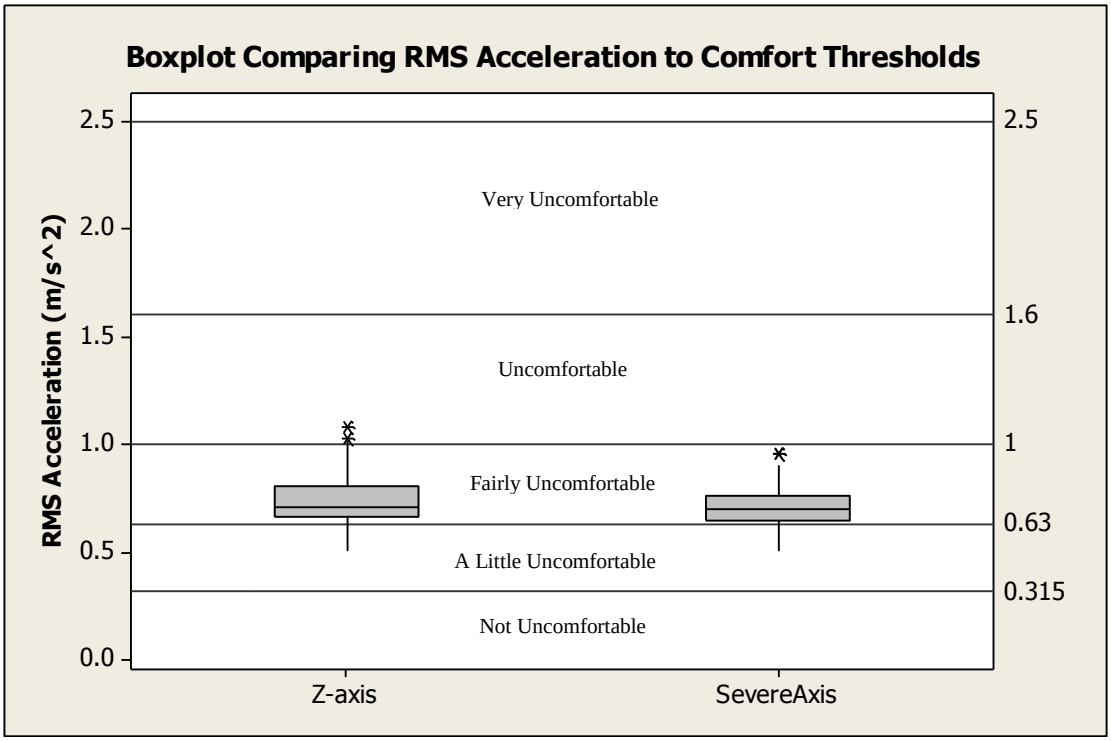
a_w represents total weighted root mean squared vibration magnitude.

A one-sample t-test found that the weighted RMS vibration magnitude (μ=1.3, σ=0.020) was significantly greater than the threshold for "not uncomfortable" ($t = 36.93$, $p<0.001$), "a little uncomfortable" ($t=27.72$, $p<0.001$), and fairly uncomfortable ($t=9.22$, $p<0.001$). The average total weighted RMS vibration was not significantly greater than the thresholds for "very uncomfortable" or "extremely uncomfortable." A box plot for the

severe total mean squared acceleration compared to the comfort thresholds is shown below in

Figure 11.

Figure 11. RMS Acceleration and Comfort Threshold Boxplot



Hypothesis 1.5 – Whole-Body-Vibration Perception

According to ISO STD 2361.C.3 (p26), 50-percent of alert fit people can detect weighted vibration with a peak magnitude of 0.015 meters per second squared, but this perception may be noticeable for peak magnitudes of between 0.01 to 0.02 meters per second squared for different people. Most severe axis vibration was compared to this threshold using a one-sample t-test, with the hypothesis shown below:

$$H_0: a_i < 0.02 \frac{m}{s^2}$$

$$H_0: a_i \geq 0.02 \frac{m}{s^2}$$

Where:

a_i represents the most severe axis vibration.

An Anderson-Darling test showed that a_{wz} followed a normal distribution (p=0.090), so the z-axis RMS vibration magnitude was compared to the threshold value of 0.02 using a one sample test on means, and was found to be significantly greater than the threshold of 0.02 m/s^2 (t=79.76, p<0.001). Because the z-axis was not always the most severe axis, this data was also analyzed looking at the weighted root mean squared acceleration for the most severe axis in every trip and was then found to be significantly greater than the transformed threshold value for perception (t=50.24, p<0.001).

Objective 1: Additional Analyses

Because some crest factors were calculated that were greater than 9.0, descriptive statistics summarizing vibration dose values are reported below in Table 15. These values are compared to VDV calculated for vehicles of similar size and weight from past literature in

Table 16.

Table 15. Descriptive Statistics for Whole-Body Vibration VDV

Descriptive Statistics for Whole-Body Vibration VDV ($m/s^{1.78}$)			
	X-axis	**Y-axis**	**Z-axis**
Mean	1.283	1.060	1.176
Median	1.270	1.037	1.158
Max	2.627	2.220	2.070
Min	0.804	0.643	0.760
Standard Deviation	0.267	0.230	0.177

Table 16. Mean VDV in Ambulance Compared to Similar Vehicles

Comparison of VDV in Ambulance to Similar Vehicles			
	X-axis	**Y-axis**	**Z-axis**
	Mean (standard deviation) ($m/s^{1.75}$)		
Ambulance	1.28 (0.267)	1.06 (0.230)	1.18 (0.177)
Van (good road)*	9.1 (3.55)	8.8 (3.81)	12.0 (1.79)
Van (poor road)*	8.4 (0.80)	8.0 (0.40)	13.2 (3.01)
Van (cobblestone)*	21.1 (0.89)	20.9 (1.06)	23.2 (0.85)
Car**	NR	NR	1.51 (NR)
Van**	NR	NR	1.76 (NR)
Bus**	NR	NR	2.17 (NR)
Minibus (asphalt)***	5.237 (NR)	4.910 (NR)	8.288 (NR)
Single Decker Bus (asphalt)***	6.721 (NR)	15.862 (NR)	19.233 (NR)
Double Decker Bus (asphalt)***	6.417 (NR)	6.498 (NR)	4.570 (NR)

*Source: Okunribido, Magnusson, & Pope, 2006
**Paddan & Griffin, 2001 (VDV values reported for most severe axis; axis not specified)
***Okunribido, 2007

ISO standard 2361-1 provides lower and upper bounds for VDV to be between 8.5 $m/s^{1.75}$ and 17.0 $m/s^{1.75}$. These bounds describe a "health caution zone" which indicates thresholds that are believed to contribute to potential negative health effects over time. The described health caution zone is for an exposure of between 4 and 8 hours, which is much longer than the 96.2 minute daily exposure to vibration in the rear patient compartment experienced by medics. ISO 2361-1 B.2 provides an equation which establishes a relationship between different exposure durations, shown below in Equation 1.

$$a_{w1}T_1^{\frac{1}{4}} = a_{w2}T_2^{\frac{1}{4}} \quad \text{Eq. 1}$$

This equation described a health caution zone between 12.7 $m/s^{1.75}$ and 21.4 $m/s^{1.75}$. Caution is recommended when using this equation to examine vibration exposure in shorter exposure durations than 4 hours due to the lack of study of long-term effects from short-term WBV exposure. However, it is reasonable to assert that the VDV statistics collected from this study are similar to VDV levels for similar-style ambulances operating under heavier call volumes resulting in longer exposure durations. VDV comparisons were made to the health caution zone thresholds and found to be significantly lower than the lower bound of 12.7.

Hypothesis 2.1 –Patient Injury in Emergency Mode

Data used in this analysis was collected from Patient Care Records (PCRs) provided by Bozeman AMR. A PCR is filled out as part of standard protocol for every patient transport, and details specific information pertaining to patient illness and medic responsive activities while under the care of an EMS worker. The record set used for analysis includes all PCRs submitted by AMR between July 2, 2005 and July 1, 2010. This data set consists of 13,253 individual calls, and the variables, descriptions, and example data entry values from the PCRs are listed below in Table 17.

Of the 13,253 PCRs provided by, the only records included in this analysis were those with an outcome of "Transported," which excluded 3,802 records. Excluded patient outcomes include "Patient Refused AMA (2345 records excluded)," "Cancelled FD/PD (702)," "Cancelled ENR (386)," "Dead On Arrival (97)," "No Patient Found

(84)," "No Treatment Req'd (53)," "Lift Assist (48)," "Inter-Facility (29)," "Treated and Pronounced (26)," "Police Custody (17)," "Treat/No Trans. (14)," and "Helicopter (1),"

Table 17. Patient Care Report Variable Descriptions

Variable	**Description**	**Example PCR Entries**
Transportation Mode: From Scene (Initial)	Whether or not the transportation was previously scheduled, an immediate request but no lights and sirens, or a request with lights and sirens	Scheduled, Urgent (no lights and sirens), Emergency (lights and sirens)
Transportation Mode: From Scene (Last)	Whether or not the transportation was previously scheduled, an immediate request but no lights and sirens, or a request with lights and sirens	Scheduled, Urgent (no lights and sirens), Emergency (lights and sirens)
Primary Illness/Symptom	Primary patient injury or illness recorded by EMT	Trauma, pain, seizure, breathing problem, bleeding, etc. (62 unique primary illnesses)
Administered Care	Specific procedures performed by the EMS worker providing care during the transportation	CPR, 12-lead EKG, Peripheral IV, intubation, bandaging, etc (47 unique procedures)
Outcome	Whether or not the patient was successfully transported. If patient was not transported, specific reason is detailed.	Transported, Cancelled en route, no treatment required, no patient found, dead on arrival, etc (13 unique outcomes)

An inflated model was built consisting of all levels of the predictor *patient illness*, but a definitive model could not be built due to quasi-complete separation of data. Quasi-complete separation of data occurs when any cell in an outcome table has a zero events. By way of example, this was evident in the data for "Nausea." There were 229 instances where nausea was the primary patient illness, but there were zero instances where nausea

was the primary *patient illnes*s and the ambulance traveled in emergency transportation mode. All *patient illnesses* that had zero events in either emergency or non emergency mode were dropped from the model. Dropped *illnesses* include shock (1 observation), behavioral/psychological (229), nausea (126), vertigo (54), fever/flu (44), CP-Musc/Skel (35), epistaxis (20), hypertension (20), dehydration (18), diarrhea (18), swelling (16), hypothermia (14), eye problem (12), malaise (8), environmental injury (4), mass/lesion (3), newborn (3), contagious disease (1), device/equipment (1), drainage/discharge (1), and "not applicable (10)." Shock was only observed during emergency transportation mode, and the remaining *patient illnesses* were observed only during nonemergency transportation mode.

The Proc Logistic procedure was applied in SAS to build a binary logistic regression model using the remaining variables. The SAS code is provided in Appendix E and output showing a complete table of *patient illness* predictors is shown in Appendix F. Significant and marginally significant *patient illnesses* are reported in Table 18. Coefficient estimates should be interpreted such that for a trip with a listed primary patient illness, the difference in log odds for emergency transportation mode is expected to change by the listed coefficient estimate. By way of example, a transport with a patient whose primary *illness* is "Airway Obstruction" increases the likelihood of emergency transportation over non-emergency transportation mode by $e^{1.7361}$, or 5.7 times.

Table 18. Odds Ratio for Patient Illnesses and Emergency Mode

Patient Illness	**Coefficient Estimate**	**Odds Ratio**	**95% Wald Lower CI**	**95% Wald Upper CI**	**p-value**
Airway Obstruct	1.7361	5.7	1.1	28.9	0.0368
Altered LOC	0.8353	2.3	1.1	4.9	0.0280
Asthma	1.4678	4.3	0.9	21.7	0.0736
Bleeding	0.8229	2.3	1.0	4.9	0.0376
Breathing Prob.	5.5696	262.3	100.3	686.4	<0.0001
Cardiac Arrest	1.3878	4.0	1.8	8.8	0.0005
Cardiac Sympt.	1.0661	2.9	1.4	6.1	0.0049
Chest Pain	2.2216	9.2	2.6	33.2	0.0007
CHF/PE	1.5930	4.9	1.0	24.8	0.0535
Fever/Flu	1.1656	3.2	0.9	10.8	0.0606
Headache	2.2862	9.8	3.5	27.4	<0.0001
Ingestion	2.2216	9.2	0.9	91.0	0.0572
Not App.	1.9985	7.4	1.8	30.1	0.0053
Poison/OD	4.1957	66.4	18.5	238.4	<0.0001
Resp. Arrest	1.6883	5.4	2.2	13.5	0.0003
Resp. Distress	0.7109	2.0	0.9	4.4	0.0722
Sick Person	1.3413	3.8	1.7	8.8	0.0015
Terminal Illness	1.0188	2.8	1.4	5.5	0.0039
Trauma	2.7717	16.0	6.3	40.5	<0.0001

Patient illnesses which were not evaluated in the regression model due to under-representation of events were analyzed separately to determine if that illness was overrepresented in emergency or nonemergency transports. Because the contingency table cells have both very small (event) and very large (non-event) values, neither Chi-Square nor Fishers' Exact test was possible, but the percent association is shown below in Table 19.

Table 19. Patient Illnesses Not Analyzed in Model

Patient Illness	**No. Emergency**	**No. Non-Emergency**	**Percent Emergency**
Behav/Psych	0	229	0.0
Contagious Disease	0	1	0.0
COPD	1	14	6.7
CP-Musc./Skel.	0	35	0.0
Dehydration	0	18	0.0
Diabetic	5	114	4.2
Diarrhea	0	18	0.0
DT's	1	25	3.8
Envirnmntl Inj.	0	4	0.0
Epistaxis	0	20	0.0
Eye Problem	0	12	0.0
Heart/Cardiac	8	30	21.1
Hypotension	3	46	6.1
Inhalation	1	4	20.0
Malaise	0	8	0.0
Mass/Lesion	0	3	0.0
Nausea	0	126	0.0
Newborn	0	3	0.0
Seizure	25	453	5.2
Stroke/CVA	17	164	9.4
Unknown	1	10	9.1

Hypothesis 2.2 –Medical Response Activity in Emergency Mode

Initially an inflated model was going to be built including both *patient illness* and *medical response activity*. However, this violated the assumption that the main factors in the model are independent. It is reasonable to assume that the *medical response activity* is related to the *patient illness*, as certain activities are treatments for specific injuries. Consequently, *response activities* were analyzed in a separate model from *patient*

illnesses to identify any significant relationships between *medical response activity* and *emergency transportation mode*. These factors are not assumed to be causal, since it is reasonable to assert that the *medical response activity* does not influence emergency mode. However, it is useful to understand the procedures which are frequently associated with emergency mode to provide a better understanding of the working environment in the rear patient compartment during emergency transportations.

An inflated model was built consisting of all levels of the predictor *medical response*, but a definitive model could not be built due to quasi-complete separation of data. All *medical responses* that had zero events in either emergency or non emergency mode were dropped from the model. Dropped *medical responses* include OB Delivery (1 observation), psych. assist (20), CPAP (8), cricothyrotomy (1), gastric tube (2), heparin/saline lock (2), and Magill forceps (4). Cricothyrotomy was only observed during emergency transportation mode, and the remaining *medic response activities* were observed only during nonemergency transportation mode.

The Proc Logistic procedure was applied in SAS to build a binary logistic regression model using the remaining variables. The SAS code for analysis is provided in Appendix G and output showing a complete table of *medical response* predictors is shown in Appendix H. Significant and marginally significant *medical responses* are reported in Table 20. Coefficient estimates should be interpreted such that for a trip with a listed *medical response activity*, the difference in log odds for emergency transportation mode is expected to change by the listed coefficient estimate. By way of example, a transport with a patient whose primary *illness* is “Airway/Manual” increases the

likelihood of emergency transportation mode over nonemergency transportation mode by $e^{0.7745}$, or 2.2 times.

Table 20. Odds Ratio for Medical Response Activity and Emergency Mode

Medic Response Activity	**Coefficient Estimate**	**Odds Ratio**	**95% Wald Lower CI**	**95% Wald Upper CI**	**p-value**
Airway – Manual	0.7745	2.2	1.0	4.5	0.0371
Airway – Oral/Nasal	1.2210	3.4	2.0	5.9	<0.0001
Bandaging/Hemorrhage Control	0.8108	2.3	1.3	3.8	0.0023
BVM-Assisted Ventilation	1.5421	4.7	2.3	9.5	<0.0001
AED	-1.8085	0.2	0.0	1.2	0.0775
Extrication	1.4216	4.1	2.2	7.7	<0.0001
Restraints	0.7292	2.1	1.0	4.5	0.0631
Spinal Precautions	1.0470	2.8	2.1	3.8	<0.0001
Splint-Traction	1.5435	4.7	1.8	12.4	0.0018
Suction	1.7229	5.6	3.0	10.6	<0.0001
12-Lead EKG	0.2685	1.3	1.0	1.7	0.0658
Blood Drawn	-0.3083	0.7	0.6	0.9	0.0118
Cardiac Monitor	0.5270	1.7	1.3	2.1	<0.0001
Defibrillation	1.7007	5.5	1.7	17.1	0.0035
End Tidal CO2	1.1566	3.1	1.4	7.1	0.0049
Intraosseous	3.0034	20.2	5.5	73.5	<0.0001
IV-Peripheral	1.5337	4.6	3.2	6.6	<0.0001
Medication Admin	0.3482	1.4	1.1	1.8	0.0026
Pacing	2.2199	9.2	2.2	38.2	0.0022
Rescue Airway	3.0130	20.3	1.5	269.1	0.0222

Medic response activities which were not evaluated in the regression model due to under-representation of events were analyzed separately to determine if each *response* was overrepresented in emergency or nonemergency transports. Because the contingency table cells have both very small (event) and very large (non-event) values, neither Chi-

Square nor Fishers' Exact test was possible, but the percent association is shown below in Table 21.

Table 21. Medic Response Activities Not Analyzed in Model

Patient Illness	**No. Emergency**	**No. Non-Emergency**	**Percent Emergency**
OB Delivery	0	1	0.0
Psych. Assist	0	20	0.0
CPAP	0	8	0.0
Cricothyrotomy	1	0	100.0
Gastric tube	0	2	0.0
Heparin/Saline Lock	0	2	0.0
Magill Forceps	0	4	0.0

Hypothesis 2.3 – Additional Analysis

Reducing the predictor variables to achieve a data set that is not characterized by separation of data has the unfortunate effect of eliminating what may be some of the more useful predictive measures. For example, behavioral and psychological illnesses are characterized solely by nonemergency transportation mode (229 of 229 transports), but are not analyzed in the logistic regression model due to the absence of events occurring during emergency travel. As part of exploratory data analysis, a classification tree for categorical data was developed in R using *transportation mode* as a response variable, with *patient illness* and *medical response action* as predictor variables. The tree is shown below in Figure 12.

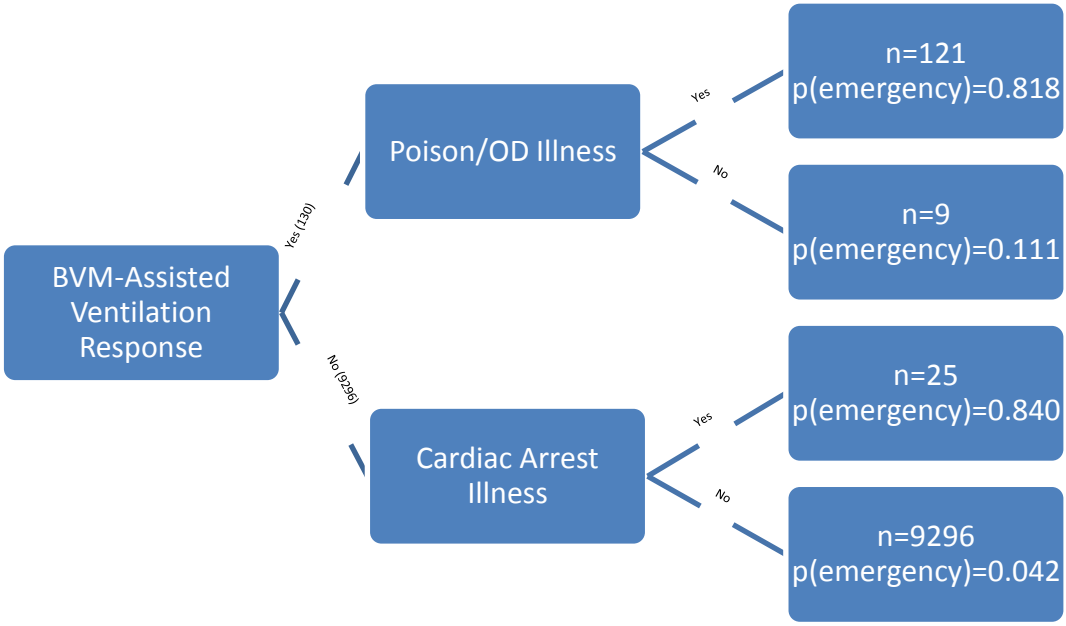


Figure 12. Classification Tree for Emergency Transportation Mode

The tree shows that high probabilities of emergency mode are associated with interactions between the presence of BVM-Assisted Ventilation *response* and Poison/OD *illness*, as well as with the presence of Cardiac Arrest *illness* when BVM-Assisted Ventilation *response* is absent.

Hypothesis 3.1 – Observed Restraint Usage in Rear of Ambulance

Video data from the ambulance was collected in the rear patient compartment during emergency response trips. One of the variables that was analyzed was restraint usage, which was reduced as a binary variable (restrained | not restrained) any time that the attending medic was visible on the camera during a transport. In total, 79 medics were analyzed from 67 unique trips. When multiple medics were active in the cabin during a trip, the medics were analyzed separately. The total time belted is reported as a

percentage of the total time the medic is present in the video. Of the 79 observed medic trips, three contained medics who at some point were restrained. Because the represented restrained medics are so infrequent, they are presented as a case-by-case basis in Table 22. The trip duration indicates the entire period of time in which the medic is visible in the rear patient compartment. Total time belted indicates the total amount of time during which the medic is observed to be belted. The number of belted periods indicates the number of separate periods in which the medic is restrained; a medic who repeatedly engages and disengages his restraint during the ambulance transport will have a higher number of belted periods than a medic who remains belted throughout, or disengages his restraint and does not re-engage it at a later point in the trip.

Table 22. Case Listing of Observations with Restrained Medics

Medic Trip Index	Trip Duration (s)	Total Time Belted	Percent of Time Belted	Number of Belted Periods
1	6368.8	4500.8	70.7%	6
2	1244.2	1055.7	84.8%	4
3	579.6	275.2	47.5%	1
4-79	Variable	Variable	0.0%	0

The observed medics in restrained observations 1 and 2 were from the same medic, who was also observed with a 0% restraint rate in 2 additional trips. Trip 3 was from a different medic, who was observed with a 0% restraint rate in 4 additional trips. The remaining 10 medics who are represented in this set were observed in 75 trips with a 0% restraint rate.

The data analysis was performed examining the per-trip observed restraint rate, with each observation being a number representative of the percent of time the medic was observed in a restrained state during each trip. Descriptive statistics and a histogram is shown below in Table 23 and the histogram showing the distribution of observations is shown in Figure 13.

Table 23. Descriptive Statistics for Observed Rear Restraint Rates

Statistic	**Percent of Time Belted in Rear (n = 79)**
Mean	2.6%
Standard Deviation	13.36%
Median	0.0%
Maximum	84.8%
Minimum	0.0%

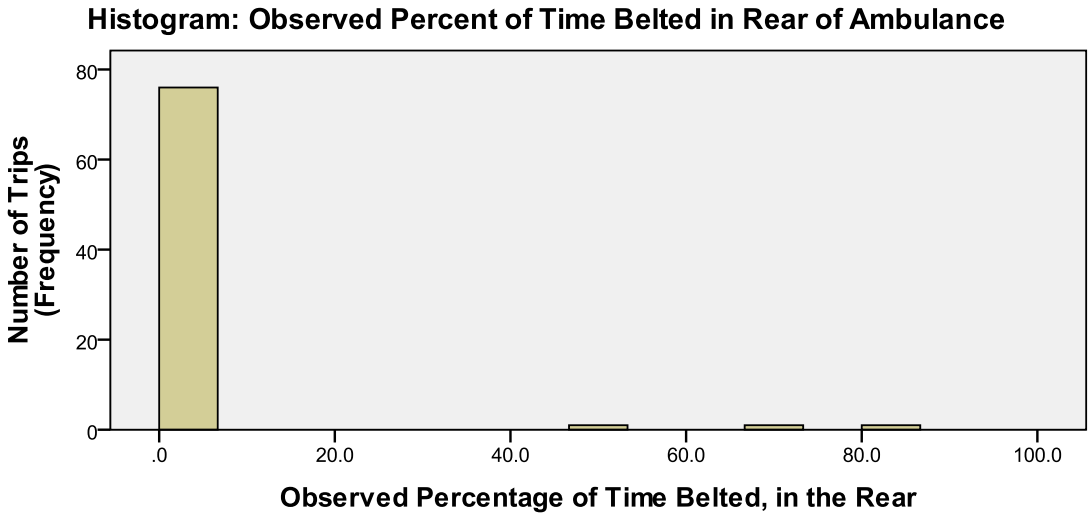


Figure 13. Distribution of Observed Rear Restraint Rates

Due to the large number of ties in the data, the Wilcoxon signed-rank test was only able to use 3 of 79 observations. This smaller sample showed that the median value was not dissimilar to the hypothesized median of 0% restraint use in the front (WS=6.0, n=3, p=0.181), however the small sample size cannot be used to reliably compare restraint rates against a hypothesized median value.

Because standard nonparametric testing methods lost power due to ties, the restraint usage data was analyzed as a proportion, testing a one-sided confidence limit against a hypothesized value of 0.0 which represents 0.0% restraint use in the rear of the ambulance.

$$H_0: p = 0.0$$

$$H_1: p > 0.0$$

$$Lower\ CI\ Limit = \hat{p} - Z_{\propto}\sqrt{\frac{\hat{p}(1-\hat{p})}{n}}$$

$$Lower\ CI\ Limit = 0.0380 - 1.65\sqrt{\frac{0.0380(1-0.0380)}{79}} = 0.0165$$

If the lower limit to the confidence interval includes 0.0, then the proportion will not be significantly different to 0.0% restraint use in the ambulance. Because the lower limit of the confidence interval does not include 0.0, the null hypothesis is rejected, showing that the observed rear restraint usage rate is higher than 0% compliance.

However, reducing the alpha level from 0.05 to 0.03836 would include 0.0 in the lower limit to the confidence interval.

Hypothesis 3.2 – Self-Reported Restraint Usage in Rear of Ambulance

Survey data was collected from Montana EMS workers. One question asked was "When you are in the rear patient cabin, providing patient care, what percentage of the time do you wear a seatbelt?" Participants then provided self-reported restraint usage rates as a numeric response. If the participant provided a definite categorical response ("never" or "always"), the corresponding numeric response was used for data analysis (0 percent or 100 percent). No subjective categorical responses provided by participants ("mostly" or "sometimes") were used. This question was answered by 191 people, or 95% of the 201 survey participants. Descriptive statistics are shown in Table 24, and the histogram showing the distribution of responses is shown in Figure 14.

Table 24. Descriptive Statistics for Self-Reported Rear Restraint Rates

Statistic	**Percent of Time Belted in Rear (n = 191)**
Mean	21.5%
Standard Deviation	27.1
Median	10.0%
Maximum	100 %
Minimum	0.0 %

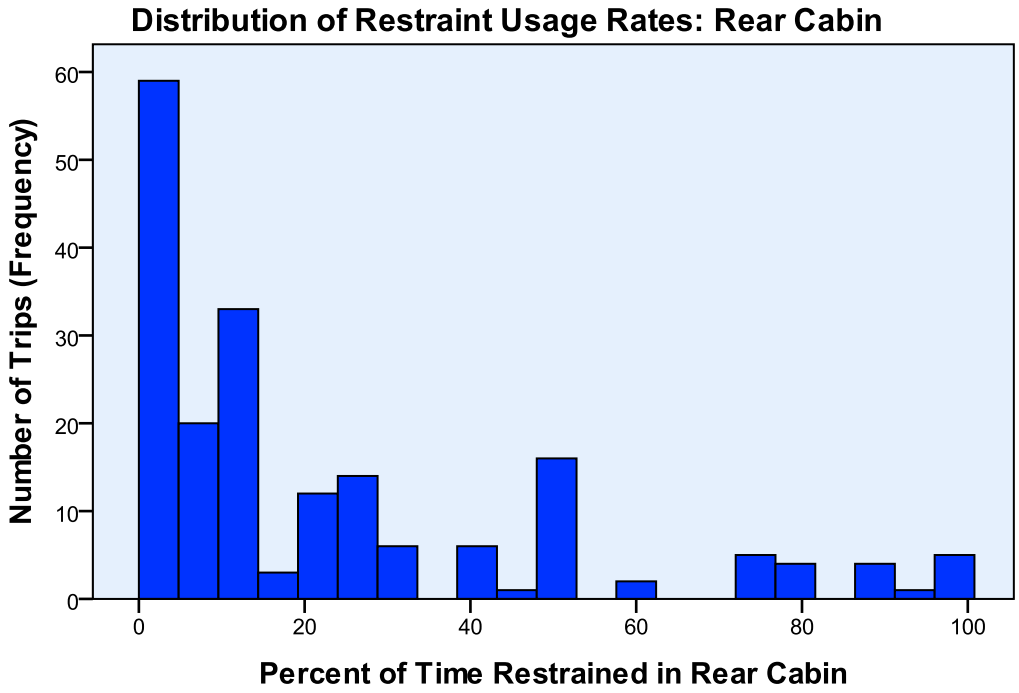


Figure 14. Distribution of Self-Reported Rear Restraint Rates

To test the hypothesis, a One-Sample Wilcoxon Signed Rank Test was used to compare median values against a null value of 0% restraint use, which found that the median value for self-reported rear restraint rate was significantly different than the hypothesized value of 0% (WS=9453, n=137, p=0.000).

Hypothesis 3.3 – Self-Reported Restraint Usage in Front of Ambulance

Survey data was collected from Montana EMS workers. One question asked was "When you are in the front driver cabin, as a driver or passenger, what percentage of the time do you wear a seatbelt?" Participants then provided self-reported restraint usage rates as a numeric response. If the participant provided a definite categorical response

("never" or "always"), the corresponding numeric response was used for data analysis (0 percent or 100 percent). No subjective categorical responses provided by participants ("mostly" or "sometimes") were used. This question was answered by 196 people of the 201 total survey participants (98% response rate). Descriptive statistics are shown in Table 25, and the histogram showing the distribution of responses is shown in Figure 15.

Table 25. Descriptive Statistics for Self-Reported Front Restraint Rates

Statistic	**Percent of Time Belted in Front (n = 191)**
Mean	96.8%
Standard Deviation	12.1%
Median	100.0%
Maximum	100.0%
Minimum	0.0%

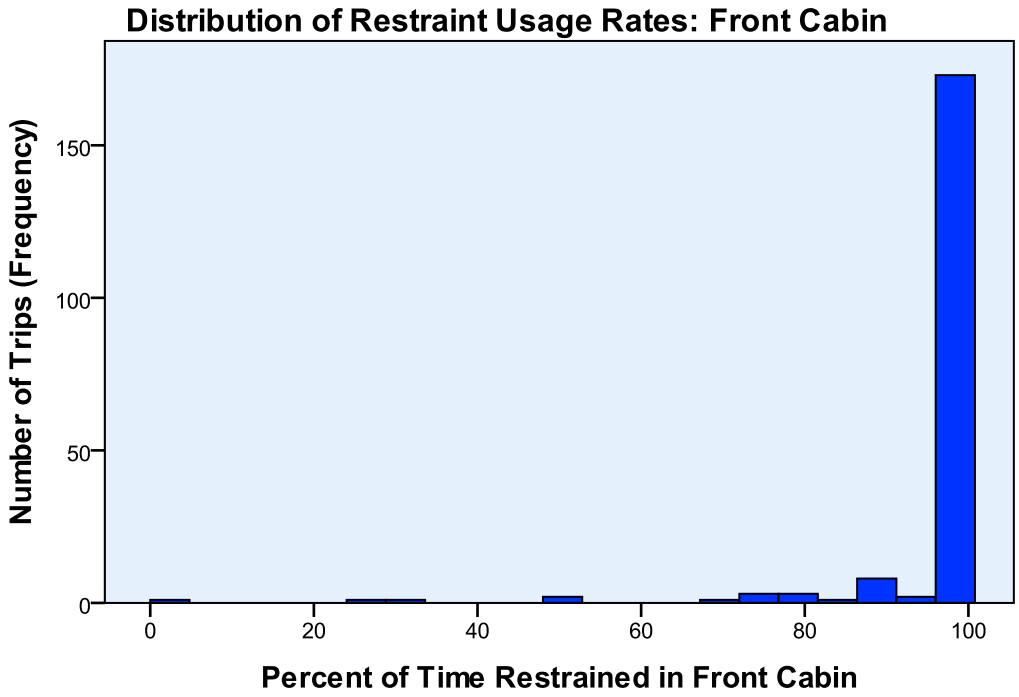


Figure 15. Distribution of Self-Reported Front Restraint Rates

Due to the large number of ties in the data, the Wilcoxon signed-rank test was only able to use 27 of 196 observations. This smaller sample showed that the median value was not equal to the hypothesized median of 100% restraint use in the front (WS=0.0, n=27, p=0.000), however the small sample size cannot be used to reliably compare restraint rates against a hypothesized median value.

Because standard nonparametric testing methods lost power due to ties, the restraint usage data was analyzed as a proportion, testing against a hypothesized value of 1.0 which represents 100% restraint use in the front of the ambulance.

$$H_0: p = 1.0$$

$$H_1: p < 1.0$$

$$Upper\ CI\ Limit = \hat{p} + Z_{\propto}\sqrt{\frac{\hat{p}(1-\hat{p})}{n}}$$

$$Upper\ CI\ Limit = 0.8622 + 1.65\sqrt{\frac{0.8622(1-0.8622)}{196}} = 0.9027$$

If the upper limit to the confidence interval includes 1.0, then the proportion will not be significantly different to 100% restraint use in the ambulance. Because the upper limit of the confidence interval does not include 1.0, the null hypothesis is rejected, showing that the front restraint usage rate is slightly less than 100% compliance.

Hypothesis 4.1 – Safety Culture as a Predictor of Restraint Compliance

Survey data provided both restraint and safety culture SAQ scores for each participant. Of the 201 survey participants, 19 completed surveys contained missing values in one or more of the following categories: adjusted SAQ-EMS scores for teamwork climate, job satisfaction, stress recognition, perception of management, working conditions, and self-reported restraint rates in the rear patient compartment. *Restraint rate* is a self-reported variable regarding the percentage of time the EMT is restrained in the rear of the ambulance, while providing patient care. The SAQ-EMS scores are averages of responses to multiple questions involving each category, adjusted to a scale of 1-100. SAQ-EMS scores higher than 75 indicate agreement with positive attitudes about each category, and high restraint rates indicate that the EMS worker

spends a higher percentage of time restrained in the rear of the ambulance. A regression model was built using the SAQ-EMS score categories as predictor variables for the response variable of *restraint rate* in the rear patient compartment, with the following hypothesis:

Model: $y_i = \beta_0 + \beta_1 x_1 + \cdots + \beta_j x_j + \in_{ij}$

Where:

y_i represents the i^{th} response variable for self-reported rear restraint usage

x_i represents the j^{th} category of SAQ score (j= 1 to 6);

β_j represents the j^{th} coefficient for SAQ score category;

$\in_{ij}$ represents the i^{th}, j^{th} random error component.

$$H_1: \beta_1 = \beta_2 = \cdots = \beta_j$$

$$H_1: at\ least\ one\ \beta_j \neq 0$$

The only SAQ-EMS categorical predictor which was significant in this model was *Safety Climate* (t=2.11, p=0.037). The complete table of predictors and coefficients is shown below in

Table 26.

Table 26. Regression Model Using SAQ Categories to Predict Restraint Compliance

Predictor	**Coefficient**	**SE Coef**	**t-value**	**p-value**
Constant	-2.68	12.09	-0.22	0.825
Teamwork Climate	-0.32	0.21	-1.56	0.121
Safety Climate**	0.45	0.21	2.11	0.037
Job Satisfaction	0.002	0.20	0.01	0.991
Stress Recognition	0.11	0.10	1.10	0.275
Perception of Management	-0.012	0.1565	-0.08	0.939
Working Conditions	0.12	0.17	0.69	0.491

Hypothesis 4.2 – Focus Group Findings for Low Restraint Compliance

Focus groups were asked "What can influence your use of restraint devices?" Answers were varied, and the reasons provided included "The procedures I'm trying to do," along with a comment addressing the importance of the patient injury severity, "I would say the ideal situation for a seatbelt is a non-emergent, because 75 percent of the time a patient [in a non-emergent call] needs minimal care: check vitals, so it's not a lot of moving around." A third point of view identified in focus group was a more sobering rationale of the inherently poor safety conditions in the rear patient compartment in the event of a crash, "I mean realistically, if we crash, being in the back of the ambulance, we're going to be dead…And thinking about it that way. I mean, if I'm restrained and I

end up paralyzed versus being not restrained and dead, I'd rather be dead, but that's just me."

Hypothesis 5.1 – Reach Envelops for Seated Medics

Inside the patient compartment, medic equipment and storage locations for providing patient care were analyzed by examining reaches. Reaches resulted from up to four unique reach origin positions to up to nine unique reach termination points that were observed in the visual data reduction. Figure 16 shows an overhead view of the rear patient compartment, with the reach envelopes for a 5% female and a 95% male care provider sitting in the primary patient care position on the bench. The two concentric circles for each modeled caregiver represent the envelope of convenient reach (inner circle), and the envelope of maximum reach (outer circle).

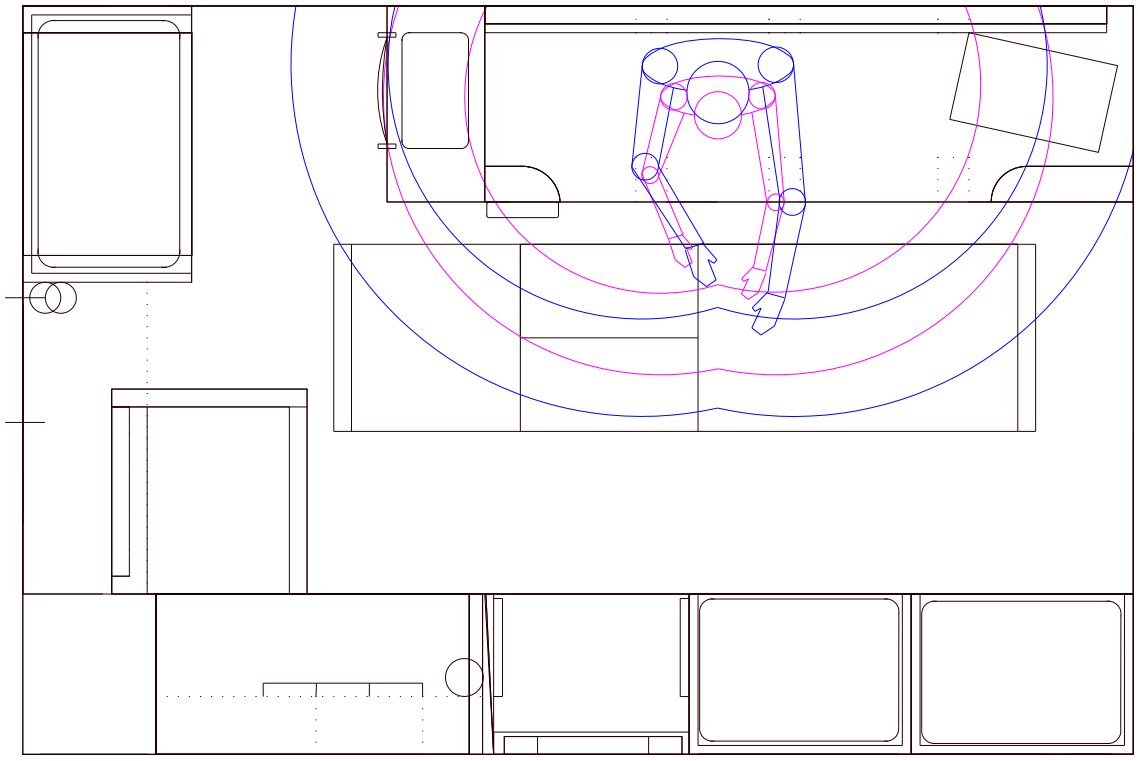


Figure 16. Overhead View of Rear Patient Compartment with Reach Envelopes: 5% Female and 95% Male

Video data from the ambulance was collected in the rear patient compartment during emergency response trips. One of the variables that was analyzed was *reaches*, which was characterized by the medic's position at the initiation of the reach, the duration of the reach (seconds), and the termination point of the reach describing what the medic was reaching for. In total, 67 unique trips were analyzed. When multiple medics were active in the cabin during a trip, the medics were analyzed separately, yielding an additional 12 observations. In the 79 observed medic trips, 111 unique reaches were observed, reported in

Table 27. The reach duration indicates the entire period of time in which the medic is visible in the rear patient compartment. Reach duration is the length of time in seconds from the beginning of the reach until the medic resumed a neutral posture, or began a second reach. The reach termination is the location within the ambulance that the medic was reaching for. The total number of reaches is the observed event count for each unique *reach*.

From examining reach envelopes, the only reaches within reach envelopes are from the side-facing jump seat to the electrical panel (Reach index 10), side-facing jump seat to the adjacent rear middle storage (4), rear-facing seat to the electrical panel (8), rear-facing seat to blanket and linen storage (12), and the rear-facing seat to the pass-through window.

Table 27. Unique Reaches and Descriptive Characteristics

Medic Reach Index	Avg. Reach Duration (s)	Reach Termination	Reach Origin	Number of Reaches Total
1	8.32	Rear Top Side Storage	Bench Seat	4
2	6.12	Rear Middle Side Storage	Rear Facing Seat	2
3	7.46	Rear Middle Side Storage	Floor near Door	1
4	15.71	Rear Middle Side Storage	Side Jump Seat	4
5	12.12	Rear Middle Side Storage	Bench Seat	20
6	10.96	Rear Bottom Side Storage	Floor near Door	1
7	34.42	Front Side Storage	Rear Facing Seat	1
8	10.30	Electrical Panel	Rear Facing Seat	3
9	11.39	Electrical Panel	Floor near Door	5
10	6.87	Electrical Panel	Side Jump Seat	2
11	12.93	Electrical Panel	Bench Seat	25
12	3.78	Blanket Storage	Rear Facing Seat	1
13	5.07	Blanket Storage	Floor near Door	2
14	7.64	Blanket Storage	Side Jump Seat	2
15	10.49	Blanket Storage	Bench Seat	10
16	6.03	Monitor on Bench	Rear Facing Seat	3
17	7.13	Monitor on Bench	Side Jump Seat	7
18	4.94	O2 Equip on Stretcher	Bench Seat	4
19	6.45	Pass-thru window	Rear Facing Seat	3
20	18.67	Pass-thru window	Bench Seat	11

Hypothesis 5.2 – REBA Reach Analysis

Reach data was analyzed for 79 observed medic trips, resulting in the identification of 111 reaches (20 unique reaches). Each reach was characterized the medic's position at the initiation of the reach and the termination point of the reach describing what the medic was reaching for. Each individual reach was analyzed using Rapid Entire Body Assessment (REBA) analysis to assess ergonomic risk during the various reaches. These REBA scores are presented, along with the scoring metrics generally used to analyze REBA analyses. REBA analysis was conducted at the midway point of each trip, which consistently was the point of the most severe posture between two neutral postures. For example, Figure 17 shows an EMS worker reaching from a seated position on the bench seat (figure right side) to the electrical panel (figure left). REBA analysis was conducted at the reach termination, as shown below.

Figure 17. Reach from Bench Seat to Electrical Panel

Images were not collected from the video recorded during actual EMS patient care transports. This was due to two reasons: 1) IRB restricted the length of time video images were allowed to be kept to one month, and 2) the patient confidentiality masks restricted a full view of the EMS workers' body positions and postures. Video was taken at focus groups of the medics performing various procedures, and REBA analysis was conducted on screenshots of the appropriate reaches. Any reaches which were not able to be collected from those mockup videos were recreated by the researcher, and the visual material was used for REBA analysis.

The scoring metrics for REBA analysis revolve around the amount of risk due to the body positioning. Scores should be interpreted as shown in below in Table 28 [44].

Table 28. REBA Scoring Risk Level Interpretation

REBA Score	**Risk Level**	**Action (including further assessment)**
1	Negligible	None necessary
2-3	Low	May be necessary
4-7	Medium	Necessary
8-10	High	Necessary soon
11-15	Very High	Necessary NOW

The list of reaches and REBA scores is shown below in

Table 29, the REBA sheets used to conduct analysis are provided in Appendix I.

Table 29. REBA Scores for Observed Medic Reaches

Medic Reach Index	**REBA Score**	**Risk Level**	**Number of Times Each Reach was Observed**
1	10	High	4
2	10	High	2
3	10	High	1
4	2	Low	4
5	9	High	20
6	11	Very High	1
7	6	Medium	1
8	1	Negligible	3
9	10	High	5
10	7	Medium	2
11	10	High	25
12	4	Medium	1
13	3	Low	2
14	10	High	2
15	9	High	10
16	10	High	3
17	9	High	7
18	10	High	4
19	3	Low	3
20	9	High	11

CHAPTER 5

DISCUSSION AND CONCLUSIONS

Objective 1.1 – Whole-Body-Vibration Peak Acceleration

Maximum forces experienced by the medics during the data collection period were as high as 11.3 m/s^2 in the vertical direction (z-axis), 9.1 m/s^2 in the direction of forward travel (x-axis), and 6.5 m/s^2 laterally (y-axis). Of the three axes, the most severe was generally the vertical axis. The average peak forces that were observed in this study ($x=4.6\ m/s^2$; $y=3.2\ m/s^2$; $z=5.6\ m/s^2$) are comparable to the peak acceleration values reported for vehicles of similar size in past literature.

Severe deceleration for EMS workers in the type III ambulance studied in this paper is currently mitigated by a vertical "net" of nylon webbing designed to stabilize the medic during extreme force events, and to act as a catcher to prevent impact with the forward wall and storage unit in the event the medic is not restrained. Mitigation for lateral forces involves a lap belt restraint and a pad designed to protect the medic's head from impact with the passenger side rear cabin wall.

While environmental g-force levels do not have standard values known to impact efficacy of care, it is reasonable to assert that forces of this magnitude could substantially affect motor activities if they were being conducted during periods of extreme lateral, forward, or vertical accelerations. These forces affect the efficacy of a seated medic, and would have more severe effect on an EMS worker standing in an awkward posture

reaching for supplies. A medic unprepared for a severe lateral event may find himself losing balance in the rear patient compartment. In this case, the medic could become a projectile in the rear cabin, and potentially inadvertently injure his patient, or himself.

While a driver may be able to notify the attending EMS care provider about upcoming steering or braking events, it is important to note that the communication between the driver and the attending EMS care provider is highly dependent on the style of ambulance they are working in, as well as ambient noise conditions. Some ambulances (such as the one in this study) have a small pass-through window that can used for verbal communication between the rear medic and the driver, but the medics noted in focus groups that it can be difficult to get the attending EMS worker's attention if they are highly involved in their tasks, or if the sirens in the ambulance are activated. In this case, it may be beneficial to have some sort of communication or notification system between the driver and the attending EMS worker that is either audible or visible in the rear patient compartment while they are providing care. This may be in the form of radio communication, or even an advance warning light advising the attending EMS worker of upcoming severe g-forces due to high-speed turns or obstacles in the road, so the EMS worker can temporarily cease activities which could be impacted by severe driving events (IV sticks, intubation).

Objective 1.2 – Whole-Body-Vibration Crest Factors

The crest factors calculated from vibration data indicate that shock events are present during the data collection period. The most severe axis for the vibration was the

vertical axis, which was expected. Severe vertical shocks are unlikely to unbalance the medic, however they could negatively impact delicate patient care activities (IV stick, intubation) if they are unexpected.

The average crest factor in that severe axis was 7.9 (no units), which is below the ISO standard threshold (the standard threshold crest factor is 9.0) which states that there is sufficient vibration exposure greater than the RMS acceleration value to require a different evaluation technique which places more emphasis on shock events. Of the 102 trips, 19 had sufficient shock events to result in a crest factor greater than nine in the vertical axis.

The crest factors reported were similar to the low-end crest factors found in past literature associated with heavy and light trucks, and higher than crest factors found in an automobile traveling on a city road, and trucks traveling on a rough road. Examining reported crest factor values for different vehicles, it appears that the magnitude for crest factors is not consistent based solely on vehicle size. Crest factors reported for a van on good roads in one study (CF = 15.6) [31] are higher than reported values for a van on a country road in a different study (CF = 5.7) [51]. The inconsistency in crest factor values in similar sized vehicles in past publications makes it difficult to define ambulances as similar to some other type of vehicle in this regard. When trying to make comparisons across publications for crest factors, the CF values observed in this study (x=5.7; y=4.6; z=7.9) are lower than those calculated for vehicles of similar size in past literature. It is worth noting that crest factor is a ratio value; lower crest factors do not necessarily

indicate low presence of shock, this may possibly indicate also that the peak acceleration was high relative to a high R.M.S. acceleration value.

The most severe crest factor values were observed in the vertical axis, which may be indicative of poor road condition. The types of road travelled by the ambulance in this coverage area can range from good roads (interstate) to rural roads in extremely poor condition. Due to video data collection restrictions, environmental video data was not able to be collected so it is unknown what types of roads were travelled for the trips with high crest factor values. Another potential factor for the severity of the vertical shocks is the vehicle condition; the ambulance that was equipped with data collection equipment was nearly ten years old at the time of this study and so the vehicle suspension may contribute to these shock events. It should be noted that vehicle condition and age will affect all vibration characteristics, not just crest factor.

Objective 1.3 – Whole-Body-Vibration Health

The whole body vibration exposure was not significant enough to flag potential harm to EMS workers through exposure in the rear patient compartment. However, it is important to note that WBV is believed to exacerbate existing back and neck injuries—both of which are common to people working in the EMS profession. Literature has been cited on the musculoskeletal impacts of awkward lifts, which are present mainly outside of the ambulance as lifting patients onto stretchers, and lifting stretchers into the ambulance. While the ambient vibration exposure during transport does not appear to indicate immediate threat to the EMS worker's health, the effects of WBV have not been

substantially studied for populations already at higher risk of back pain due to injuries from non-WBV related tasks in their work.

Objective 1.4 – Whole-Body-Vibration Comfort

The finding that EMS workers vibration exposure represents a "fairly uncomfortable" level impacts physical administration of care as well as the EMS worker's mental assessment of the patient. Physically, the vibration can impact the medic's ability to perform delicate tasks (IV sticks, intubation). Cognitively, the EMS worker is responsible for determining the care procedures to apply by assessing the patient condition, or in filling out paperwork. This may not be a significant issue relative to the physical impact of vibration discomfort. However, the distraction created by vibration may add to the cognitive load already present in the medic's work environment during patient care.

Objective 1.5 – Whole-Body-Vibration Perception

As expected, the vibration experienced in the rear patient compartment is perceptible.

Objective 2.1 –Patient Injury in Emergency Mode

The identification of patient illnesses that contribute toward the likelihood of emergency mode is helpful in that it provides a list of critical illnesses to groups who may not realize the severity of a patient's condition. This information is largely already known or suspected by the EMS community, but this data analysis objectively

substantiates that knowledge. While approximately five percent of all responded calls required emergency transportation mode, several illnesses had disproportionately higher percentages of emergency mode: heart and cardiac injuries (21.1% emergency mode), inhalation (20.0), stroke/CVA (9.4%), and calls where the patient's condition is unknown (9.1%).

This list of illnesses associated with emergency mode transportation could be of use to dispatch personnel, who may be able to identify a particular patient condition during the initial call for assistance. The entire basis for the encouragement of emergency transportation mode revolves around a study which focused on cardiac arrest patients, and their outcomes as a result of transportation time. This list of patient illnesses contains more than cardiac arrest and related symptoms. An interesting future study would be to expand this data to describe significant illnesses associated with emergency response mode in a larger population. The resulting list of patient illnesses could then be examined along with EMS response times and patient outcomes to identify if any difference in patient survivability exists in these illnesses.

Objective 2.2 –Medical Response Activity in Emergency Mode

Medical response activity is not independent of patient illness, that is, we expect specific procedures to be repeated when they treat a certain patient illness. With this in mind, the medical response activities identified in the logistic regression model are supportive of the patient injuries identified in Hypothesis 2.1. One exception found to be significant toward traveling in non-emergency mode is the activity of drawing blood.

One procedure which was conducted only once and that time was conducted in emergency mode, was a Cricothyrotomy, although having occurred only once means it is difficult to make inference about its association with emergency mode

One application of this knowledge is that the equipment could be placed in a location nearer to the medic's primary working position. Emergency transportation mode trips may cause additional stress to the EMS worker(s) providing care in the rear, and it could help ease this stress or physical strain from awkward reaches or equipment retrievals to have necessary equipment close at hand for the necessary patient care procedures.

Objective 2: Additional Exploratory Data Analysis

The classification tree for categorical data that was developed in R using *transportation mode* as a response variable, with *patient illness* and *medical response action* as predictor variables shows that high probabilities of emergency mode are associated with interactions between the presence of BVM-Assisted Ventilation *response* and Poison/OD *illness*, as well as with the presence of Cardiac Arrest *illness* when BVM-Assisted Ventilation *response* is absent. These interactions could be useful to 911 operators in determining the appropriate EMS transportation mode to send toward a scene. A patient requiring breathing assistance due to a poison or overdose condition could be given alternate instructions for medical response modes.

A more realistic application of the findings from this type of decision tree would be for researchers to compare the interactions of the EMS agency studied here with EMS

groups in different population and geographical areas. The data used in this analysis required very little effort to collect for analysis, as it is already collected and kept in electronic formats for billing and legal purposes by EMS agencies, nationally. Detailed and specific analyses of the common patient illnesses and responsive actions could show the effects of patient groups with similar characteristics.

Focus groups with the EMS workers from this agency indicated that the ultimate decision to activate emergency mode lies with the attending EMS worker in the rear patient compartment. In addition, the EMS workers indicated that there are other factors that can influence whether or not emergency mode is initiated. Traffic conditions can affect emergency mode; in poor traffic conditions the EMS workers reported that they would sometimes turn on their lights and sirens to bypass traffic, sometimes only for a brief time. Another affecting condition is the weather. Poor weather conditions in Montana can result in icy, snowy, and slick roads. The focus group participants indicated that they will frequently avoid emergency mode in these conditions, as other drivers sometimes maneuver poorly to avoid the ambulance, which can potentially result in crashes on poor roads. However, the attitude regarding when it is safe to use lights and sirens within the focus group of EMS workers may not be referential to the attitudes of more urban EMS groups, or groups in geographically different areas.

Objective 3: Restraint Use Behaviors

With such a low rate of observed restraint usage in the rear patient compartment, it is difficult to definitively comment on reasons the EMS workers actively used

restraints. One implication is that since two of the three observed trips were from the same individual, the tendency toward actively using restraints is associated with individual beliefs about safety in the workplace. Casual conversation during the data collection period with the restrained EMS worker revealed that the medic had suffered two concussive head injuries on the job; the focus group participants who rarely used seatbelts conveyed that they had sustained no injuries while in the rear patient compartment. While this discussion point cannot be proven here with any statistical certainty, another study may wish to look into the correlation between observed restraint use patterns (not self reported restraint use) and the number and severity of any injuries sustained in the rear patient compartment.

During focus group discussion, EMS workers were asked "How many separate times would you need to stand and then become reseated before you would stop using your restraint device?" The answer generally agreed upon in that focus group was "once." The argument for remaining unrestrained being that the inconvenience of being belted far outweighs the benefits associated with re-belting between reaches or periods of standing to provide care.

One EMS worker's reason for remaining unbelted was that he felt that the risk associated with crashing while belted was greater than a crash while unrestrained. This logic revolves around the inherent danger in crashes, and the medic's belief that if there is going to be a high-speed crash with potential for fatality, he will probably be killed if he is not belted, but may become paralyzed if he is restrained. It is an unfortunate commentary on the level of acceptable risk to the people working in the EMS field who

feel they are choosing between paralysis and death when deciding whether or not to engage restraints. While this is a personal choice for the specific medic in question, it highlights the importance of realistic education for the types of ambulance crashes prevalent in different geographical areas.

Another reason for low restraint compliance provided during the focus groups was that it was difficult to provide care, especially in critical emergency situations. With severe patients, there are often multiple care providers in the rear patient compartment. Emergency mode transports are a much rarer occurrence than urgent or scheduled transports (at this agency, 5% of transports were emergency). Keeping in mind the rarity of emergency mode transportations, a comprehensive study of FARS data from 1988 until 1997 found that 72.9% of incapacitating injuries to occupants in the rear of an ambulance occurred during emergency runs [14]. Becker et al.'s study additionally found that 82% of people injured (non-fatally) in the rear patient compartment were not restrained. This indicates that medics are routinely avoiding restraint devices when they are most needed.

The medics tend to sacrifice their own personal level of safety at the expense of rapidly transporting their patients to the hospital. This may be a difficult mindset to overcome, but one point that may influence EMS workers to encourage restraint use is that an unrestrained medic can cause harm to his patient, in the same way unsecured equipment becomes a projectile.

The restraint patterns self-reported in the front of the ambulance, as a passenger or a driver, were almost uniformly described as "100 percent." Among the survey

participants, matched answers describing each participant's restraint behavior in the front and the rear of the ambulance were analyzed, yielding very different answers. While the median front restraint rate was 100 percent, the median rear restraint rate was 10%. This suggests that the EMS workers are separating the safety benefits of wearing their seatbelts in the front compartment with those of wearing it in the rear patient compartment.

Another point to raise here is that it is the policy of this specific EMS group to remain belted anytime possible while providing patient care; this policy is clearly not enforced. Policy enforcement will be necessary to adjust any culture of safety at an institution, and would be an excellent first step toward increasing safety within an ambulance group.

Objective 3: Comparing Self-Reported and Observed Restraint Rates

Self-reported restraint usage rates in the ambulances (21% restrained) are much higher than those actually observed (2.6% restrained). The populations being compared are not identical (observed rates coming from one smaller group of ten medics, with self-reported rates coming from 201 medics across Montana). This discrepancy in usage rates (self-reported versus actual) could be due to an association between workplace safety culture and restraint use patterns. If this is true, it may indicate that although the observed EMS population has a low restraint use pattern, this is not indicative of the restraint use behavior of EMS as a whole.

The more likely scenario is that the self-reported restraint usage rates are simply higher than observed rates for EMS workers. This may be due to the EMS workers' belief that their survey answers would be reported to their management. Although the surveys were conducted with individual anonymity, the EMS workers were asked to provide the location where they worked. This was in an effort to perform analysis examining comparisons between EMS groups; however, there were no EMS groups with high enough response rates to perform this analysis. The observed EMS group has a policy regarding restraint rates, stating that seatbelts should be engaged whenever possible while providing patient care. Observation shows this policy to be largely ignored, even on many of the longer transports where the medics are not required to be out of their seats for any substantial portion of the trip. The higher self-reported seatbelt usage rates could be due to the medics knowledge of the association between their answers and the EMS agency they work for in an effort to avoid discipline for a behavior largely accepted by the EMS community in practice, if not in policy.

The higher self-reported rates of seatbelt compliance could be due to the "social desirability" of reporting a higher restraint usage pattern. This supports findings from Nelson [53], who found self-reported rates to be higher than observed seatbelt usage percentages in passenger cars. Nelson goes on to suggest that only individuals who answer "always" on a Likert scale should be considered to exhibit the self-reported pattern on a habitual basis. This pattern has been found in studies of self-reporting behaviors which are not socially desirable – smoking [54] and drunken driving [55] for example. If this is true, then it suggests that the EMS workers are aware that it is more

socially accepted to engage in restraints, but still do not use restraints while providing patient care.

Another possible contributor to the difference in self-reported and observed restraint rates could involve a different perceived time frame for the question being asked. While the observed restraint rates involved a smaller number of more immediate trips, the medics may be referring to an entire career of EMS transports in their self-reported data.

Objective 4: Safety Culture

While the EMS-SAQ is a test designed to address safety culture within an organization, a wider application of this test, such as is performed in this paper, can be considered a viable indicator of "perception" of safety culture. By associating an individual's ideas about safety culture to their self-reported restraint usage patterns, an association within the EMS-SAQ can be established between self-reported seatbelt use in the rear of the ambulance and EMS-SAQ Safety Climate scores. As the participants' EMS-SAQ score rises, so does their self-reported restraint use rates. While the EMS-SAQ is already a validated testing protocol, this finding adds weight to the Safety Climate category shown to have association with applied safety habits in the rear of the ambulance. Agency managers concerned about their crew's safety habits may find it interesting to observe EMS-SAQ scores to identify crew members who may be of assistance in persuading their peers to adopt a more adhered-to policy for seatbelt use.

Focus groups identified several contributors toward their decision to engage seatbelts in the rear of the ambulance: 1) equipment locations for particular procedures requiring movement from a seated position, 2) patient severity demanding extra care or attention, and 3) belief that being restrained during a crash will inflict injury.

Equipment location in its current state inhibits patient care from a belted, seated position. While this requires EMS workers to periodically gather equipment and perform procedures, it is generally punctuated by longer periods of the medics being idle, or performing tasks while seated (paperwork, phone communication, and verbal interaction with patient). The reason for the medics' decision to not engage seatbelts during these seated periods has not been entirely discerned, although it appears to be largely inconvenience. When the medics were asked how many times they would be willing to disengage and then reengage their seatbelts (to reach for equipment, or provide patient care) before they would simply leave them disengaged, the response was "probably once." This attitude demonstrates a prioritization of convenience over safety in regards to performing job-related duties.

In calls involving highly critical patients, multiple EMS workers are present in the rear patient compartment to provide care. Critical patients require additional assistance and additional care, and these requirements will affect the possibility of restraint during the patient transport. While this may be unavoidable in its present state, it is worth mentioning that the majority of patient transports are not critical—only five percent of patient transports from the studied EMS group were critical enough to require lights and sirens. The goal of a program designed to heighten safety within this working

environment should consider that EMS workers caring for highly critical patients may lie outside the scope of a policy designed to increase practiced restraint rates. At the same time, the conditions associated with these critical patients may contribute towards an effort on the part of the driver to arrive at the terminal destination more quickly. Driver habits while transporting critical patients should be examined to determine if there is increased likelihood of crash, along with the type of crash (side, front, rear, or angular impact), to understand any interventions that could be examined for these scenarios.

A belief held by multiple EMS workers present during focus groups was that restraint devices would inflict injury. None of the workers had direct experience with anyone whom this had happened to, but it was still a topic of discussion. There is little existing research on any type of injury that could be sustained while wearing a lap belt and seated in a direction parallel with motion. Much research promoting seatbelt use cites studies involving front-seat car passengers, but the primary location for the EMS workers in this study is on the bench seat alongside the passenger, facing a direction orthogonal to motion. A study showing crash injury outcomes for individuals using lap belts and seated in a similar manner could clear misconceptions about potential injury. Another approach could be to relay to the EMS workers the scope of injury that could be sustained by the patient due to an unrestrained EMS worker impacting that patient. EMS care providers seem to accept a high level of personal risk to personal safety in order to help a patient, and may not have considered that by being unbelted they have become a potential projectile in the rear patient compartment in the event of a crash.

Objective 5: Reach Analysis

The working area inside the rear patient compartment in the ambulance studied for this paper indicates that very little consideration was given to reach feasibility while planning equipment and storage location. The advantages of naturalistic data collection in this case is clear—the researchers were able to collect an accurate and objective picture of EMS worker behavior and patterns in the rear patient compartment. In the case of reaches, the research team was able to positively identify and classify different EMS activities, observing each movement multiple times to collect more data than could be obtained from direct observations.

The range of REBA scores for the observed reaches is large, from between 1 (low risk) to 11 (very high risk level). The lowest risk reaches involved reaching to access materials that were adjacent to the medic's origin position. For example, a reach from the rear-facing seat towards the electrical panel resulted in a REBA score of 1. Figure 18 shows the frequency of the reach risk levels, using the total observed number of reaches.

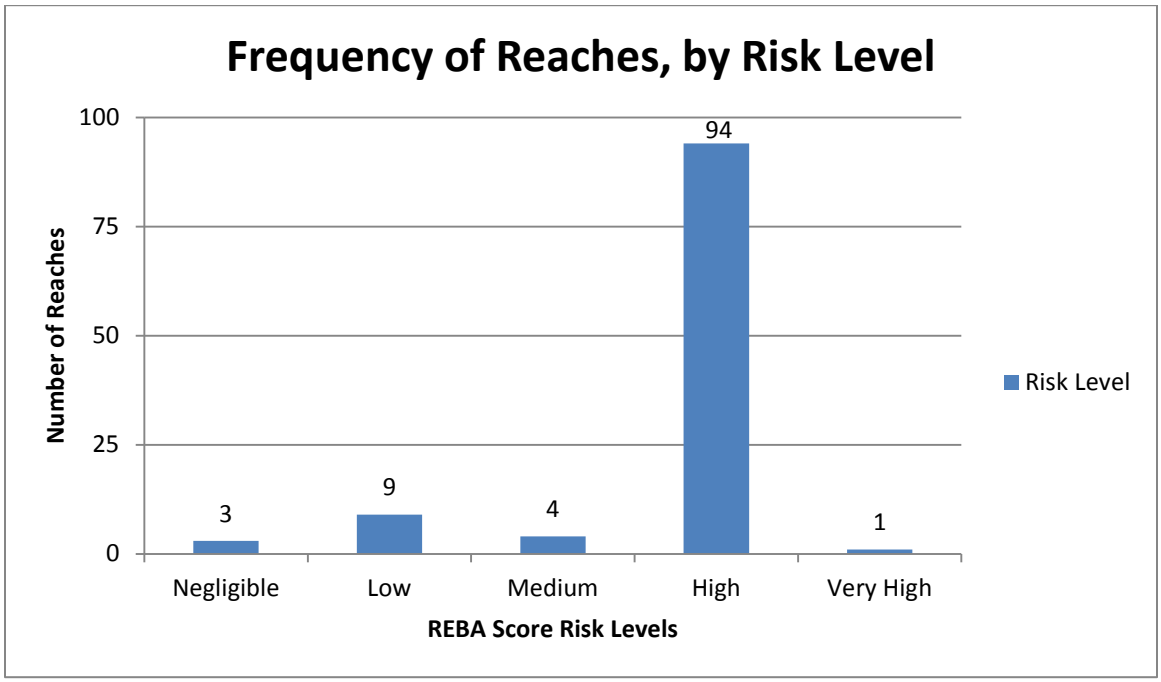


Figure 18. Distribution of Reaches, by Risk Level

This figure shows that the risk category of high-risk reaches is over-represented. This is due in part to the poor interior design layout of this ambulance, which is fairly common across Type III ambulances. One potential reason for these high-risk reaches can be attributed to how ambulances are designed as related to layout standards. AMD standard KKK-1822-E requires that many of the frequently accessed equipment be readily available to the medic seated in the "action area," which is the terminology in federal standards used to designate the seat of primary patient caregiving as the rear-facing seat near the patient's head. It is unclear why this area was designated the action area, as the medics in this study had an overwhelming preference to sit alongside the patient in the bench seat. During focus groups, EMS workers stated that they preferred

this position generally because it places the medic in a good position to place IV lines, perform activities, and maintain conversation and/or eye contact with the patient. EMS preference to sit alongside the patient has been found in multiple studies (Ferreira & Hignett, 2005; Gilad & Byran, 2007). It is reasonable to suggest that standards which dictate the interior organization of ambulances should be revisited to account for where the EMS workers are actually sitting in an ambulance.

While identifying alternative rear ambulance layouts, the main issues include 1) allowing the EMS worker patient access while comfortably seated; 2) locating equipment and patient care items nearer the actual primary EMS worker; and 3) being cognizant of the paths of cables and cords while that equipment is being relocated. The ultimate goal in this situation should be to increase the time the EMS worker is willing to remain in a seated, belted position—this can be accomplished by revisiting the equipment storage locations. Just as EMS workers evaluate patients to determine the level of importance, EMS equipment should be evaluated to place the most frequently used items closer-at-hand to encourage a safer working environment.

Future Research Opportunities

Future studies may be valuable in looking into the correlation between observed restraint use patterns (not self reported restraint use) and the number and severity of any injuries sustained in the rear patient compartment. The relationship mentioned in this study was not able to be statistically validated, as it was only noted through conversation with a single participant. If this relationship is real, it is possible that this may provide an

avenue for safety training groups to promote safer behaviors through influence from EMS peers.

While the vibration exposure found in this study indicated no overall health risk, it is still largely unknown the level of vibration that will impact the degree of patient care that can be provided. Theoretically, there is some level of ambient vibration at which EMS care providers are not able to perform certain duties, such as establishing successful IV lines while in transport, or completing a patient intubation. This level of vibration would be a valuable tool in determining if any vibration-dampening interventions are needed in EMS.

An additional opportunity involves patient care records. This data is maintained by all EMS groups, since it is used to process billing information. An interesting future study would be to perform survivability testing on the significant illnesses found here to be associated with emergency response mode in a larger population, similar to the tests which have already been conducted on cardiac arrest patients. The resulting list of patient illnesses could then be examined along with EMS response times and patient outcomes to identify if any difference in patient survivability exists in these illnesses

Conclusion

A safer work environment for EMS professionals is approachable through evaluation of current medic practices and behaviors in the rear patient compartment. A potential source of injury to EMS workers lies in the current safety culture and ideology surrounding safety practices in the rear patient compartment. Although standards are in

place that mandate restraint compliance, these regulations are seldom enforced. In order to adjust human behavior in dealing with restraint systems, buy-in to the concept of an increased culture of safety has to occur at all levels of the organization. Managers, staff, peers all need to understand the risks associated with failure to restrain in the rear, as well as promote safer behavior. A regulation designed to increase safety is of no value if it is not followed, or enforced.

While the culture of safety within rural EMS groups should be evaluated, the physical working environment is also found to be very lacking in basic ergonomic function. Very little equipment is accessible from the primary care provider position, and the patient compartment is arranged in a way that inhibits patient care from a restrained and safe position. There is enormous potential to increase safety through layout redesign or equipment reorganization in ambulances. By analyzing the physical EMS workspace as well as the safety culture inherent in EMS work, this study hopes to highlight areas available to increase the overall safety level for the EMS community, as well as the general public they serve.

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APPENDICES

APPENDIX A

HUMAN SUBJECTS COMMITTEE APPLICATION AND CONSENT FORM

MONTANA STATE UNIVERSITY
Institutional Review Board Application for Review
(revised 07/01/2009)

[Include copies of PI's and Co-PI's "Completion Certificate(s)" as proof that all have received the education and instructions for researchers using human subjects. The preferred instruction and education is that from the National Cancer Institute: http:/Cancer.gov - Human Participant Protections Education for Research Teams/cme.cancer.gov/clinicaltrials/learning/humanparticipant-protections.asp

Beginning January 1, 2006, University policy requires that all protocols submitted from individuals NOT employeed by Montana State University be charged a $500 review fee per application. Renewals for those proposals will be at no charge.

THIS AREA IS FOR INSTITUTIONAL REVIEW BOARD USE ONLY. DO NOT WRITE IN THIS AREA.

Application Number: Approval Date:
Disapproved: IRB Chair's Signature:

Submit 14 copies of this application (including the signature copy), along with 14 copies of the subject consent form and 14 copies of all other relevant Materials, to Institutional Review Board, 960 Technology Blvd., Room 127, Montana State University, Bozeman, MT 59717-3610. (Please staple, bind or clip together the application form, surveys, etc. as 14 individual packets; one complete packet for each board member.) Submit one copy of grant contract proposal for the office file. For information and assistance, call 994-6783 or contact the Institutional Review Board Chair, Mark Quinn at 994-5721.

PLEASE TYPE YOUR RESPONSES IN BOLD

Date: February 24, 2010

I. Investigators and Associates (list all investigators involved; application will be filed under name of first
person listed)

NAME: **Laura Stanley** TITLE: **Assistant Professor**
DEPT: **MIE** PHONE #: **1399**
ADDRESS: **302 Roberts Hall**
E-MAIL ADDRESS: **laura.stanley@ie.montana.edu**
DATE TRAINING COMPLETED: **on file**

NAME: **Jessica Mueller** TITLE: **Graduate Researcher**

DEPT: **MIE** PHONE #: **(865) 660-6521**
ADDRESS: **206 Nelson Story Tower Bozeman, MT 59715**
E-MAIL ADDRESS: **Jessica.mueller@coe.montana.edu**
DATE TRAINING COMPLETED: **on file**

(repeat if needed)

Do you as PI, any family member or any of the involved researchers or their family members have consulting agreements, management responsibilities or substantial equity (greater than $10,000 in value or greater than 5% total equity) in the sponsor, subcontractor or in the technology, or serve on the Board of the Sponsor? _____ YES ___**X**__ NO

If you answered Yes, you will need to contact the Director of the Technology Transfer Office, Dr. Rebecca Mahurin at 406-994-7868.

II. Title of Proposal:
SAFETY EVALUATION OF EMERGENCY MEDICAL SERVICE PERSONNEL DURING TRANSPORT

III. Beginning Date for Use of Human Subjects:
March 3, 2010

IV. Type of Grant and/or Project (if applicable)
Research Grant: X
Contract:
Training Grant:
Classroom Experiments/Projects:
Thesis Project:
Other (Specify):

V. Name of Funding Agency to which Proposal is Being Submitted (if applicable):

VI. Signatures

Submitted by Investigator
Typed Name: **Laura Stanley**
Signature:
Date:**2/24/10**

Faculty sponsor (for student)
Typed Name: **Jessica Mueller**
Signature:
Date: **2/24/10**

VII. Summary of Activity. Provide answers to each section and add space as needed. Do not refer to an accompanying grant or contract proposal.

A. RATIONALE AND PURPOSE OF RESEARCH (What question is being asked?)

The goal of this project is to design and evaluate the biomechanical, ergonomic, and safety needs of Emergency Medical Service (EMS) personnel, specifically the medic's work environment while in transport to and from the hospital. The specific objectives include: 1) identifying and quantifying the biomechanical forces experienced by the medics in their day to day operations, 2) identifying contributing factors to unusual driving events, and 3) identifying the needs of the drivers, medics, and patients so that changes can be recommended to increase safety for all personnel in transport.

B. RESEARCH PROCEDURES INVOLVED. Provide a short description of sequence and methods of procedures that will be performed with human subjects. Include details of painful or uncomfortable procedures, frequency of procedures, time involved, names of psychological tests, questionnaires, restrictions on usual life patterns, and follow up procedures.

This research project includes the study and evaluation of medic behavior involved in day-to-day activities associated with emergency medical service transport of patients to and from the hospital. One ambulance from the Bozeman EMS ambulance group will be outfitted with data collection hardware. The data to be collected in this study include visual and vehicle data. Visual information will be recorded by cameras that collect two views;, which represent two different angles of the rear of the ambulance. Vehicle data parameters that will be recorded include speed, acceleration, luminance, GPS location, heading, gear position, and forward radar information. Data will be collected over a 3 month time period (March – May 2010). Data collection hardware will not interfere with operating procedures within the ambulance.

This ambulance will be designated by ambulance staff as a "research vehicle." Data will only be collected when two conditions are both met: **Condition 1**) when the ambulance ignition is in the "on" position, and **Condition 2**) the data collection hardware power switch is in the "on" position. Crews who consent to participate in this project will be instructed on how to turn the power switch "on"

at the beginning of a shift and back to “off” at the end of the shift. Using this method, data can only be generated and collected when it involves consenting medics. The driver and medic personnel of the ambulance will provide consent. As it is being collected, video data will be covered by a static mask over the patient and entry/exit doors to protect patients from being videotaped.

Once data has been collected, it will be transferred to a secure computer in a locked room, with no internet connection. The PI, Laura Stanley, will preview all video before it can be analyzed. Any video that includes photographs of anyone who has not given written consent to being videotaped, e.g., 1) patient companions, 2) any person that is not a consenting medic, or 3) a patient outside of the masked zone will be deleted immediately. Nevertheless, we request that the IRB waive the need for informed consent from anyone who is inadvertently captured in the videotape in accordance with 45 CFR §46.116 (d). The research involves no more than minimal risk to such persons. Because the images of such persons will be immediately and permanently discarded, the waiver will not adversely affect the rights and welfare of such persons. Because it is totally impracticable in emergency situations to get consent, the research could not be conducted without waiving the consent for these persons, and if asked, these persons will be informed about the research.

All EMS personnel inside the ambulance will provide consent to collect video data of the interior of the back of the vehicle. The crews will also be instructed that they can turn off the data collection system at any time if they choose to end participation for any reason.

No data regarding the patient’s identity or condition will be collected.

C. DECEPTION - If any deception (withholding of complete information) is required for the validity of this activity, explain why this is necessary and attach debriefing statement.

No deception will be employed.

D. SUBJECTS

1. Approximate number and ages
   How Many Subjects: **8-10**
   Age Range of Subjects: **18 to 65 years**
   How Many Normal/Control: **Included**
   Age Range of Normal/Control: **Included**

2. Criteria for selection:

Must be employed by the local ambulance group.

3. Criteria for exclusion:

Drivers not employed by the local ambulance group or drivers not providing consent.

4. Source of Subjects (including patients):

Subjects will be recruited with the assistance of the Critical Illness and Trauma Foundation (CITF) that represents ambulance fleets, paramedics, and related stakeholders in the Bozeman area.

5. Who will approach subjects and how? Explain steps taken to avoid coercion.

CITF personnel will provide study information to an interested medic work group.

6. Will subjects receive payments, service without charge, or extra course credit?
Yes or No
(If yes, what amount and how? Are there other ways to receive similar benefits?)
Subjects will be offered compensation of $50. To be eligible for the $50 compensation, the subjects must participate over the entire three-month time period. Participants will be paid in the form of cash.

7. Location(s) where procedures will be carried out.

Recruitment will be conducted within 50 miles of Bozeman, MT; data collection will occur inside the ambulance.

E. RISKS AND BENEFITS (ADVERSE EFFECTS)

1. Describe nature and amount of risk and/or adverse effects (including side effects), substantial stress, discomfort, or invasion of privacy involved.

There is no substantive or increased risk from this study given that subjects will be observed doing their normal job as ambulance drivers and medics. All data collection equipment is mounted such that, to the greatest extent possible, it does not pose a hazard in any foreseeable way. None of the data collection equipment will interfere with any part of the participant's normal field of view or will impair their ability to perform their duties. The addition of the data collection systems to the vehicle will in no way affect the operating or handling characteristics of the vehicles. All data recorded by the devices will remain

confidential and will be protected on secure computers with limited access and secure passwords.

2. Will this study preclude standard procedures (e.g., medical or psychological care, school attendance, etc.)? If yes, explain.

   No.

3. Describe the expected benefits for individual subjects and/or society.

   Examination of contributing factors to rural ambulance collisions and increasing awareness of these factors may improve the future safety of ambulance drivers, medics, and patients.

F. ADVERSE EFFECTS

1. How will possible adverse effects be handled?

   By investigator(s):
   Referred by investigator(s) to appropriate care: Subjects will be referred to their local hospital.

   Other (explain): Note that all subjects are also paramedics and will be able to self-administer care.

2. Are facilities/equipment adequate to handle possible adverse effects? **Yes** or No (If no, explain.)

3. Describe arrangements for financial responsibility for any possible adverse effects.

   MSU compensation (explain): **None**
   Sponsoring agency insurance:
   Subject is responsible: **Yes**
   Other (explain):

G. CONFIDENTIALITY OF RESEARCH DATA

1. Will data be coded? **Yes** or No

2. Will master code be kept separate from data? **Yes** or No

3. Will any other agency have access to identifiable data? Yes or **No**
   (If yes, explain.)

Data access is protected under MSU standard terms and conditions.

4. How will documents, data be stored and protected?

Locked file: The subject identity record, which contains subject name, address, email, and social security number (required for payments) as well as the assigned identity code will be stored in locked file. The identity code will be removed from the subject identity record and the record will be destroyed at the completion of participation. All video data will be deleted permanently immediately following data analysis, or a 30 day window from the point of data collection, whichever comes first. Because of the small amount of data that will be collected as a result of the stated protocol, the 30 day window will provide ample time for data reduction.

Computer with restricted password: Data will be stored on a password protected computer under identity codes.

VIII. Checklist to be completed by Investigator(s)

A. Will any group, agency, or organization be involved? **Yes** or No
(If yes, please confirm that appropriate permissions have been obtained.)

The *Critical Illness and Trauma Foundation* has agreed to participate in this study.

B. Will materials with potential radiation risk be used (e.g. x-rays, radioisotopes)? Yes or **No**

1. Status of annual review by MSU Radiation Sources Committee (RSC). Pending or Approved
(If approved, attach one copy of approval notice.)

2. Title of application submitted to MSU RSC (if different).

C. Will human blood be utilized in your proposal? Yes or **No**
(If yes, please answer the following)

1. Will blood be drawn? Yes or No
(If yes, who will draw the blood and how is the individual qualified to draw blood? What procedure will be utilized?)

2. Will the blood be tested for HIV? Yes or No

3. What disposition will be made of unused blood?

4. Has the MSU Occupational Health Officer been contacted? Yes or No

D. Will non-investigational drugs or other substances be used for purposes of the research? Yes or **No**

E. Will any investigational new drug or other investigational substance be used? Yes or **No**

[*If yes, provide information requested below and one copy of: 1) available toxicity data; 2) reports of animal studies; 3) description of studies done in humans; 4) concise review of the literature prepared by the investigator(s); and 5) the drug protocol.]*

F. Will an investigational device be used? Yes or **No**
(If yes, provide name, source description of purpose, how used, and status with the U.S. Food and Drug Administration FDA). Include a statement as to whether or not device poses a significant risk. Attach any relevant material.)

G. Will academic records be used? Yes or **No**

H. Will this research involve the use of:
Medical, psychiatric and/or psychological records Yes or **No**
Health insurance records Yes or **No**
Any other records containing information regarding personal health and illness Yes or **No**

If you answered "Yes" to any of the items under "H.", you must complete the HIPAA worksheet.

I. Will audio-visual or tape recordings or photographs be made? **Yes** or No

All EMS personnel inside the ambulance will provide consent to collect video data of the interior of the back of the vehicle. Video and vehicle data will only be collected when the medics turn the data collection hardware power switch “on.”

No data regarding the patient’s identity or condition will be collected.

J. Will written consent form(s) be used? **Yes**
(If no, explain.)

EMS personnel on board the ambulance will provide written consent forms, but patients that are captured on video will be unable to provide consent due to the time-critical and physical limitations present in emergency situations. To protect patients, all video is covered with a mask as it is recorded. This mask, which also

covers the entry doors, is a black mask that cannot be removed. Video containing patients and companions that appear outside of the masked region will be deleted upon being previewed by the PI, Laura Stanley. Pictures are attached to show the permanent masking that is employed for this project.

A laminated card (see next page) will be given to medics to provide to patients who express interest or concern about the video data collection.

RESEARCH STUDY - Regarding the Use of In-Cab Cameras

The purpose of this research study entitled, *Safety Evaluation of Emergency Medical Service Personnel During Transport*, is to evaluate the work environment of an ambulance during the transport of patients to and from the hospital. The study is being conducted in collaboration with Montana State University, Critical Illness and Trauma Foundation, and the American Medical Response.

The cameras mounted in the ambulance are collecting images of the Emergency Medical Service personnel ONLY. The method of video ensures that NO images that could identify patients or companions are being used for analysis. And, any images inadvertently collected of patient or companions will be permanently deleted as soon as such inadvertent images are identified.

Questions or complaints about the research should be directed to Dr. Laura Stanley, Western Transportation Institute, Montana State University – Bozeman, MT 59717-4250. Phone: 406-994-1399.

You are welcome to ask any questions about this study and its procedures. Additional questions about human subject research and protection can be answered by the Chairman of the Institutional Review Board, Mark Quinn, at (406) 994-4707.

SUBJECT CONSENT FORM
FOR PARTICIPATION IN HUMAN SUBJECT RESEARCH AT
MONTANA STATE UNIVERSITY

SAFETY EVALUATION OF EMERGENCY MEDICAL SERVICES PERSONNEL DURING TRANSPORT

You are being asked to participate in a research study that will evaluate the work environment of an ambulance during the transport of patients to and from the hospital.

Your participation is completely voluntary. This study may help us to improve your EMS personnel safety.

Procedures: If you agree to participate in this study, you will participate in a program that uses a data collection system that records vehicle behavior and collects videos of medic behavior in the rear patient compartment of the ambulance. The video system will be recording in the rear cabin any time that **both** the power switch on the data collection system is "ON" **and** the ambulance ignition is in the "on" position. When all members of a shift have consented to project participation, you will be asked to turn the data collection system "ON" at the start of your shift and "OFF" again at the end of the shift. No additional work will be required beyond turning the data collection system on and off. The system will then run unobtrusively in the background while you perform your job as normal. Video analysis will look at ergonomic postures, reaches, and body positioning within the ambulance cabin. Vehicle data will be analyzed to examine vibration effects in the ambulance. Patient privacy will be protected by blocking of patient images in all video images; however, a laminated card will also be given to medics to provide to patients or other occupants who express interest or concern about the video data collection. Data collection will occur over a three month time period, from March 3, 2010 to May 31, 2010.

Risks: The risk to you during your day-to-day operations is no more than you would normally experience while driving or working. The data collection equipment is mounted such that it does not pose a hazard in any foreseeable way and will not interfere with any part of your normal field of view or your ability to perform your work duties.

Benefits: There may be no immediate benefits to you. Future benefits of the research may include better design of advanced safety systems in ambulances, hence reducing the number of fatalities and injuries to EMS personnel.

Compensation: For your participation in this project, we are offering compensation of $50. To be eligible for the $50 compensation, you will need to participate during the entire three month time period, from March 1, 2010 to May 31, 2010.

Participation is voluntary. Study participation is voluntary. Refusal to participate will involve no penalty or loss of benefits to which you are otherwise entitled. Your decision to not participate in this study will not impact your future relationship with Montana State University, Critical Illness and Trauma Foundation, or American Medical Response. If you choose to participate, you are able to withdraw from the study at any time without penalty or loss of benefits to which you are otherwise entitled. During the study, it is acceptable for ambulance personnel to turn off the camera at anytime should you choose to withdraw from the study.

Confidentiality: All data gathered in this research study will be treated with confidentiality. The data recorded will be protected by the researcher team and will not be made public unless required by law. All data will be secured by encryption or password protection in locked environments.

All video data will be kept for a maximum of thirty days for researcher analysis from the time of data collection. After thirty days, video data will be permanently deleted. The data recordings prior to being deleted will only be accessible to the study researchers, not to anyone outside of the research study, e.g. American Medical Response. Your decision to not participate in this study will not impact your future relationship with Montana State University, Critical Illness and Trauma Foundation, or American Medical Response.

Questions:

You are welcome to ask any questions about this study and its procedures prior to consenting to participate by contacting the Principal Investigator, Dr. Laura Stanley, at (406) 994-1399. Additional questions about human subject research and protection can be answered by the Chairman of the Institutional Review Board at Montana State University, Dr. Mark Quinn, at (406) 994-4707.

_____

AUTHORIZATION: I have read the above consent form and it has been explained to me. A copy of this consent form has been given to me. All of my questions have been answered to my satisfaction. **I choose to participate in this research study, and consent to be videotaped.** I understand that I may later withdraw my consent at any time.

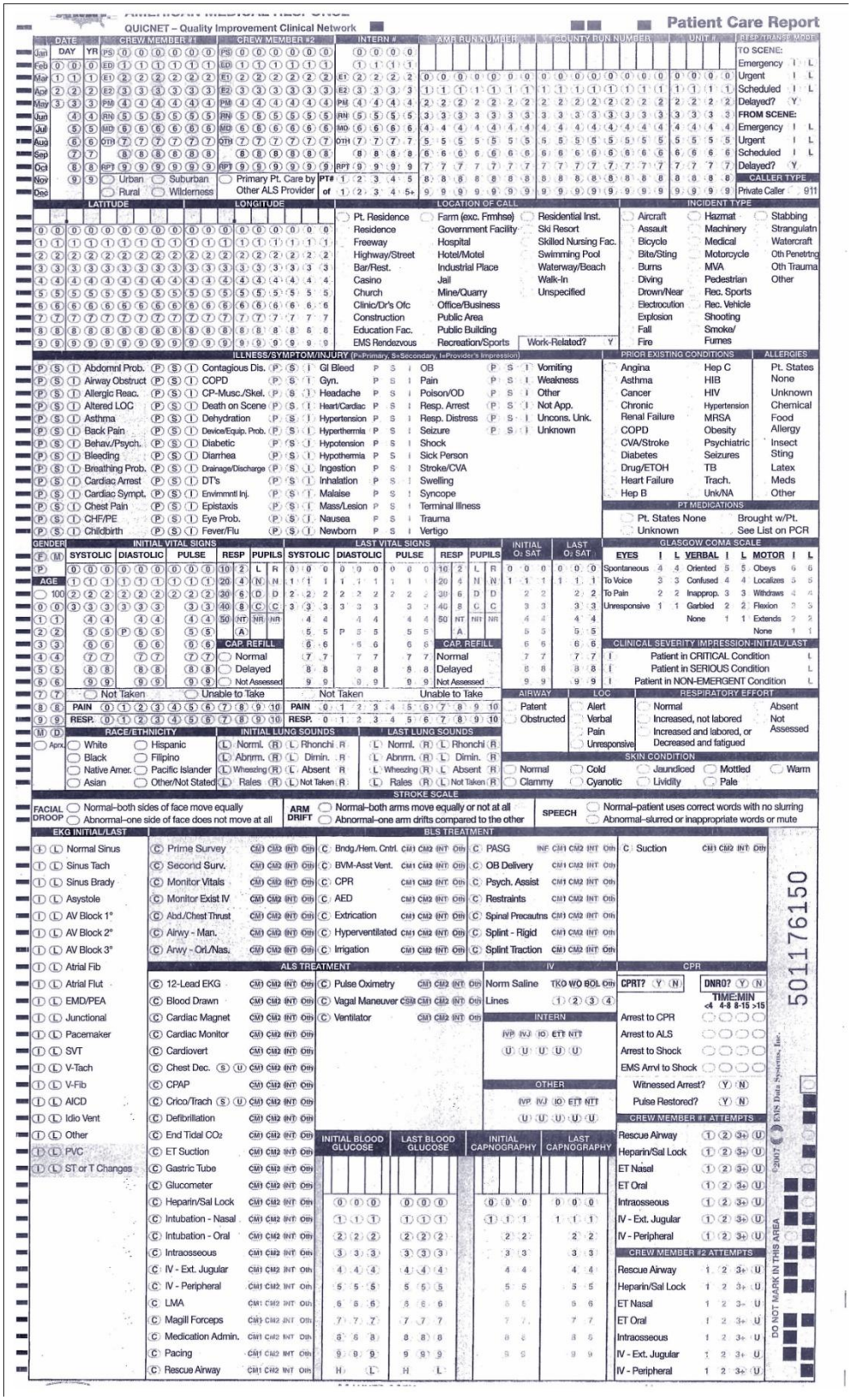
Name (Print): _____ Date:_____

Signature: _____

Investigator: _____

APPENDIX B

PATIENT CARE RECORDS



QUICNET – Quality Improvement Clinical Network

Patient Care Report

DATE
DAY
YR
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec

CREW MEMBER #1
CREW MEMBER #2
PS
ED
E1
E2
PM
RN
MD
OTH
RPT
Urban
Suburban
Rural
Wilderness
Primary Pt. Care by
Other ALS Provider

INTERN #
AMR RUN NUMBER
COUNTY RUN NUMBER
UNIT #
RESP/TRANSP MODE
TO SCENE:
Emergency I L
Urgent I L
Scheduled I L
Delayed? Y
FROM SCENE:
Emergency I L
Urgent I L
Scheduled I L
Delayed? Y
CALLER TYPE
Private Caller
911

PT#
of

LATITUDE
LONGITUDE

LOCATION OF CALL
Pt. Residence
Residence
Freeway
Highway/Street
Bar/Rest.
Casino
Church
Clinic/Dr's Ofc
Construction
Education Fac.
EMS Rendezvous
Farm (exc. Frmhse)
Government Facility
Hospital
Hotel/Motel
Industrial Place
Jail
Mine/Quarry
Office/Business
Public Area
Public Building
Recreation/Sports
Residential Inst.
Ski Resort
Skilled Nursing Fac.
Swimming Pool
Waterway/Beach
Walk-In
Unspecified
Work-Related? Y

INCIDENT TYPE
Aircraft
Assault
Bicycle
Bite/Sting
Burns
Diving
Drown/Near
Electrocution
Explosion
Fall
Fire
Hazmat
Machinery
Medical
Motorcycle
MVA
Pedestrian
Rec. Sports
Rec. Vehicle
Shooting
Smoke/
Fumes
Stabbing
Strangulatn
Watercraft
Oth Penetrtng
Oth Trauma
Other

ILLNESS/SYMPTOM/INJURY (P=Primary, S=Secondary, I=Provider's Impression)
Abdominl Prob.
Airway Obstruct
Allergic Reac.
Altered LOC
Asthma
Back Pain
Behav./Psych.
Bleeding
Breathing Prob.
Cardiac Arrest
Cardiac Sympt.
Chest Pain
CHF/PE
Childbirth
Contagious Dis.
COPD
CP-Musc./Skel.
Death on Scene
Dehydration
Device/Equip. Prob.
Diabetic
Diarrhea
Drainage/Discharge
DT's
Envirnmntl Inj.
Epistaxis
Eye Prob.
Fever/Flu
GI Bleed
Gyn.
Headache
Heart/Cardiac
Hypertension
Hyperthermia
Hypotension
Hypothermia
Ingestion
Inhalation
Malaise
Mass/Lesion
Nausea
Newborn
OB
Pain
Poison/OD
Resp. Arrest
Resp. Distress
Seizure
Shock
Sick Person
Stroke/CVA
Swelling
Syncope
Terminal Illness
Trauma
Vertigo
Vomiting
Weakness
Other
Not App.
Uncons. Unk.
Unknown

PRIOR EXISTING CONDITIONS
Angina
Asthma
Cancer
Chronic
Renal Failure
COPD
CVA/Stroke
Diabetes
Drug/ETOH
Heart Failure
Hep B
Hep C
HIB
HIV
Hypertension
MRSA
Obesity
Psychiatric
Seizures
TB
Trach.
Unk/NA

ALLERGIES
Pt. States None
Unknown
Other
Brought w/Pt.
See List on PCR

PT MEDICATIONS

GENDER
F M P

INITIAL VITAL SIGNS
SYSTOLIC
DIASTOLIC
PULSE
RESP
PUPILS
L R
N
D
C
NT
NR
A
CAP. REFILL
Normal
Delayed
Not Assessed
Not Taken
Unable to Take
PAIN 0 1 2 3 4 5 6 7 8 9 10
RESP. 0 1 2 3 4 5 6 7 8 9 10

LAST VITAL SIGNS
INITIAL O2 SAT
LAST O2 SAT

GLASGOW COMA SCALE
EYES
Spontaneous 4
To Voice 3
To Pain 2
Unresponsive 1
VERBAL
Oriented 5
Confused 4
Inappop. 3
Garbled 2
None 1
MOTOR
Obeys 6
Localizes 5
Withdraws 4
Flexion 3
Extends 2
None 1

CLINICAL SEVERITY IMPRESSION-INITIAL/LAST
Patient in CRITICAL Condition
Patient in SERIOUS Condition
Patient in NON-EMERGENT Condition

AGE
100

RACE/ETHNICITY
Aprx.
White
Black
Native Amer.
Asian
Hispanic
Filipino
Pacific Islander
Other/Not Stated

INITIAL LUNG SOUNDS
LAST LUNG SOUNDS
Norml. (R) (L)
Rhonchi (R) (L)
Abnrm. (R) (L)
Dimin. (R) (L)
Wheezing (R) (L)
Absent (R) (L)
Rales (R) (L)
Not Taken (R) (L)

AIRWAY
Patent
Obstructed

LOC
Alert
Verbal
Pain
Unresponsive

RESPIRATORY EFFORT
Normal
Increased, not labored
Increased and labored, or
Decreased and fatigued
Absent
Not Assessed

SKIN CONDITION
Normal
Clammy
Cold
Cyanotic
Jaundiced
Lividity
Mottled
Pale
Warm

STROKE SCALE
FACIAL DROOP
Normal–both sides of face move equally
Abnormal–one side of face does not move at all
ARM DRIFT
Normal–both arms move equally or not at all
Abnormal–one arm drifts compared to the other
SPEECH
Normal–patient uses correct words with no slurring
Abnormal–slurred or inappropriate words or mute

EKG INITIAL/LAST
Normal Sinus
Sinus Tach
Sinus Brady
Asystole
AV Block 1°
AV Block 2°
AV Block 3°
Atrial Fib
Atrial Flut
EMD/PEA
Junctional
Pacemaker
SVT
V-Tach
V-Fib
AICD
Idio Vent
Other
PVC
ST or T Changes

BLS TREATMENT
Prime Survey
Second Surv.
Monitor Vitals
Monitor Exist IV
Abd./Chest Thrust
Airwy - Man.
Arwy - Orl./Nas.
Bndg./Hem. Cntrl.
BVM-Asst Vent.
CPR
AED
Extrication
Hyperventilated
Irrigation
PASG
OB Delivery
Psych. Assist
Restraints
Spinal Precautns
Splint - Rigid
Splint Traction
Suction
CM1 CM2 INT Oth

ALS TREATMENT
12-Lead EKG
Blood Drawn
Cardiac Magnet
Cardiac Monitor
Cardiovert
Chest Dec. S U
CPAP
Crico/Trach S U
Defibrillation
End Tidal CO2
ET Suction
Gastric Tube
Glucometer
Heparin/Sal Lock
Intubation - Nasal
Intubation - Oral
Intraosseous
IV - Ext. Jugular
IV - Peripheral
LMA
Magill Forceps
Medication Admin.
Pacing
Rescue Airway
Pulse Oximetry
Vagal Maneuver
Ventilator

IV
Norm Saline
TKO WO BOL
Lines 1 2 3 4

INTERN
IVP IVJ IO ETT NTT
U U U U U

OTHER
IVP IVJ IO ETT NTT
U U U U U

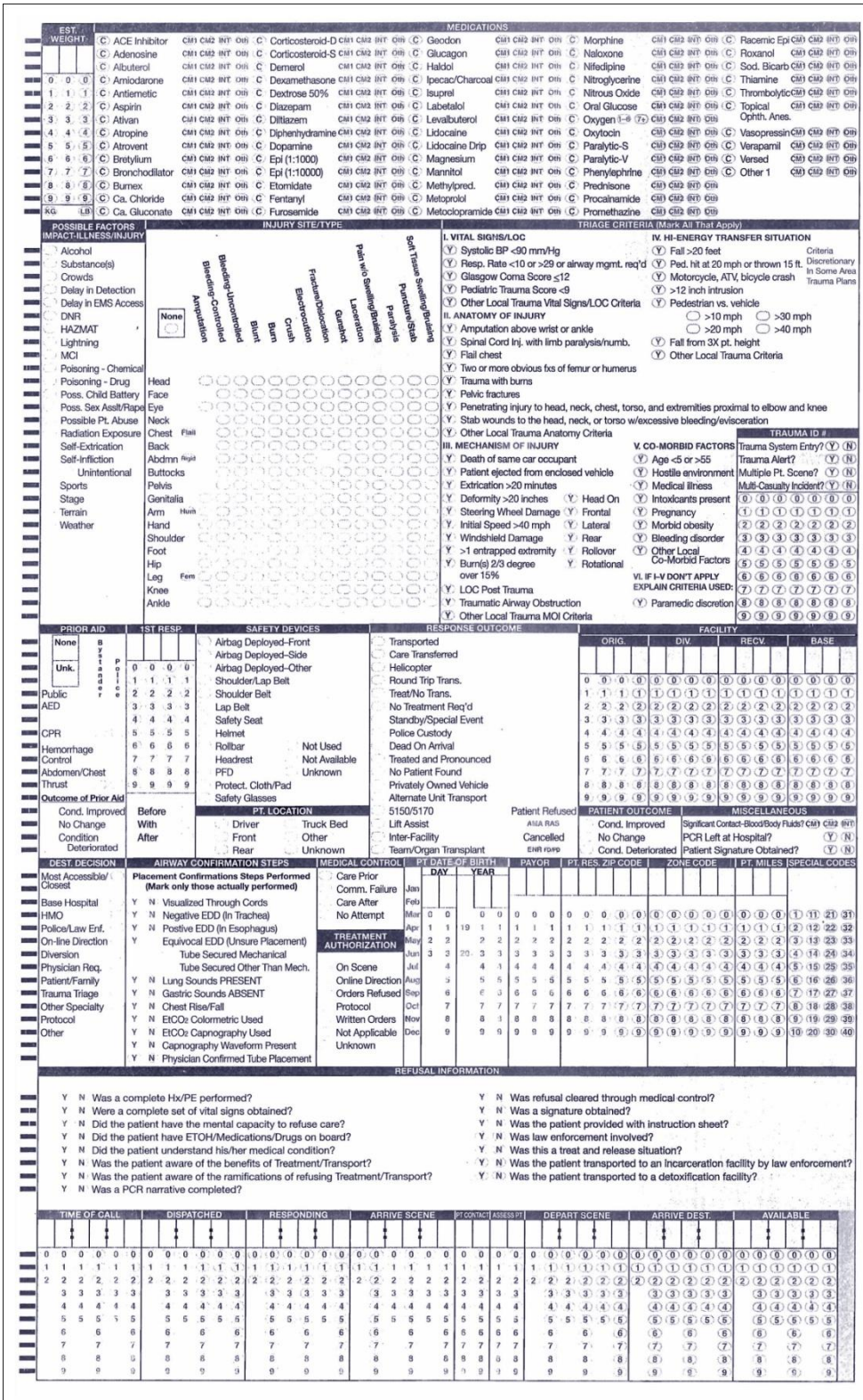
CPR
CPR? Y N
DNR? Y N
TIME:MIN
<4 4-8 8-15 >15
Arrest to CPR
Arrest to ALS
Arrest to Shock
EMS Arrvl to Shock
Witnessed Arrest? Y N
Pulse Restored? Y N

CREW MEMBER #1 ATTEMPTS
CREW MEMBER #2 ATTEMPTS
Rescue Airway
Heparin/Sal Lock
ET Nasal
ET Oral
Intraosseous
IV - Ext. Jugular
IV - Peripheral

INITIAL BLOOD GLUCOSE
LAST BLOOD GLUCOSE
INITIAL CAPNOGRAPHY
LAST CAPNOGRAPHY

50117615O

DO NOT MARK IN THIS AREA


EST. WEIGHT
KG LB
MEDICATIONS
(C) ACE Inhibitor
(C) Adenosine
(C) Albuterol
(C) Amiodarone
(C) Antiemetic
(C) Aspirin
(C) Ativan
(C) Atropine
(C) Atrovent
(C) Bretylium
(C) Bronchodilator
(C) Burnex
(C) Ca. Chloride
(C) Ca. Gluconate
(C) Corticosteroid-D
(C) Corticosteroid-S
(C) Demerol
(C) Dexamethasone
(C) Dextrose 50%
(C) Diazepam
(C) Dilitiazem
(C) Diphenhydramine
(C) Dopamine
(C) Epi (1:1000)
(C) Epi (1:10000)
(C) Etomidate
(C) Fentanyl
(C) Furosemide
(C) Geodon
(C) Glucagon
(C) Haldol
(C) Ipecac/Charcoal
(C) Isuprel
(C) Labetalol
(C) Levalbuterol
(C) Lidocaine
(C) Lidocaine Drip
(C) Magnesium
(C) Mannitol
(C) Methylpred.
(C) Metoprolol
(C) Metoclopramide
(C) Morphine
(C) Naloxone
(C) Nifedipine
(C) Nitroglycerine
(C) Nitrous Oxide
(C) Oral Glucose
(C) Oxygen
(C) Oxytocin
(C) Paralytic-S
(C) Paralytic-V
(C) Phenylephrine
(C) Prednisone
(C) Procalnamide
(C) Promethazine
(C) Racemic Epi
(C) Roxanol
(C) Sod. Bicarb
(C) Thiamine
(C) Thrombolytic
(C) Topical Ophth. Anes.
(C) Vasopressin
(C) Verapamil
(C) Versed
(C) Other 1
POSSIBLE FACTORS IMPACT-ILLNESS/INJURY
Alcohol
Substance(s)
Crowds
Delay in Detection
Delay in EMS Access
DNR
HAZMAT
Lightning
MCI
Poisoning - Chemical
Poisoning - Drug
Poss. Child Battery
Poss. Sex Asslt/Rape
Possible Pt. Abuse
Radiation Exposure
Self-Extrication
Self-Infliction
Unintentional
Sports
Stage
Terrain
Weather
INJURY SITE/TYPE
None
Amputation
Bleeding-Controlled
Bleeding-Uncontrolled
Blunt
Burn
Crush
Electrocution
Fracture/Dislocation
Gunshot
Laceration
Pain w/o Swelling/Bruising
Paralysis
Puncture/Stab
Soft Tissue Swelling/Bruising
Head
Face
Eye
Neck
Chest
Back
Abdmn
Buttocks
Pelvis
Genitalia
Arm
Hand
Shoulder
Foot
Hip
Leg
Knee
Ankle
Flail
Rigid
Hurt
Fem
TRIAGE CRITERIA (Mark All That Apply)
I. VITAL SIGNS/LOC
Systolic BP <90 mm/Hg
Resp. Rate <10 or >29 or airway mgmt. req'd
Glasgow Coma Score ≤12
Pediatric Trauma Score <9
Other Local Trauma Vital Signs/LOC Criteria
II. ANATOMY OF INJURY
Amputation above wrist or ankle
Spinal Cord Inj. with limb paralysis/numb.
Flail chest
Two or more obvious fxs of femur or humerus
Trauma with burns
Pelvic fractures
Penetrating injury to head, neck, chest, torso, and extremities proximal to elbow and knee
Stab wounds to the head, neck, or torso w/excessive bleeding/evisceration
Other Local Trauma Anatomy Criteria
III. MECHANISM OF INJURY
Death of same car occupant
Patient ejected from enclosed vehicle
Extrication >20 minutes
Deformity >20 inches
Steering Wheel Damage
Initial Speed >40 mph
Windshield Damage
>1 entrapped extremity
Burn(s) 2/3 degree over 15%
LOC Post Trauma
Traumatic Airway Obstruction
Other Local Trauma MOI Criteria
Head On
Frontal
Lateral
Rear
Rollover
Rotational
IV. HI-ENERGY TRANSFER SITUATION
Fall >20 feet
Ped. hit at 20 mph or thrown 15 ft.
Motorcycle, ATV, bicycle crash
>12 inch intrusion
Pedestrian vs. vehicle
>10 mph
>20 mph
>30 mph
>40 mph
Fall from 3X pt. height
Other Local Trauma Criteria
Criteria Discretionary In Some Area Trauma Plans
V. CO-MORBID FACTORS
Age <5 or >55
Hostile environment
Medical illness
Intoxicants present
Pregnancy
Morbid obesity
Bleeding disorder
Other Local Co-Morbid Factors
VI. IF I-V DON'T APPLY EXPLAIN CRITERIA USED:
Paramedic discretion
TRAUMA ID #
Trauma System Entry?
Trauma Alert?
Multiple Pt. Scene?
Multi-Casualty Incident?
PRIOR AID
None
Unk.
Bystander
Police
Public
AED
CPR
Hemorrhage Control
Abdomen/Chest Thrust
Outcome of Prior Aid
Cond. Improved
No Change
Condition Deteriorated
1ST RESP.
Before
With
After
SAFETY DEVICES
Airbag Deployed–Front
Airbag Deployed–Side
Airbag Deployed–Other
Shoulder/Lap Belt
Shoulder Belt
Lap Belt
Safety Seat
Helmet
Rollbar
Headrest
PFD
Protect. Cloth/Pad
Safety Glasses
Not Used
Not Available
Unknown
PT. LOCATION
Driver
Front
Rear
Truck Bed
Other
Unknown
RESPONSE OUTCOME
Transported
Care Transferred
Helicopter
Round Trip Trans.
Treat/No Trans.
No Treatment Req'd
Standby/Special Event
Police Custody
Dead On Arrival
Treated and Pronounced
No Patient Found
Privately Owned Vehicle
Alternate Unit Transport
5150/5170
Lift Assist
Inter-Facility
Team/Organ Transplant
Patient Refused
AMA RAS
Cancelled
ENR FD/PD
FACILITY
ORIG.
DIV.
RECV.
BASE
PATIENT OUTCOME
Cond. Improved
No Change
Cond. Deteriorated
MISCELLANEOUS
Significant Contact-Blood/Body Fluids?
PCR Left at Hospital?
Patient Signature Obtained?
DEST. DECISION
Most Accessible/ Closest
Base Hospital
HMO
Police/Law Enf.
On-line Direction
Diversion
Physician Req.
Patient/Family
Trauma Triage
Other Specialty
Protocol
Other
AIRWAY CONFIRMATION STEPS
Placement Confirmations Steps Performed (Mark only those actually performed)
Visualized Through Cords
Negative EDD (In Trachea)
Postive EDD (In Esophagus)
Equivocal EDD (Unsure Placement)
Tube Secured Mechanical
Tube Secured Other Than Mech.
Lung Sounds PRESENT
Gastric Sounds ABSENT
Chest Rise/Fall
EtCO2 Colormetric Used
EtCO2 Capnography Used
Capnography Waveform Present
Physician Confirmed Tube Placement
MEDICAL CONTROL
Care Prior
Comm. Failure
Care After
No Attempt
TREATMENT AUTHORIZATION
On Scene
Online Direction
Orders Refused
Protocol
Written Orders
Not Applicable
Unknown
PT DATE-OF BIRTH
DAY
YEAR
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
PAYOR
PT. RES. ZIP CODE
ZONE CODE
PT. MILES
SPECIAL CODES
REFUSAL INFORMATION
Was a complete Hx/PE performed?
Were a complete set of vital signs obtained?
Did the patient have the mental capacity to refuse care?
Did the patient have ETOH/Medications/Drugs on board?
Did the patient understand his/her medical condition?
Was the patient aware of the benefits of Treatment/Transport?
Was the patient aware of the ramifications of refusing Treatment/Transport?
Was a PCR narrative completed?
Was refusal cleared through medical control?
Was a signature obtained?
Was the patient provided with instruction sheet?
Was law enforcement involved?
Was this a treat and release situation?
Was the patient transported to an incarceration facility by law enforcement?
Was the patient transported to a detoxification facility?
TIME OF CALL
DISPATCHED
RESPONDING
ARRIVE SCENE
PT CONTACT
ASSESS PT
DEPART SCENE
ARRIVE DEST.
AVAILABLE

NOTICE OF PRIVACY PRACTICES
OF AMERICAN MEDICAL RESPONSE

THIS NOTICE DESCRIBES HOW MEDICAL INFORMATION ABOUT YOU MAY BE USED AND DISCLOSED AND HOW YOU CAN GET ACCESS TO THIS INFORMATION. PLEASE REVIEW IT CAREFULLY.

Your health information is personal, and we are committed to protecting it. Your health information is also very important to our ability to provide you with quality care, and to comply with certain laws. This Notice applies to all records about care provided to you by American Medical Response. (Your physician may have different policies and a different notice regarding your health information that is created in the physician's office.)

I. We Are Legally Required to Safeguard Your Protected Health Information.

We are required by law to:

A. maintain the privacy of your health information, also known as "protected health information" or "PHI;"
B. provide you with this Notice, and
C. comply with this Notice.

II. Future Changes to Our Practices and This Notice.

We reserve the right to change our privacy practices and to make any such change applicable to the PHI we obtained about you previously. If a change in our practices is material, we will revise this Notice to reflect the change. You may obtain a copy of any revised Notice by contacting the Ethics & Compliance Department at 888-828-7284. We will also make any revised Notice available on our website at www.amr.net

III. How We May Use and Disclose Your Protected Health Information.

The law requires us to have your authorization for some uses and disclosures. In other circumstances, the law allows us to use or disclose PHI without your authorization. This section gives examples of each of these circumstances.

Uses and Disclosures That Require Us to Give You the Opportunity to Object. Unless you object, we may provide relevant portions of your PHI **to a family member, friend or other person you indicate** is involved in your health care or in helping you get payment for your health care. We may use or disclosure your PHI to notify your family or personal representative of your location or condition. In an emergency or when you are not capable of agreeing or objecting to these disclosures, we will disclose PHI as we determine is in your best interest, but will tell you about it later, after the emergency, and give you the opportunity to object to future disclosures to family and friends. Unless you object, we may also disclose your PHI to persons performing disaster relief activities.

A. Certain Uses and Disclosures Do Not Require Your Authorization The law allows us to disclose PHI without your authorization in the following circumstances:

(1) When Required by Law.
(2) For Public Health Activities.
(3) For Reports About Victims of Abuse, Neglect or Domestic Violence.
(4) To Health Oversight Agencies.
(5) For Lawsuits and Disputes.
(6) To Law Enforcement. We may release PHI if asked to do so by a law enforcement official, in the following circumstances: (a) in response to a court order, subpoena, warrant, summons or similar process; (b) to identify or locate a suspect, fugitive, material witness or missing person; (c) about the victim of a crime if, under certain limited circumstances, we are unable to obtain the person's agreement; (d) about a death we believe may be due to criminal conduct; (e) about criminal conduct at our facility; and (f) in emergency circumstances, to report a crime, its location or victims, or the identity, description or location of the person who committed the crime.
(7) To Coroners, Medical Examiners and Funeral Directors.
(8) To Organ Procurement Organizations.
(9) For Medical Research. We may disclose your PHI without your authorization to medical researchers who request it for approved medical research projects.
(10) To Avert a Serious Threat to Health or Safety.
(11) For Specialized Government Functions.
(12) To Workers' Compensation or Similar Programs.

IV. Other Uses and Disclosures of Your Protected Health Information.

Other uses and disclosures of your PHI that are not covered by this Notice or the laws that apply to us will be made only with your written authorization. If you give us written authorization for a use or disclosure of your PHI, you may revoke that authorization, in writing, at any time. If you revoke your authorization we will no longer use or disclosure your PHI for the purposes specified in the written authorization, except that we are unable to retract any disclosures we have already made with your permission. In addition, we can use or disclose your PHI after you have

revoked your authorization for actions we have already taken in reliance on your authorization. We are also required to retain certain records of the uses and disclosures made when the authorization was in effect.

V. Your Rights Related to Your Protected Health Information.

You have the following rights:

A. The Right to Request Limits on Uses and Disclosures of Your PHI. You have the right to ask us to limit how we use and disclose your PHI. Any such request must be submitted in writing to our Privacy Officer. We are not required to agree to your request. If we do agree, we will put it in writing and will abide by the agreement except when you require emergency treatment.

B. The Right to Choose How We Communicate With You. You have the right to ask that we send information to you at a specific address (for example, at work rather than at home) or in a specific manner (for example, by e-mail rather than by regular mail, or never by telephone). We must agree to your request as long as it would not be disruptive to our operations to do so. You must make any such request in writing, addressed to our Privacy Officer.

C. The Right to See and Copy Your PHI. Except for limited circumstances, you may look at and copy your PHI if you ask in writing to do so. Any such request must be addressed to our Patient Billing Service Center, which will respond to your request within 10 days (or 30 days if the extra time is needed). In certain situations we may deny your request, but if we do, we will tell you in writing of the reasons for the denial and explain your rights with regard to having the denial reviewed.

D. The Right to Correct or Update Your PHI. If you believe that the PHI we have about you is incomplete or incorrect, you may ask us to amend it. Any such request must be made in writing and must be addressed to our Patient Billing Service Center, and must tell us why you think the amendment is appropriate. We will not process your request if it is not in writing or does not tell us why you think the amendment is appropriate. We will act on your request within 30 days or less if state law requires (or 60 days if the extra time is needed), and will inform you in writing as to whether the amendment will be made or denied. If we agree to make the amendment, we will ask you who else you would like us to notify of the amendment.

We may deny your request if you ask us to amend information that:

(1) was not created by us, unless the person who created the information is no longer available to make the amendment;
(2) is not part of the PHI we keep about you;
(3) is not part of the PHI that you would be allowed to see or copy; or
(4) is determined by us to be accurate and complete.

If we deny the requested amendment, we will tell you in writing how to submit a statement of disagreement or complaint, or to request inclusion of your original amendment request in your PHI.

E. The Right to Get a List of the Disclosures We Have Made. You have the right to get a list of instances in which we have disclosed your PHI. The list will not include disclosures we have made for our treatment, payment and health care operations purposes, those made directly to you or your family or friends or through our facility directory, or for disaster relief purposes. Neither will the list include disclosures we have made for national security purposes or to law enforcement personnel, or disclosures made before April 14, 2003.

Your request for a list of disclosures must be made in writing and be addressed to the Patient Billing Service Center address that is listed on your invoice. We will respond to your request within 30 days, or less if state law requires (or 60 days if the extra time is needed). The list we provide will include disclosures made within the last six years unless you specify a shorter period. The first list you request within a 12-month period will be free. You will be charged our costs for providing any additional lists within the 12-month period.

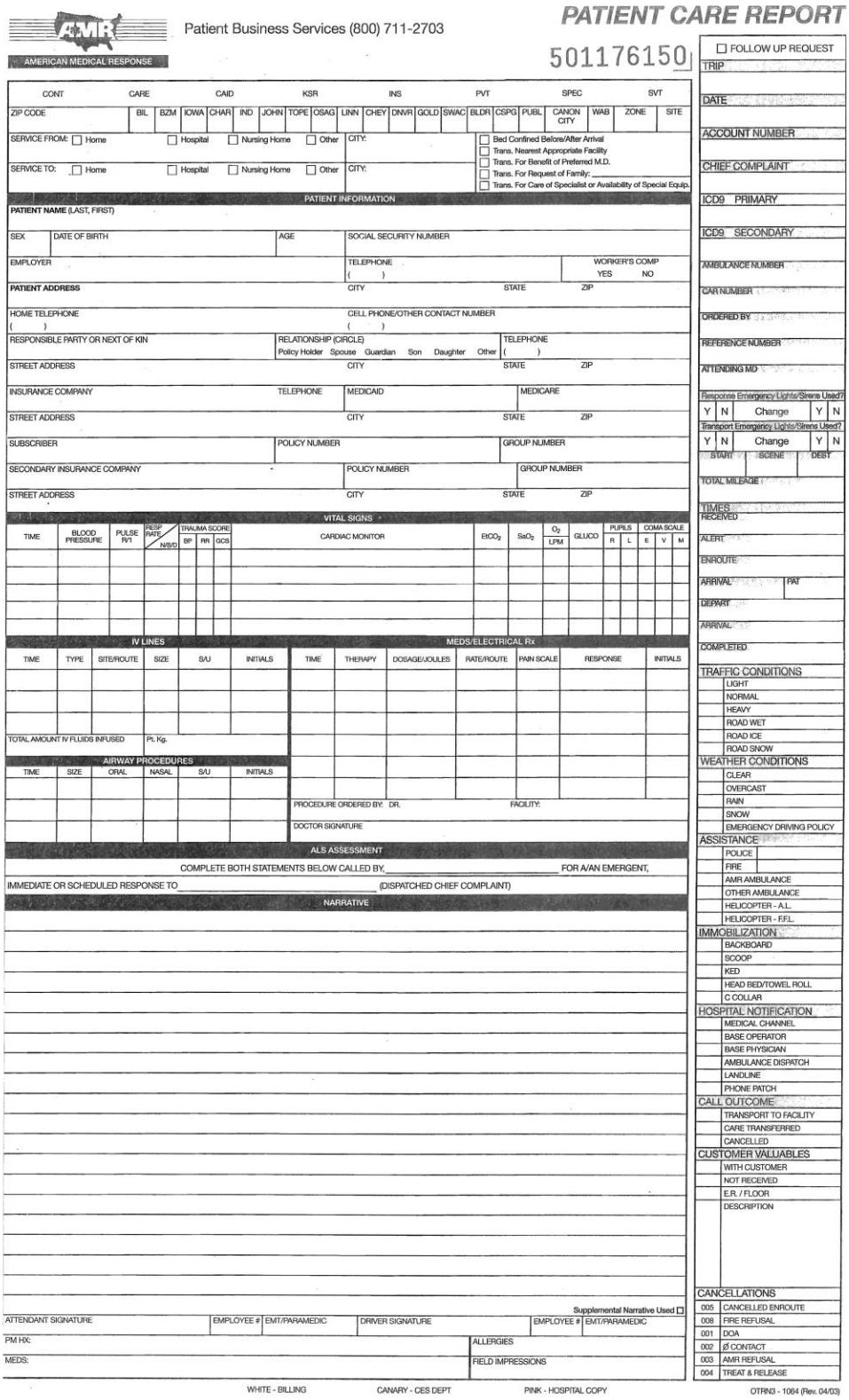
F. The Right to Get a Paper Copy of This Notice. Even if you have agreed to receive the Notice by e-mail, you have the right to request a paper copy as well. You may obtain a paper copy of this Notice by contacting the Ethics & Compliance Department at 888-828-7284. The Notice is also available on-line at www.amr.net.

VI. Complaints.

If you believe your privacy rights have been violated, you may file a complaint with us or with the Secretary of the federal Department of Health and Human Services. To file a complaint with the DHHS put your complaint in writing and address it to the U S Department of Health & Human Services, 200 Independence Ave. S.W., Washington DC, 20201. Or call them at 877-696-6775. To file a complaint with us, put your complaint in writing and address it to our AMR HIPAA Privacy Officer at AMR 6200 South Syracuse Way, Suite 200, Greenwood Village, CO 80111. We will not retaliate against you for filing a complaint. You may also contact our Privacy Officer if you have questions or comments about our privacy practices.

Effective Date: April 14, 2003.

Revision Date: January 1, 2006



AMERICAN MEDICAL RESPONSE

Patient Business Services (800) 711-2703

PATIENT CARE REPORT

501176150

☐ FOLLOW UP REQUEST

CONT | CARE | CAID | KSR | INS | PVT | SPEC | SVT

ZIP CODE | BIL | BZM | IOWA | CHAR | IND | JOHN | TOPE | OSAG | LINN | CHEY | DNVR | GOLD | SWAC | BLDR | CSPG | PUBL | CANON CITY | WAB | ZONE | SITE

SERVICE FROM: ☐ Home ☐ Hospital ☐ Nursing Home ☐ Other CITY:

SERVICE TO: ☐ Home ☐ Hospital ☐ Nursing Home ☐ Other CITY:

☐ Bed Confined Before/After Arrival
☐ Trans. Nearest Appropriate Facility
☐ Trans. For Benefit of Preferred M.D.
☐ Trans. For Request of Family: _____
☐ Trans. For Care of Specialist or Availability of Special Equip.

PATIENT INFORMATION

PATIENT NAME (LAST, FIRST)

SEX | DATE OF BIRTH | AGE | SOCIAL SECURITY NUMBER

EMPLOYER | TELEPHONE ( ) | WORKER'S COMP YES NO

PATIENT ADDRESS | CITY | STATE | ZIP

HOME TELEPHONE ( ) | CELL PHONE/OTHER CONTACT NUMBER ( )

RESPONSIBLE PARTY OR NEXT OF KIN | RELATIONSHIP (CIRCLE) Policy Holder Spouse Guardian Son Daughter Other | TELEPHONE ( )

STREET ADDRESS | CITY | STATE | ZIP

INSURANCE COMPANY | TELEPHONE | MEDICAID | MEDICARE

STREET ADDRESS | CITY | STATE | ZIP

SUBSCRIBER | POLICY NUMBER | GROUP NUMBER

SECONDARY INSURANCE COMPANY | POLICY NUMBER | GROUP NUMBER

STREET ADDRESS | CITY | STATE | ZIP

VITAL SIGNS

TIME	BLOOD PRESSURE	PULSE R/T	RESP RATE N/S/D	TRAUMA SCORE BP	RR	GCS	CARDIAC MONITOR	$EtCO_2$	SaO_2	O_2 LPM	GLUCO	PUPILS R	L	COMA SCALE E	V	M

IV LINES

TIME	TYPE	SITE/ROUTE	SIZE	S/U	INITIALS

TOTAL AMOUNT IV FLUIDS INFUSED | Pt. Kg.

AIRWAY PROCEDURES

TIME	SIZE	ORAL	NASAL	S/U	INITIALS

MEDS/ELECTRICAL Rx

TIME	THERAPY	DOSAGE/JOULES	RATE/ROUTE	PAIN SCALE	RESPONSE	INITIALS

PROCEDURE ORDERED BY: DR. | FACILITY:

DOCTOR SIGNATURE

ALS ASSESSMENT

COMPLETE BOTH STATEMENTS BELOW CALLED BY _____ FOR A/AN EMERGENT,

IMMEDIATE OR SCHEDULED RESPONSE TO _____ (DISPATCHED CHIEF COMPLAINT)

NARRATIVE

Supplemental Narrative Used ☐

ATTENDANT SIGNATURE | EMPLOYEE # | EMT/PARAMEDIC | DRIVER SIGNATURE | EMPLOYEE # | EMT/PARAMEDIC

PM HX: | ALLERGIES

MEDS: | FIELD IMPRESSIONS

TRIP

DATE

ACCOUNT NUMBER

CHIEF COMPLAINT

ICD9 PRIMARY

ICD9 SECONDARY

AMBULANCE NUMBER

CAR NUMBER

ORDERED BY

REFERENCE NUMBER

ATTENDING MD

Response Emergency Lights/Sirens Used? Y N Change Y N

Transport Emergency Lights/Sirens Used? Y N Change Y N

START | SCENE | DEST

TOTAL MILEAGE

TIMES
RECEIVED
ALERT
ENROUTE
ARRIVAL | PAT
DEPART
ARRIVAL
COMPLETED

TRAFFIC CONDITIONS
☐ LIGHT ☐ NORMAL ☐ HEAVY ☐ ROAD WET ☐ ROAD ICE ☐ ROAD SNOW

WEATHER CONDITIONS
☐ CLEAR ☐ OVERCAST ☐ RAIN ☐ SNOW ☐ EMERGENCY DRIVING POLICY

ASSISTANCE
☐ POLICE ☐ FIRE ☐ AMR AMBULANCE ☐ OTHER AMBULANCE ☐ HELICOPTER - A.L. ☐ HELICOPTER - F.F.L.

IMMOBILIZATION
☐ BACKBOARD ☐ SCOOP ☐ KED ☐ HEAD BED/TOWEL ROLL ☐ C COLLAR

HOSPITAL NOTIFICATION
☐ MEDICAL CHANNEL ☐ BASE OPERATOR ☐ BASE PHYSICIAN ☐ AMBULANCE DISPATCH ☐ LANDLINE ☐ PHONE PATCH

CALL OUTCOME
☐ TRANSPORT TO FACILITY ☐ CARE TRANSFERRED ☐ CANCELLED

CUSTOMER VALUABLES
☐ WITH CUSTOMER ☐ NOT RECEIVED ☐ E.R. / FLOOR ☐ DESCRIPTION

CANCELLATIONS
005 CANCELLED ENROUTE
008 FIRE REFUSAL
001 DOA
002 Ø CONTACT
003 AMR REFUSAL
004 TREAT & RELEASE

WHITE - BILLING CANARY - CES DEPT PINK - HOSPITAL COPY

OTRN3 - 1064 (Rev. 04/03)

Please check all applicable charges. List number of units if applicable.

AIRWAY/NASAL		DEFIB SUPPLIES		IV DRIP D5W		RESTRAINTS	
AIRWAY/ORAL		DRESSING MAJOR		IV BUFF CAP		SPLINT-EXTREMITY	
ALS BASE		DRESSING MINOR		IV VOLUME EXPANDER		SPLINT-SPINAL	
BLOOD DRAW		EKG MONITOR		NASAL GASTRIC TUBE		SUCTION SUPPLIES	
BLS BASE		GLUCOMETER		NEBULIZER		WHEELCHAIR	
BURN SHEET		INTUBATION		OB PACK			
COLD/HOT PACK		IO SUPPLIES		OXYGEN			
CRICO CHEST SUPPLIES		IRRIGATION FLUID		PACING SUPPLIES			
ACE INHIBITOR		DIPHENHYDRAMINE		LIDOCAINE DRIP		PROCAINAMIDE	
ADENOSINE		DOPAMINE		MAGNESIUM		PROMETHAZINE	
ALBUTEROL		EPI (1:1000)		METHYLPREDNISOLONE		RACEMIC EPI	
AMIODARONE		EPI (1:10000)		METOCLOPRAMIDE		ROXANOL	
ASPIRIN		ETOMIDATE		MORPHINE		SOD. BICARB	
ATROPINE		FENTANYL		NALOXONE		TOPICAL OPHTH. ANES.	
ATROVENT		FUROSEMIDE		NITROGLYCERINE		VASOPRESSIN	
CA. CHLORIDE		GLUCAGON		ORAL GLUCOSE		VERAPAMIL	
CA. GLUCONATE		HALDOL		OXYGEN		VERSED	
DEXAMETHASONE		IPECAC/CHARCOAL		PARALYTIC-S		OTHER 1	
DEXTROSE 50%		LABETALOL		PARALYTIC-V			
DIAZEPAM		LIDOCAINE		PHENYLEPHRINE			
ADDITIONAL ATTENDANT		EQUIPMENT TRANSFER		MAST SUIT		RESPONSE ONLY/NO TX	
BLOOD DRAW CONTACT		FLIGHT CREW RETURN		NIGHT CHARGE		STAND BY	
EMERGENCY		IV/PUMP MAINTENANCE		PULSE OXIMETRY		WAIT TIME (PER 1/4 HOUR)	

ATTENDANT NAME	DRIVER NAME		
RECEIVING FACILITY SIGNATURE:	RIDER	PARAMEDIC / EMT	AGENCY

BLOOD DRAW

OFFICER	BADGE #	C. R. #	POLICE AGENCY:

PATIENT SIGNATURE: _____ OFFICER SIGNATURE: _____

PATIENT SIGNATURE

I acknowledge that I am legally responsible for the ambulance services provided to me. I request payment of authorized Medicare benefits and/or other insurance benefits be made on my behalf to AMR for any ambulance services and supplies furnished to me by AMR, whether in the past, now or in the future. I authorize any holder of medical information about me or other relevant documentation about me to release to the Centers for Medicare and Medicaid Services and its agents and contractors, any and all appropriate third party payers and their respective agents and contractors, as well as AMR, any information or documentation in their possession needed to determine these benefits and/or the benefits payable for related services, whether in the past, now or in the future.

I acknowledge that I have been provided with a copy of AMR's Notice of Privacy Practices on this date.

_____ _____
Signature of Patient Date

REPRESENTATIVE SIGNATURE

Reason Patient could not Sign: _____

By signing below, I certify that I am one of the following individuals and that I am authorized to sign on the patient's behalf (check one):

☐ Patient's legal guardian (42 C.F.R. §424.36(b)(1))
☐ Relative or other person who receives governmental benefits on the patient's behalf (42 C.F.R. §424.36(b)(2))
☐ Relative or other person who arranges patient's treatment or manages the patient's affairs (42 C.F.R. §424.36(b)(3))

_____ _____ _____
Signature of Representative Printed Name of Representative Date

FACILITY SIGNATURE

Complete this section only if you are unable to obtain the signature of the patient or authorized representative listed above.

Reason Patient could not Sign: _____

By signing below, I certify that the above-named patient was physically or mentally incapable of signing at the time of transport, and that none of the individuals listed in 42 C.F.R. §424.36(b)(1)–(3) was available or willing to sign the claim on behalf of the beneficiary.

_____ _____
Crew Signature Date

This section is to be completed by a representative of the sending or receiving facility, whenever you are unable to obtain the signature of the patient or an authorized representative. ***Note:*** *The crew must also complete the "Crew Signature" section above.*

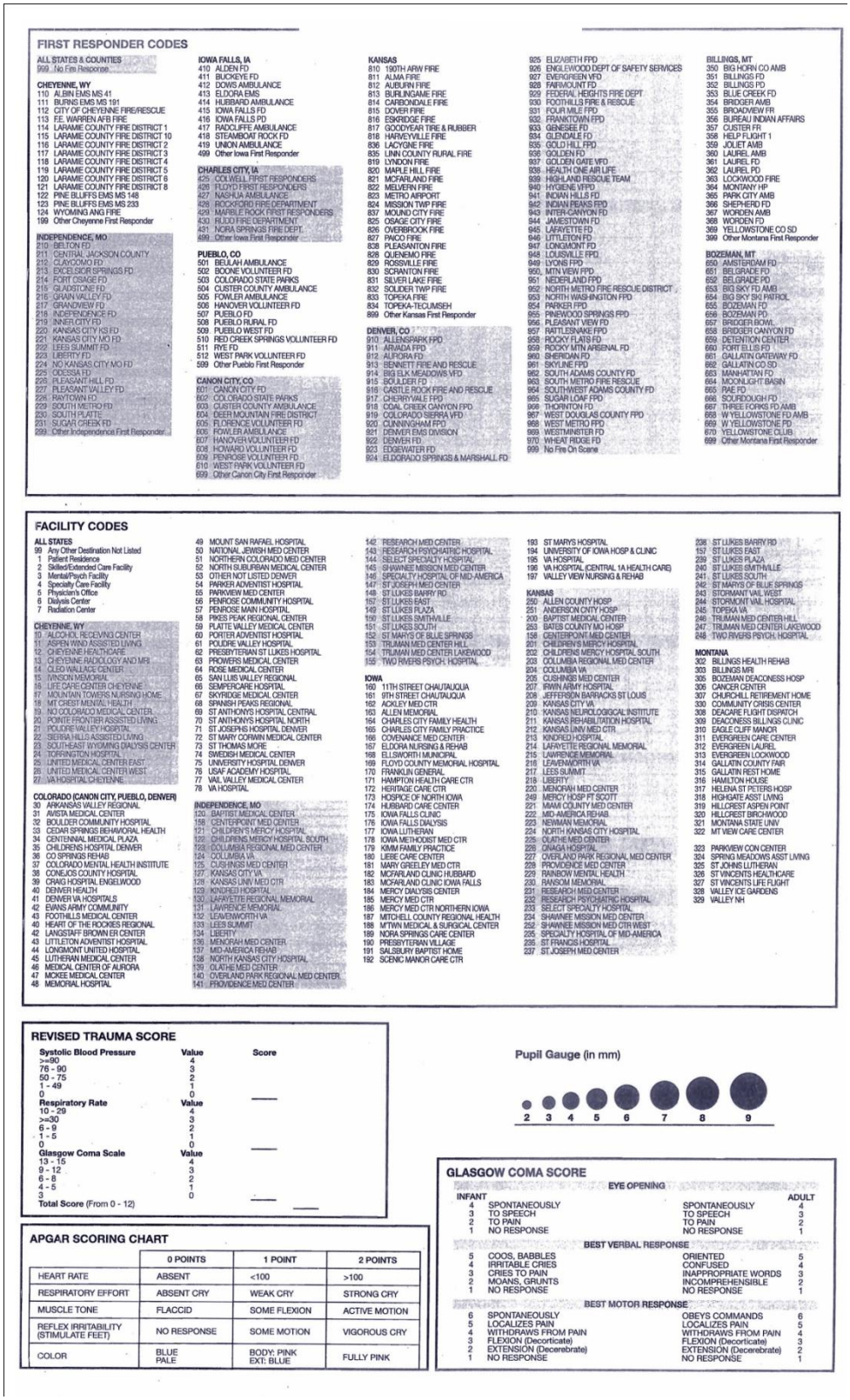
Name and Location of facility: _____

The above named patient, as described by AMR, was received by or transported from our facility, which provided care or assistance to the patient, on the date and time set forth above.

_____ _____
Signature of Receiving or Sending Facility Representative Date

_____ _____
Printed Name of Receiving or Sending Facility Representative Title

AMR is required to obtain this information in order to submit a claim for payment to Medicare or other third party payer. This Signature is not an acceptance of financial responsibility for the patient.



FIRST RESPONDER CODES

ALL STATES & COUNTIES
999 No Fire Response

CHEYENNE, WY
110 ALBIN EMS MS 41
111 BURNS EMS MS 191
112 CITY OF CHEYENNE FIRE/RESCUE
113 F.E. WARREN AFB FIRE
114 LARAMIE COUNTY FIRE DISTRICT 1
115 LARAMIE COUNTY FIRE DISTRICT 10
116 LARAMIE COUNTY FIRE DISTRICT 2
117 LARAMIE COUNTY FIRE DISTRICT 3
118 LARAMIE COUNTY FIRE DISTRICT 4
119 LARAMIE COUNTY FIRE DISTRICT 5
120 LARAMIE COUNTY FIRE DISTRICT 6
121 LARAMIE COUNTY FIRE DISTRICT 8
122 PINE BLUFFS EMS MS 148
123 PINE BLUFFS EMS MS 233
124 WYOMING ANG FIRE
199 Other Cheyenne First Responder

INDEPENDENCE, MO
210 BELTON FD
211 CENTRAL JACKSON COUNTY
212 CLAYCOMO FD
213 EXCELSIOR SPRINGS FD
214 FORT OSAGE FD
215 GLADSTONE FD
216 GRAIN VALLEY FD
217 GRANDVIEW FD
218 INDEPENDENCE FD
219 INNER CITY FD
220 KANSAS CITY KS FD
221 KANSAS CITY MO FD
222 LEES SUMMIT FD
223 LIBERTY FD
224 NO KANSAS CITY MO FD
225 ODESSA FD
226 PLEASANT HILL FD
227 PLEASANT VALLEY FD
228 RAYTOWN FD
229 SOUTH METRO FD
230 SOUTH PLATTE
231 SUGAR CREEK FD
299 Other Independence First Responder

IOWA FALLS, IA
410 ALDEN FD
411 BUCKEYE FD
412 DOWS AMBULANCE
413 ELDORA EMS
414 HUBBARD AMBULANCE
415 IOWA FALLS FD
416 IOWA FALLS PD
417 RADCLIFFE AMBULANCE
418 STEAMBOAT ROCK FD
419 UNION AMBULANCE
499 Other Iowa First Responder

CHARLES CITY, IA
425 COLWELL FIRST RESPONDERS
426 FLOYD FIRST RESPONDERS
427 NASHUA AMBULANCE
428 ROCKFORD FIRE DEPARTMENT
429 MARBLE ROCK FIRST RESPONDERS
430 RUDD FIRE DEPARTMENT
431 NORA SPRINGS FIRE DEPT
499 Other Iowa First Responder

PUEBLO, CO
501 BEULAH AMBULANCE
502 BOONE VOLUNTEER FD
503 COLORADO STATE PARKS
504 CUSTER COUNTY AMBULANCE
505 FOWLER AMBULANCE
506 HANOVER VOLUNTEER FD
507 PUEBLO FD
508 PUEBLO RURAL FD
509 PUEBLO WEST FD
510 RED CREEK SPRINGS VOLUNTEER FD
511 RYE FD
512 WEST PARK VOLUNTEER FD
599 Other Pueblo First Responder

CANON CITY, CO
601 CANON CITY FD
602 COLORADO STATE PARKS
603 CUSTER COUNTY AMBULANCE
604 DEER MOUNTAIN FIRE DISTRICT
605 FLORENCE VOLUNTEER FD
606 FOWLER AMBULANCE
607 HANOVER VOLUNTEER FD
608 HOWARD VOLUNTEER FD
609 PENROSE VOLUNTEER FD
610 WEST PARK VOLUNTEER FD
699 Other Canon City First Responder

KANSAS
810 190TH ARW FIRE
811 ALMA FIRE
812 AUBURN FIRE
813 BURLINGAME FIRE
814 CARBONDALE FIRE
815 DOVER FIRE
816 ESKRIDGE FIRE
817 GOODYEAR TIRE & RUBBER
818 HARVEYVILLE FIRE
836 LACYGNE FIRE
835 LINN COUNTY RURAL FIRE
819 LYNDON FIRE
820 MAPLE HILL FIRE
821 MCFARLAND FIRE
822 MELVERN FIRE
823 METRO AIRPORT
824 MISSION TWP FIRE
837 MOUND CITY FIRE
825 OSAGE CITY FIRE
826 OVERBROOK FIRE
827 PAICO FIRE
838 PLEASANTON FIRE
828 QUENIEMO FIRE
829 ROSSVILLE FIRE
830 SCRANTON FIRE
831 SILVER LAKE FIRE
832 SOLIDER TWP FIRE
833 TOPEKA FIRE
834 TOPEKA-TECUMSEH
899 Other Kansas First Responder

DENVER, CO
910 ALLENSPARK FPD
911 ARVADA FPD
912 AURORA FD
913 BENNETT FIRE AND RESCUE
914 BIG ELK MEADOWS VFD
915 BOULDER FD
916 CASTLE ROCK FIRE AND RESCUE
917 CHERRYVALE FPD
918 COAL CREEK CANYON FPD
919 COLORADO SIERRA VFD
920 CUNNINGHAM FPD
921 DENVER EMS DIVISION
922 DENVER FD
923 EDGEWATER FD
924 ELDORADO SPRINGS & MARSHALL FD
925 ELIZABETH FPD
926 ENGLEWOOD DEPT OF SAFETY SERVICES
927 EVERGREEN VFD
928 FAIRMOUNT FD
929 FEDERAL HEIGHTS FIRE DEPT
930 FOOTHILLS FIRE & RESCUE
931 FOUR MILE FPD
932 FRANKTOWN FPD
933 GENESEE FD
934 GLENDALE FD
935 GOLD HILL FPD
938 GOLDEN FD
937 GOLDEN GATE VFD
938 HEALTH ONE AIR LIFE
939 HIGHLAND RESCUE TEAM
940 HYGIENE VFPD
941 INDIAN HILLS FD
942 INDIAN PEAKS FPD
943 INTER-CANYON FD
944 JAMESTOWN FD
945 LAFAYETTE FD
946 LITTLETON FD
947 LONGMONT FD
948 LOUISVILLE FPD
949 LYONS FPD
950 MTN VIEW FPD
951 NEDERLAND FPD
952 NORTH METRO FIRE RESCUE DISTRICT
953 NORTH WASHINGTON FPD
954 PARKER FPD
955 PINEWOOD SPRINGS FPD
956 PLEASANT VIEW FD
957 RATTLESNAKE FPD
958 ROCKY FLATS FD
959 ROCKY MTN ARSENAL FD
960 SHERIDAN FD
961 SKYLINE FPD
962 SOUTH ADAMS COUNTY FD
963 SOUTH METRO FIRE RESCUE
964 SOUTHWEST ADAMS COUNTY FD
965 SUGAR LOAF FPD
966 THORNTON FD
967 WEST DOUGLAS COUNTY FPD
968 WEST METRO FPD
969 WESTMINSTER FD
970 WHEAT RIDGE FD
999 No Fire On Scene

BILLINGS, MT
350 BIG HORN CO AMB
351 BILLINGS FD
352 BILLINGS PD
353 BLUE CREEK FD
354 BRIDGER AMB
355 BROADVIEW FR
356 BUREAU INDIAN AFFAIRS
357 CUSTER FR
358 HELP FLIGHT 1
359 JOLIET AMB
360 LAUREL AMB
361 LAUREL FD
362 LAUREL PD
363 LOCKWOOD FIRE
364 MONTANY HP
365 PARK CITY AMB
366 SHEPHERD FD
367 WORDEN AMB
368 WORDEN FD
369 YELLOWSTONE CO SD
399 Other Montana First Responder

BOZEMAN, MT
650 AMSTERDAM FD
651 BELGRADE FD
652 BELGRADE PD
653 BIG SKY FD AMB
654 BIG SKY SKI PATROL
655 BOZEMAN FD
656 BOZEMAN PD
657 BRIDGER BOWL
658 BRIDGER CANYON FD
659 DETENTION CENTER
660 FORT ELLIS FD
661 GALLATIN GATEWAY FD
662 GALLATIN CO SD
663 MANHATTAN FD
664 MOONLIGHT BASIN
665 RAE FD
666 SOURDOUGH FD
667 THREE FORKS FD AMB
668 W YELLOWSTONE FD AMB
669 W YELLOWSTONE PD
670 YELLOWSTONE CLUB
699 Other Montana First Responder

FACILITY CODES

ALL STATES
99 Any Other Destination Not Listed
1 Patient Residence
2 Skilled/Extended Care Facility
3 Mental/Psych Facility
4 Specialty Care Facility
5 Physician's Office
6 Dialysis Center
7 Radiation Center

CHEYENNE, WY
10 ALCOHOL RECEIVING CENTER
11 ASPEN WIND ASSISTED LIVING
12 CHEYENNE HEALTHCARE
13 CHEYENNE RADIOLOGY AND MRI
14 CLEO WALLACE CENTER
15 IVINSON MEMORIAL
16 LIFE CARE CENTER CHEYENNE
17 MOUNTAIN TOWERS NURSING HOME
18 MT CREST MENTAL HEALTH
19 NO COLORADO MEDICAL CENTER
20 POINTE FRONTIER ASSISTED LIVING
21 POUDRE VALLEY HOSPITAL
22 SIERRA HILLS ASSISTED LIVING
23 SOUTHEAST WYOMING DIALYSIS CENTER
24 TORRINGTON HOSPITAL
25 UNITED MEDICAL CENTER EAST
26 UNITED MEDICAL CENTER WEST
27 VA HOSPITAL CHEYENNE

COLORADO (CANON CITY, PUEBLO, DENVER)
30 ARKANSAS VALLEY REGIONAL
31 AVISTA MEDICAL CENTER
32 BOULDER COMMUNITY HOSPITAL
33 CEDAR SPRINGS BEHAVIORAL HEALTH
34 CENTENNIAL MEDICAL PLAZA
35 CHILDRENS HOSPITAL DENVER
36 CO SPRINGS REHAB
37 COLORADO MENTAL HEALTH INSTITUTE
38 CONEJOS COUNTY HOSPITAL
39 CRAIG HOSPITAL ENGELWOOD
40 DENVER HEALTH
41 DENVER VA HOSPITALS
42 EVANS ARMY COMMUNITY
43 FOOTHILLS MEDICAL CENTER
40 HEART OF THE ROCKIES REGIONAL
42 LANGSTAFF BROWN ER CENTER
43 LITTLETON ADVENTIST HOSPITAL
44 LONGMONT UNITED HOSPITAL
45 LUTHERAN MEDICAL CENTER
46 MEDICAL CENTER OF AURORA
47 MCKEE MEDICAL CENTER
48 MEMORIAL HOSPITAL
49 MOUNT SAN RAFAEL HOSPITAL
50 NATIONAL JEWISH MED CENTER
51 NORTHERN COLORADO MED CENTER
52 NORTH SUBURBAN MEDICAL CENTER
53 OTHER NON LISTED DENVER
54 PARKER ADVENTIST HOSPITAL
55 PARKVIEW MED CENTER
56 PENROSE COMMUNITY HOSPITAL
57 PENROSE MAIN HOSPITAL
58 PIKES PEAK REGIONAL CENTER
59 PLATTE VALLEY MEDICAL CENTER
60 PORTER ADVENTIST HOSPITAL
61 POUDRE VALLEY HOSPITAL
62 PRESBYTERIAN ST LUKES HOSPITAL
63 PROMERIS MEDICOM, CENTER
64 ROSE MEDICAL CENTER
65 SAN LUIS VALLEY REGIONAL
66 SAN LUIS VALLEY HOSPITAL
67 SKYRIDGE MEDICAL CENTER
68 SPANISH PEAKS REGIONAL
69 ST ANTHONYS HOSPITAL CENTRAL
70 ST ANTHONYS HOSPITAL NORTH
71 ST JOSEPHS HOSPITAL DENVER
72 ST MARY CORWIN MEDICAL CENTER
73 ST THOMAS MORE
74 SWEDISH MEDICAL CENTER
75 UNIVERSITY HOSPITAL DENVER
76 USAF ACADEMY HOSPITAL
77 VAIL VALLEY MEDICAL CENTER
78 VA HOSPITAL

INDEPENDENCE, MO
120 BAPTIST MEDICAL CENTER
158 CENTERPOINT MED CENTER
121 CHILDREN'S MERCY HOSPITAL
122 CHILDRENS MERCY HOSPITAL SOUTH
123 COLUMBIA REGIONAL MED CENTER
124 COLUMBIA VA
125 CUSHINGS MED CENTER
127 KANSAS CITY VA
128 KANSAS UNIV MED CTR
129 KINDRED HOSPITAL
130 LAFAYETTE REGIONAL MEMORIAL
131 LAWRENCE MEMORIAL
132 LEAVENWORTH VA
133 LEES SUMMIT
134 LIBERTY
136 MENORAH MED CENTER
137 MID-AMERICA REHAB
138 NORTH KANSAS CITY HOSPITAL
139 OLATHE MED CENTER
140 OVERLAND PARK REGIONAL MED CENTER
141 PROVIDENCE MED CENTER
142 RESEARCH MED CENTER
143 RESEARCH PSYCHIATRIC HOSPITAL
144 SELECT SPECIALTY HOSPITAL
145 SHAWNEE MISSION MED CENTER
146 SPECIALTY HOSPITAL OF MID-AMERICA
147 ST JOSEPH MED CENTER
148 ST LUKES BARRY RD
157 ST LUKES EAST
149 ST LUKES PLAZA
150 ST LUKES SMITHVILLE
151 ST LUKES SOUTH
152 ST MARYS OF BLUE SPRINGS
153 TRUMAN MED CENTER HILL
154 TRUMAN MED CENTER LAKEWOOD
155 TWO RIVERS PSYCH. HOSPITAL

IOWA
160 11TH STREET CHAUTAUQUA
161 9TH STREET CHAUTAUQUA
162 ACKLEY MED CTR
163 ALLEN MEMORIAL
164 CHARLES CITY FAMILY HEALTH
165 CHARLES CITY FAMILY PRACTICE
166 COVENANCE MED CENTER
167 ELDORA NURSING & REHAB
168 ELLSWORTH MUNICIPAL
169 FLOYD COUNTY MEMORIAL HOSPITAL
170 FRANKLIN GENERAL
171 HAMPTON HEALTH CARE CTR
172 HERITAGE CARE CTR
173 HOSPICE OF NORTH IOWA
174 HUBBARD CARE CENTER
175 IOWA FALLS CLINIC
176 IOWA FALLS DIALYSIS
177 IOWA LUTHERAN
178 IOWA METHODIST MED CTR
179 KIMM FAMILY PRACTICE
180 LIEBE CARE CENTER
181 MARY GREELEY MED CTR
182 MCFARLAND CLINIC HUBBARD
183 MCFARLAND CLINIC IOWA FALLS
184 MERCY DIALYSIS CENTER
185 MERCY MED CTR
186 MERCY MED CTR NORTHERN IOWA
187 MITCHELL COUNTY REGIONAL HEALTH
188 MTWN MEDICAL & SURGICAL CENTER
189 NORA SPRINGS CARE CENTER
190 PRESBYTERIAN VILLAGE
191 SALSBURY BAPTIST HOME
192 SCENIC MANOR CARE CTR
193 ST MARYS HOSPITAL
194 UNIVERSITY OF IOWA HOSP & CLINIC
195 VA HOSPITAL
196 VA HOSPITAL (CENTRAL 1A HEALTH CARE)
197 VALLEY VIEW NURSING & REHAB

KANSAS
250 ALLEN COUNTY HOSP
251 ANDERSON CNTY HOSP
200 BAPTIST MEDICAL CENTER
253 BATES COUNTY MO HOSP
158 CENTERPOINT MED CENTER
201 CHILDREN'S MERCY HOSPITAL
202 CHILDRENS MERCY HOSPITAL SOUTH
203 COLUMBIA REGIONAL MED CENTER
204 COLUMBIA VA
205 CUSHINGS MED CENTER
207 IRWIN ARMY HOSPITAL
208 JEFFERSON BARRACKS ST LOUIS
209 KANSAS CITY VA
210 KANSAS NEUROLOGICAL INSTITUTE
211 KANSAS REHABILITATION HOSPITAL
212 KANSAS UNIV MED CTR
213 KINDRED HOSPITAL
214 LAFAYETTE REGIONAL MEMORIAL
215 LAWRENCE MEMORIAL
216 LEAVENWORTH VA
217 LEES SUMMIT
218 LIBERTY
220 MENORAH MED CENTER
249 MERCY HOSP ST SCOTT
221 MIAMI COUNTY MED CENTER
222 MID-AMERICA REHAB
223 NEWMAN MEMORIAL
224 NORTH KANSAS CITY HOSPITAL
225 OLATHE MED CENTER
226 ONAGA HOSPITAL
227 OVERLAND PARK REGIONAL MED CENTER
228 PROVIDENCE MED CENTER
229 RAINBOW MENTAL HEALTH
230 RANSOM MEMORIAL
231 RESEARCH MED CENTER
232 RESEARCH PSYCHIATRIC HOSPITAL
233 SELECT SPECIALTY HOSPITAL
234 SHAWNEE MISSION MED CENTER
252 SHAWNEE MISSION MED CTR WEST
235 SPECIALTY HOSPITAL OF MID-AMERICA
236 ST FRANCIS HOSPITAL
237 ST JOSEPH MED CENTER
238 ST LUKES BARRY RD
157 ST LUKES EAST
239 ST LUKES PLAZA
240 ST LUKES SMITHVILLE
241 ST LUKES SOUTH
242 ST MARYS OF BLUE SPRINGS
243 STORMANT VAIL WEST
244 STORMONT VAIL HOSPITAL
245 TOPEKA VA
246 TRUMAN MED CENTER HILL
247 TRUMAN MED CENTER LAKEWOOD
248 TWO RIVERS PSYCH. HOSPITAL

MONTANA
302 BILLINGS HEALTH REHAB
303 BILLINGS MRI
305 BOZEMAN DEACONESS HOSP
306 CANCER CENTER
307 CHURCHILL RETIREMENT HOME
330 COMMUNITY CRISIS CENTER
308 DEACONESS FLIGHT DISPATCH
309 DEACONESS BILLINGS CLINIC
310 EAGLE CLIFF MANOR
311 EVERGREEN CARE CENTER
312 EVERGREEN LAUREL
313 EVERGREEN LOCKWOOD
314 GALLATIN COUNTY FAIR
315 GALLATIN REST HOME
316 HAMILTON HOUSE
317 HELENA ST PETERS HOSP
318 HIGHGATE ASST LIVING
319 HILLCREST ASPEN POINT
320 HILLCREST BIRCHWOOD
321 MONTANA STATE UNIV
322 MT VIEW CARE CENTER
323 PARKVIEW CON CENTER
324 SPRING MEADOWS ASST LIVING
325 ST JOHNS LUTHERAN
326 ST VINCENTS HEALTHCARE
327 ST VINCENTS LIFE FLIGHT
328 VALLEY ICE GARDENS
329 VALLEY NH

REVISED TRAUMA SCORE

Systolic Blood Pressure	Value	Score
>=90	4	
76 - 90	3	
50 - 75	2	
1 - 49	1	
0	0	____
Respiratory Rate	**Value**	
10 - 29	4	
>=30	3	
6 - 9	2	
1 - 5	1	
0	0	____
Glasgow Coma Scale	**Value**	
13 - 15	4	
9 - 12	3	
6 - 8	2	
4 - 5	1	
3	0	____
Total Score (From 0 - 12)		____

Pupil Gauge (in mm)

2 3 4 5 6 7 8 9

APGAR SCORING CHART

	0 POINTS	1 POINT	2 POINTS
HEART RATE	ABSENT	<100	>100
RESPIRATORY EFFORT	ABSENT CRY	WEAK CRY	STRONG CRY
MUSCLE TONE	FLACCID	SOME FLEXION	ACTIVE MOTION
REFLEX IRRITABILITY (STIMULATE FEET)	NO RESPONSE	SOME MOTION	VIGOROUS CRY
COLOR	BLUE PALE	BODY: PINK EXT: BLUE	FULLY PINK

GLASGOW COMA SCORE

INFANT	EYE OPENING	ADULT
4	SPONTANEOUSLY	4
3	TO SPEECH	3
2	TO PAIN	2
1	NO RESPONSE	1
	BEST VERBAL RESPONSE	
5	COOS, BABBLES	5
4	IRRITABLE CRIES	4
3	CRIES TO PAIN	3
2	MOANS, GRUNTS	2
1	NO RESPONSE	1
	BEST MOTOR RESPONSE	
6	SPONTANEOUSLY	6
5	LOCALIZES PAIN	5
4	WITHDRAWS FROM PAIN	4
3	FLEXION (Decorticate)	3
2	EXTENSION (Decerebrate)	2
1	NO RESPONSE	1

ORIENTED	5
CONFUSED	4
INAPPROPRIATE WORDS	3
INCOMPREHENSIBLE	2
NO RESPONSE	1
OBEYS COMMANDS	6
LOCALIZES PAIN	5
WITHDRAWS FROM PAIN	4
FLEXION (Decorticate)	3
EXTENSION (Decerebrate)	2
NO RESPONSE	1

CARDIAC	
A-Fib	42731
A-Flutter	42732
Abnormal EKG	79431
Angina Pectoris	413
AV Block	42610
Bradycardia	42781
Bundle Branch Block	42650
Cardiac Arrest	427.5
CHF	4280
Myocardial Infarction	4109
PSVT	4270
PVCs	42769
Tachycardia	7850
V-Tach	4271

ILLNESS	
Abdominal Aortic Aneurism	4414
Allergic Reaction	9952
Appendicitis	5409
Arthritis	7169
Bowel Obstruction	56090
Calculus (Kidney Stones)	5920
Cancer (Neoplasm)	
Benign	2399
Malignant	1991
Deep Vein Thrombosis	4538
Dehydration/Hypovolemia	2765
Diabetes	2509
Diabetic Ketoacidosis	2501
Hypoglycemia	2512
CVA	43600
Food Poisoning	005.9
Flu / Influenza	487.1
Gallbladder	5759
GI Bleed	5789
Hernia	5539
Hypertension	4019
Migraine	3469
Obesity	2780
Paraplegia	3441
Quadriplegia	34400
Renal Failure	5849
Seizure (Grand Mal)	345.1
Febrile	780.31
Status (Grand Mal)	345.1
Septic Shock	78559
TIA	435.9
Ulcer, Gastric	5319
Urinary Tract Infection (UTI)	5990

DISEASE PROCESSES	
Alzheimer's Disease	3310
CHF	4280
Cerebral Palsy	3439
Cirrhosis	5715
COPD	496
Emphysema	4928
Epilepsy	3459
Hepatitis	5733
HIV	042
Leukemia	2089
Meningitis	3229
Mental Retardation	319
Multiple Sclerosis	340
Organic Brain Syndrome	2949
Parkinson's Disease	332
Senile Dementia	290
SIDS	7980
Tuberculosis	010
Osteoporosis	7330

ENVIRONMENTAL	
Altitude Sickness	99320
CO Poisoning	986
Drowning/Near Drowning	9941
Electrocution	99480
Frostbite	99130
Heat Stroke	9920
Heat Exhaustion	99250
Hypothermia	9916
Lightning Shock	9940
Venomous Bite/Sting	98950

PSYCH	
Depression	2962
Emotional Distress, Anxiety	30000
Hallucination (Auditory)	7801
Hallucination (Visual)	36816
Paranoid	29790
Phobia Disorder	30020
Psychosis	29890
Schizophrenia	2959
Suicidal Tendencies / Risk	3009

TRAUMA	
Concussion without L.O.C.	8500
Concussion with L.O.C.	8505
Hanging & Strangulation	9947
Shock, Traumatic	9584
Pneumohemothorax, Traumatic	8604

RESPIRATORY	
Anaphylactic Shock	
Stings	98950
Drugs	99520
Arrest, Respiratory	799.1
Aspiration/Choking	934.9
Asthma	493.9
Asthma Attack	49390
Status Asthmaticus	49391
Bronchitis	4660
Choking, Foreign Body	9351
COPD	496
Croup	464.4
Difficulty/Distress	78609
Embolism (Pulmonary)	4151
Epiglotitis	46430
Hyperventilation	78601
Inhalation Injury (Smoke)	9879
Pleurisy	5119
Pneumonia	486
Pneumothorax	512
Pulmonary Edema	518.4
Respiratory Failure	51882
Stridor	7861
Suffocation, Asphyxiation	7990

OB/GYN	
Abortion (Spontaneous)	634
Abruptio Placenta	641.2
Active Labor / Cramping	6599
Breech Presentation	65220
Complications of L/D	66990
Ectopic Pregnancy	633.9
Early/Threatened Labor	644
Hemorrhage (early in preg)	6409
Hemorrhage (postpartum)	6661
P.I.D.	6149
Pre-eclampsia	642.4
Prolapsed Cord	663.0
Placenta Previa	6411
Uncomplicated Delivery	650
Vaginal Bleeding (abnormal)	626.6

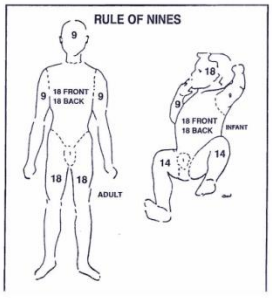
SIGNS & SYMPTOMS	
Altered Mentation	78009
Aphasia	7843
Cough	7862
Constipation	5640
Cyanosis	7825
Diarrhea	787.91
Diaphoretic	7808
Dizziness	7804
Dysphagia	7872
Dysphasia	7845
Dysuria	7881
Edema	7823
Epistaxis	78470
Fever	780.6
Headache	7840
Hematemesis	5780
Hematuria	5997
Hemiplegia	3429
Hemoptysis	7863
Hypotension	458.9
Hypertension	4019
Incontinence	
Feces	787.6
Urine	788.30
Jaundice	782.4
Nausea	78702
Melena (tarry stools)	5781
Muscle Spasm	72885
Pallor	78261
Polyuria	7884
Rash	70890
Syncope	7802
Tremors	7810
Unconscious	700.09
Vertigo	7804
Visual Disturbance	3689
Vomiting	78700
Weakness (Generalized)	7807

SUBSTANCE RELATED	
Alcohol Withdrawal (DT's)	2910
Inhalation (Fumes, Vapors)	9879
Intoxication	3030
Drug Abuse	3049
Drug Withdrawal	2920
Hallucination	
Alcohol Induced	2913
Drug Induced	29212
Overdose	9779

	Contusion	Injury	Wound	Dislocation Closed / Open	Fracture Closed / Open	Amputation	Burn	Atraumatic Pain
Abdomen	9222	9591	8792	Evisc: 86810			94203	78900
Ankle	92421	9597	8910	8570 / 8571	82480 / 82490	89610	94503	71947
Arm (Humerus)	92303	9592	88003	839.8 / 839.9	81220 / 81212	88730	94303	72950
Back (Thoracic)	92231	9591	8760	839.8 / 839.9	8052 / 8053		94204	72410
Back (Lumbar)	92231	9591	8760		8054 / 8055		94204	71450
Back (Sacrum/Coccyx)	92231	9591	8760		8056 / 8057		94204	7242
Breast	9220	9591	8790	83961 / 83971			94201	61171
Buttock	922.2	92612	8770				94204	
Chest (Wall)	9221	9591	8750		Plail 80740		94202	78650
Chest (Substernal)		8628	8629					78659
Clavicle				83104 / 83119	81000 / 81010			
Ear	920	95909	87200	38633			94101	38870
Elbow	92311	8418	88101	8320 / 8321	81240 / 81250	8872	94302	71942
Eye	9219	9213	8719	36081			9409	37991
Face	920	95909	87340		8028 / 8029		941	78400
Femur (Thigh)	920	8439	8900		82100 / 82110	8974	94306	72950
Fingers	9233	84210	8830	8340 / 8341	86100 / 81610	88510	94401	72950
Foot	92420	84510	8920	83800 / 83810	82520 / 82530	8960	94302	729.5
Forearm	92310	8419	88100	8398 / 8399	81380 / 81390	8870	94301	7295
Forehead	920	9520	87342				94107	78400
Groin	9222	9591	8794				94203	7890
Hand	92320	95940	8820	8398 / 8399	8208	8870	94400	72950
Head (Intracranial)	920	8540	8540	8541	8030 / 8035	8749	94100	7840
Head (Scalp)	920	900.9	8730				94106	7840
Heart	861.01	861.00	8610					78651
Hip	924.01	8439	8900	8350 / 8351	8208 / 8209	8972		71945
Jaw	920	8481	87344	8030 / 8031	80220 / 8023		94104	5269
Knee	92411	8449	8910	83650 / 83660	82200 / 82210	8972	94505	71946
Leg	94210	8449	8910	8398 / 8399	8238 / 8239	8970	945	72950
Lip	920	95909	87343				94103	52890
Lung	86121	86120	86130				9471	78652
Neck	920	8470	8568	83900	8050 / 8051		94108	72310
Nose	920	8480	87320	83969 / 83939	8020 / 8021		94105	47810
Pelvis		8485		83969 / 83939	8088 / 8089			47810
Penis	9224	9260	8780			8780	94305	6079
Rectum/Anus	9229	86345	86355					56942
Rib	9221			83969 / 83939	80100 / 80710			78650
Scapula	92301	912	88001	83109 / 83119	81100 / 81110		94306	
Shoulder	92300	8409	88000	8310 / 8311			94305	71941
Testicles / Scrotum	9224	9260	8782			8782	94505	6089
Throat	920	910					9470	78410
Thumb	9233	84210	8830	8340 / 8341	81600 / 81610	88610	94402	7295
Toe	9243	84510	8930	83809 / 83919	8260 / 8261	89510	94501	7295
Tongue	920	910	87364				9470	5296
Tooth		521.2	783.63		87363			5259
Vulva	9224	9260	8786				94205	6259
Wrist	92321	84200	88102	8330 / 8331	81400 / 81410		94407	7295

Rev. 1/99 MHA

Hospital	E.R. Phone	Bio-Phone Rec.	Fax
Air Force Academy	719-472-5000	719-472-5000	719-472-5237
Aurora No. Campus	303-360-3133	303-360-3200	303-360-3190
Aurora So. Campus	303-695-2628	303-695-2946	303-750-9438
Avista	303-673-1111		303-673-1122
Billings Deaconess	406-657-4150		406-652-4349
Billings St. Vincent	406-657-7067		406-657-8867
Boulder Comm	303-440-2037		303-440-2480
Bozeman Deaconess	406-585-1000		
Cheyenne VA	307-778-7550		
Childrens	303-861-6888		303-837-2990
Colo M. Health Inst	719-546-4406		
Community Hospital	970-256-6404		
Denver Health	303-436-6310	303-436-6307	303-436-6859
Evans Army Hosp.	719-526-7111	719-526-4111	719-526-7043
Kaiser ECC	303-831-6795	303-831-6795	303-831-6734
Littleton	303-733-2665		303-730-5868
Longmont United	303-651-5000		303-651-5491
Lutheran	303-425-2089	303-425-2640	303-425-2838
McGee Med. Ctr.	970-635-4071		303-635-4109
Memorial Hosp.	719-365-5221	719-365-6748	719-365-6877
North Suburban	303-450-4482		303-450-4595
Northern Colo.	303-330-6244		303-350-6274
Parkview Hosp.	719-584-4400	719-584-4435	719-584-4803
Penrose Comm.	719-776-3216		719-776-3187
Penrose Main	719-776-5333		719-776-5651
Porter Care	303-785-5777		303-788-5787
PSL	303-839-7111		303-839-7991
PSL Cent.	303-699-3060		303-699-3183
Rapid City Regional	605-341-8222		
Rose	303-320-2455		303-320-2084
Souix San Hosp.	605-342-1900		
St. Anthony Cent	303-629-3721		303-595-6189
St. Anthony No.	303-426-2020		303-426-2493
St. Joseph	303-837-7240		303-837-7107
St. Mary-Corwin	719-560-5656	719-560-5275	719-560-4715
St. Mary's	970-240-2551		
St. Thomas Moore	719-269-2270		
Swedish	303-788-6911	303-761-8721	303-788-5076
United Medical	307-633-7670		
University	303-312-8941	303-399-1211	303-372-8941
VA Medical Center	303-242-0731		



APPENDIX C

VERBAL TRANSCRIPT FROM FOCUS GROUP DISCUSSION

Opening Script

Please think about the last time you were providing emergency care in the rear patient compartment of the ambulance. What types of procedures are most affected by severe braking or steering events?

IV sticks intubation number 1, even just reading EKGs can cause artifacts and you can't get a clean read on it.

Yeah, same thing as just driving on a bumpy road, you're not going to be able to read it either.

I'd say IVs and intubation are the most common.

What kind of communication exists between you and the driver to warn of upcoming road conditions?

He yells.. [laughing]

Every once in a while there's a "hold on"

Or "bump!"

Most times it's a "sorry"

No really, it's hard, I had an ambulance call and I was driving and there was something important I had to say to her [the medic] that I gleaned from the patient's relative sitting next to me, going to the hospital. And the patient was elderly, and I hadn't communicated some things to the paramedic. And I had to communicate that to her, and I couldn't get her attention. So I mean instead of waving and screaming through the hole, boy if we had a PA system or something that would help a lot.

Or an intercom.

Or these ambulances, have a door, we have that door, which makes it easy for the person in the rear to talk to the person in the front, but, you can't open it while you're driving –

They don't all have that door –

And I mean, 6 [ambulance 6] has that little porthole.

-Yeah, and I mean plus if you just open that door and leave it open there's no locking point for the door, so its smacks around and it'll usually end up shutting anyway.

We usually have stuff on the door too.

Yeah and it –

-Yeah, projectiles.

I've been in ambulances where the door opens and then has it locking open position, which is awesome. Of course then you have a big hole that you can yell back and forth at each other. But then, you have this little slide window, sometimes you turn and then the slide window shuts, and you can't hear.

It's funny, because this just happened yesterday with this one patient. And it was imperative, like, really important information that I couldn't relay to my medic in the back. And it might have changed; we might have done some interventions sooner.

Please think about the last time you were providing emergency care in the rear patient compartment of the ambulance and lights and sirens were used during the transport:

Whose decision is it to initiate emergency response mode?

The person in the back

The care provider

I guess there are some situations where you're you know cardiac arrest and they're doing CPR, and you get in the ambulance and you already know. It's a given.

Yeah, there's some givens. Definitely, that you don't have to communicate lights and sirens, it's just a given.

Yeah sometimes just automatically code 3.

Yeah I'd say also, its rare, but there are some circumstances where the amount of traffic is big enough that its worthwhile to turn on lights and sirens for a brief period.

In that case, the driver makes that decision. That's normally just a brief period, not the entire call. Like if there's some jam up or another accident that they need to get around, the driver will decide "ok, we're probably going to light up to get around this," go code 3, then go back down.

What else can influence the initiation of emergency mode?

Certain road conditions can influence us to <u>not</u> go L&S.

Right

Like if its icy we're probably not going to go code 3. Because it's going to make everybody else freak out, and we're going to have crashes.

If it's really poor and the weathers really bad, we're probably not going to do it.

Like if we're going up Gallatin canyon, it can be more dangerous to try to have people pull over.

Yeah! Because you come around that corner, then everybody else is like "what do I do" and then stutter step, or go off the road.

Please think about the last time you were providing emergency care in the rear patient compartment of the ambulance providing emergency care. How often are you able to be belted during a patient transport?

Able? Or are belted?

That's a good point..

I'm not belted very often.

I would say the ideal situation for a seatbelt would be a non-emergent transfer, because 75% of the time the patient needs very minimal care, basically just check vitals, so it's not a lot of moving around. That would probably be the best case scenario

We've done some really long trips and we didn't buckle either.

Yeah, I always seem to just wedge myself somewhere [meaning between the stretcher and bench seat].

What influences your choice to not be restrained?

I guess the procedures that I'm doing

Yeah, severity of the patient.

In all reality, too, if the ambulance does roll, there's not a roll cage back there. So you're going to be dead, whether you have a seatbelt on or not.

What else can influence the use of restraint devices?

The procedures I'm trying to do. Whether it be putting the monitor on or back.

I mean realistically, if we crash, being in the back of the ambulance, we're going to be dead.

What was it that guy said? Any crash over 30 mph is probably going to involve fatalities?

And thinking about it that way. In that aspect, if it's my choice, I'd rather be dead than just maimed. Or paralyzed, I don't know. That's just my personal thought.

When I was in [city] we had a crew that got hit by a semi truck and basically all the cabinets on the driver's side of the ambulance, there was nothing there. Barely missed the patient's gurney, and it just folded the cabinets around the medic who was sitting in the jump seat, the rear facing seat. That's the reason he's alive, is because he was sitting in that seat, and it wrapped around him, got cocooned around him, and the patient was fine. Had a vertebral fracture, but was fine.

Please think about the last time you were providing emergency care in the rear patient compartment of the ambulance providing emergency care. What equipment is the easiest to access?

Anything on the bench.

The monitor? The monitor is probably the easiest one and that's about it. Unless we sometimes have life pack sometimes. In the big black bag

But that's usually harder to get to, because that's in front and you're trying to get to it.

Sometimes it's on the bench but it's at the feet and then it's easier to reach for. And then if you hit a corner its probably on the patient at that point.

Yeah, you basically have to unbelt to get to that bag.

What equipment is the most difficult to access?

Airway stuff. Because that's all in the front. All of your intubation equipment and airway supplies. Suction, onboard O2.

Yeah that's bad in the vans; you pretty much have to move the patient to get to it.

What equipment is most frequently accessed?

IVs, oxygen, IV meds, O2 administration. It's basically at the patient's hips, second cabinet up [straight across from bench seat].

And oxygen normally, in the van it's in the rear – Above the rear door. The type III's, the O2 is up and to the left. Top left corner. They're all different.

Do you currently do anything to work around equipment retrieval during transport?

Put some stuff on the bench?

Maybe. Once in a while.

Occasionally you'll grab the IV box and put it on the bench before you start rolling, or spike the IV before you roll –

Yeah, get your IV spike and bag setup on the bench so you can get access to it.

Yeah like 80% of the time I start my IV before we roll.

Suppose you were able to localize frequently used equipment safely to your body, in a vest or belt. Would you use this?

Like a bat belt?

Utility belt?

I think it would be handy, but it would get in the way more than not.

Stuff would get smashed.

What equipment would you include?

IV supplies, just like a basic setup kit. Maybe your most common medications (Benadryl, etc) the little ones, that take forever to find.

So your main reason for not wearing, would be that it is too big, or bulky, or unwieldy?

Cumbersome, and -

Probably more uncomfortable too. Maybe in a higher call volume area would benefit? You know, because you're constantly moving and doing things. Here, we can do a decent amount of hours, not doing anything. Like I'd probably forget it and not take it. I'd probably take it off, put it on the couch next to me and forget about it.

What about [name]? [Name] started putting stuff in an emesis basin on the bench before starts.

Oh? [Name] does that too.

Yeah, they started working together.

In [old city they worked at] we had these little bins that we kept, you know, in that little gap in the back of the bench seat. We had little bins that fit right down there so it didn't interfere if you

were sitting on it, or if you had to strap a patient on it. All your IV needles, commonly used stuff was sitting right there. That way we didn't have to get into the cabinets to get stuff out.

Yeah that might be like an option or having something out so the bench seat has a pad here and a pad here, what about –

Oh yeah, use the section in between!

Or, a drop down thing, that'd be cool

I've been in an ambulance that had a pull out cabinet, that'd be cool. They do have them out there.

Think about where you currently hang IV bags. What location is most convenient to use while providing care for the majority of patients?

The jump seat.

There, just to the back, by

The CPR seat?

Straight above the patient.

It keeps the tubing out of your way

If you have to move up and down that channel, between the patient and the bench seat, there's no tube you have to cross, trip over, rip out, or go underneath.

A cabinet on the ceiling would be kind of cool, like a drop down where you could keep all your stuff.

Yeah until the latch fails and you hit a bump and it SMACKS you in the head.

Yeah! Imagine by the time WE [emphasizing that AMR Bozeman gets used equipment] get the ambulance, it'd probably be completely shot –

200,000 miles later.

All the latches completely busted.

Think about the panel in the rear patient compartment which contains light/air controls, and oxygen controls. What on this panel do you access most frequently?

In the Action Area?

Here? Lights, the main 02, suction, and that's it. There's other switches but I don't really know what they do?

Lights, dim, hot/cold, exhaust, fan most of the time.

If this panel was relocated or duplicated, where would you place it?

Right by the bench?

No, I'd probably hit it with my elbow or something.

You know how those Type III's have the oxygen tree right there next to the bench seat?

Yeah.

Yeah but those are

Those are beneficial when you have 2 patients. Then you can have the guy that's on the bench, and have the 02 right there.

They're also beneficial when you have a couple plugs. Plug one in and – and I did a nebulizer on one side, and the CPAP on other.

I don't know if I'd want the switches somewhere else, unless they get in the way.

Maybe the Heat/AC and lights over there [rear wall of ambulance]

Suction you got to reach over there anyway

Suction you got to reach over to grab your suction anyway

Maybe over by the medic catcher? By the net? They got that light switch sometimes, like on 6, that would be a good spot to have an extra set of stuff like right there.

What about toward the back where we have that little twist-

Or towards the back, because then you could turn the heat on like if you know it's going to be cold you can turn the heat on and go get your patient, you don't have to crawl in and turn it on.

Exactly, that'd be an excellent place for it.

Would you use the panel if it was located nearer to a seat where you traditionally provide patient care?

Yeah, probably a lot. Yeah, lights and heater, that'd be great.

I would duplicate it. Yeah if we had it in both spots. I would duplicate instead of just moving it. If it's like a LDT, long distance trip, I sit in that rear-facing seat more often than not. It's the safest.

Where the cabinets wrap around you instead of on top of you [in the event of a wreck]. Yeah plus mostly your accidents are front on or head end so you have a big seat behind you, you have the big seat behind you, you have support as opposed to sitting perpendicular to the road and then a lot more spinal injury to get whipped forward like that. So I would duplicate it [the control panel]

Now thinking in general about different ideas for changing ambulance storage layouts, like if you were to move equipment to a different place, what characteristics would be important in regards to that? What would you move, and why?

I really like the ambulances, and its already done in a lot of them, that have the fold down child seat in the rear facing seat. It's got a panel that you basically pull down, with arm straps, waist straps, and a harness. That's really nice instead of an inflatable harness.

You would like to see that introduced to the ambulances?

Yeah, I mean they have them at the Yellowstone club, their ambulances, but these don't. It's just nice, you know, when you need it.

You don't have to track down the kids' seat, have the mom go get it out of their car, or try to inflate ours [imitate heavy breathing].

That's all you would move?

The emesis basin. That's something that comes up that you need really quick.

You know what'd be nice? You know how we have that medic catcher cargo net? What if we had, not a cabinet, but you know how they have those over-the-door shoe hangers? Something like that where you can stuff multiple pockets you can stuff stuff in, right there where you can grab. That would be great for oxygen, or IV supplies, have one bag sitting there for IV fluid,

We could do that, that would be easy.

That would be perfect, really easy to get set up.

Yeah, grab an alcohol swab, grab a set of needles,

Yeah, just have a bunch of little clear Velcro pockets. Or fold out picture windows. I think that would be super nice.

Anything else?

Reposition the emesis basin for rapid deployment. Like maybe a drop down puke bag.

Have you seen those bio cups?

With a zip tie on it so it doesn't spill out afterwards? They have a hook you can hook it on their shirt and it just sits there in front of them. That's nice.

Is there any other equipment that you frequently need quickly?

Well its usually unexpected [referring to vomiting]. I mean you're like "la la la" and your patient's like "I'm gonna throw up" and you're like "oh" and you're scrambling and you got to like go open up the door, pull out the emesis basin, get a towel so it doesn't splash everywhere, or pull the extra towels out, and then they're fumbling with it [the basin] because they can't hold it because they're retching, it gets ugly.

Alright. If equipment were relocated, but you could access necessary tools from your preferred seat while providing patient care, would that influence your choice to be restrained?

If I didn't have to move, at all, potentially yes.

The thing is, I mean, I think it would be hard to accomplish to be restrained and be close enough to your patient to provide care, to even be close enough in the ambulance.

So the distance from the patient to the seat is inhibitive toward patient care.

Exactly, and that's enough to-

And you can't really narrow that distance. You'd be tripping on that.

So what if you put the patient, the cot, on like a sliding track. Like pull closer, and lock, and release.

As long as there was a safety stop. Don't want to be going around a corner and crack your shins or break your ankle.

Yeah, that might not be bad. Sometimes I think that even if the patient was sitting a little higher, like more like up to your, like, on a table; you're right here with the patient –

Yeah but then you have your combative patients –

Ha, then you have a hydraulic and you can just push them away! (joking) Like WHACK and it's like padded on the ceiling. Like memory foam.

More serious patients require more EMS workers, so there is less chance to be restrained. A lot of times you have an EMT and a medic in the back, and a Fire guy driving.

So severity of patient illness can impact the number of people that are in the back, and that is something that affects restraint patterns?

Well yeah, and even if you don't have a lot of people back there, and the patient is severe, you're doing stuff the whole time.

How many times would you be willing to have a sit/stand change before you would not engage restraints?

In one call?

I think probably one would be enough.

Like if you could point the heater at the patient

Where is the heater right now?

If you're in the ambulance, it's facing back, above the right passenger side above the blankets. The new ambulances, we don't have it here, have airplane, like you can point them, directional heating. So I can turn them all off over the bench if you're hot, and turn them on the patient. Because you're dressing for the day when you're going to be stuck outside for 30 minutes while they're being cut out of the car and so you're bundled up and you're like –

You're like "how you doing for temperature?" and they're freezing, and you're sweating, and taking off your jacket. That's another thing that would inhibit care if you wore that vest, unless you wore it under your jacket.

You could get a big paramedic patch for your vest!

Do you have any questions, or other comments?

Maybe instead of the patient sliding towards you, your chair slides towards them? Like the bench is on rollers.

I'd probably fall out.

New ones probably have that. We just got a new one and our "new" one has what, 180,000 miles on it? So yeah, I've seen all these new ambulances with their captain's chairs and 5-point restraint systems you can stand up and walk around with.

Aren't there some problems with that on [the bench seat]? Like if you're strapped in and you crash and your body doesn't move but your head does and… and it's too stationary.

Yeah I like the cargo net. Fetal position, end up in the net.

What about the one that doesn't have the cargo net? [laughing]

I wonder how, could you improve the cargo net? Add a little give to it?

Yeah, what about an airbag that fills the entire compartment [joking]

Yeah! Secure foam, like on demolition man.

No really, kind of like those bungees, those nylon webbing bungee things? If the cargo net was made out of that so it had some give, with maybe like a side curtain airbag in cars?

Or even if just certain airbags deployed to keep you from hitting sharp objects.

Yeah, I think that'd be good, as long as they were like all secured, away from the patient, only in certain spots.

CLOSING SCRIPT

APPENDIX D

SAS CODE FOR VIBRATION ANALYSIS

/*Here, I am reading in individual files, separately.*/
/*This is an abbreviated list, following this comment I call in 4 of the 108 files*/

/*Reading data for each file is as follows:*/
/*DATA <what I am calling that data file>;*/
/*INFILE <"filepath"> <define my source file as comma delimted> <Handle missing observations> <First row is title> <Longest record is no greater than 1000 characters>;*/
/*Inupt <Define each parameter as well as how to read it in (character, numeric, decimals, etc)>;*/

```
DATA T_100715_2042;
      INFILE "C:\EMS Naturalistic\Vibration\DAT with medic in
them\XMSU_0000_0000_MS_100715_2042.dat" dlm=',' DSD FIRSTOBS=2 LRECL=1000;
      Input VAR1 systemtime VAR3 :$40. filename :$30. VAR5 VAR6 VAR7 VAR8
VAR9 accelx1 accely1 accelz1 VAR13 VAR14 VAR15 speedHU;
RUN;
DATA T_100808_1339;
      INFILE "C:\EMS Naturalistic\Vibration\DAT with medic in
them\XMSU_0000_0000_MS_100808_1339.dat" dlm=',' DSD FIRSTOBS=2 LRECL=1000;
      Input VAR1 systemtime VAR3 :$40. filename :$30. VAR5 VAR6 VAR7 VAR8
VAR9 accelx1 accely1 accelz1 VAR13 VAR14 VAR15 speedHU;
RUN;
DATA T_100808_2241;
      INFILE "C:\EMS Naturalistic\Vibration\DAT with medic in
them\XMSU_0000_0000_MS_100808_2241.dat" dlm=',' DSD FIRSTOBS=2 LRECL=1000;
      Input VAR1 systemtime VAR3 :$40. filename :$30. VAR5 VAR6 VAR7 VAR8
VAR9 accelx1 accely1 accelz1 VAR13 VAR14 VAR15 speedHU;
RUN;
DATA T_100809_1725;
      INFILE "C:\EMS Naturalistic\Vibration\DAT with medic in
them\XMSU_0000_0000_MS_100809_1725.dat" dlm=',' DSD FIRSTOBS=2 LRECL=1000;
      Input VAR1 systemtime VAR3 :$40. filename :$30. VAR5 VAR6 VAR7 VAR8
VAR9 accelx1 accely1 accelz1 VAR13 VAR14 VAR15 speedHU;
RUN;
DATA T_100809_2046;
      INFILE "C:\EMS Naturalistic\Vibration\DAT with medic in
them\XMSU_0000_0000_MS_100809_2046.dat" dlm=',' DSD FIRSTOBS=2 LRECL=1000;
      Input VAR1 systemtime VAR3 :$40. filename :$30. VAR5 VAR6 VAR7 VAR8
VAR9 accelx1 accely1 accelz1 VAR13 VAR14 VAR15 speedHU;
RUN;
DATA T_100809_2202;
      INFILE "C:\EMS Naturalistic\Vibration\DAT with medic in
them\XMSU_0000_0000_MS_100809_2202.dat" dlm=',' DSD FIRSTOBS=2 LRECL=1000;
      Input VAR1 systemtime VAR3 :$40. filename :$30. VAR5 VAR6 VAR7 VAR8
VAR9 accelx1 accely1 accelz1 VAR13 VAR14 VAR15 speedHU;
RUN;
DATA T_100810_0019;
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      INFILE "C:\EMS Naturalistic\Vibration\DAT with medic in
them\XMSU_0000_0000_MS_100810_0019.dat" dlm=',' DSD FIRSTOBS=2 LRECL=1000;
      Input VAR1 systemtime VAR3 :$40. filename :$30. VAR5 VAR6 VAR7 VAR8
VAR9 accelx1 accely1 accelz1 VAR13 VAR14 VAR15 speedHU;
RUN;
DATA T_100810_1443;
      INFILE "C:\EMS Naturalistic\Vibration\DAT with medic in
them\XMSU_0000_0000_MS_100810_1443.dat" dlm=',' DSD FIRSTOBS=2 LRECL=1000;
      Input VAR1 systemtime VAR3 :$40. filename :$30. VAR5 VAR6 VAR7 VAR8
VAR9 accelx1 accely1 accelz1 VAR13 VAR14 VAR15 speedHU;
RUN;
DATA T_100810_1714;
      INFILE "C:\EMS Naturalistic\Vibration\DAT with medic in
them\XMSU_0000_0000_MS_100810_1714.dat" dlm=',' DSD FIRSTOBS=2 LRECL=1000;
      Input VAR1 systemtime VAR3 :$40. filename :$30. VAR5 VAR6 VAR7 VAR8
VAR9 accelx1 accely1 accelz1 VAR13 VAR14 VAR15 speedHU;
RUN;
DATA T_100811_1414;
      INFILE "C:\EMS Naturalistic\Vibration\DAT with medic in
them\XMSU_0000_0000_MS_100811_1414.dat" dlm=',' DSD FIRSTOBS=2 LRECL=1000;
      Input VAR1 systemtime VAR3 :$40. filename :$30. VAR5 VAR6 VAR7 VAR8
VAR9 accelx1 accely1 accelz1 VAR13 VAR14 VAR15 speedHU;
RUN;
DATA T_100812_0050;
      INFILE "C:\EMS Naturalistic\Vibration\DAT with medic in
them\XMSU_0000_0000_MS_100812_0050.dat" dlm=',' DSD FIRSTOBS=2 LRECL=1000;
      Input VAR1 systemtime VAR3 :$40. filename :$30. VAR5 VAR6 VAR7 VAR8
VAR9 accelx1 accely1 accelz1 VAR13 VAR14 VAR15 speedHU;
RUN;
DATA T_100813_0949;
      INFILE "C:\EMS Naturalistic\Vibration\DAT with medic in
them\XMSU_0000_0000_MS_100813_0949.dat" dlm=',' DSD FIRSTOBS=2 LRECL=1000;
      Input VAR1 systemtime VAR3 :$40. filename :$30. VAR5 VAR6 VAR7 VAR8
VAR9 accelx1 accely1 accelz1 VAR13 VAR14 VAR15 speedHU;
RUN;
DATA T_100813_2007;
      INFILE "C:\EMS Naturalistic\Vibration\DAT with medic in
them\XMSU_0000_0000_MS_100813_2007.dat" dlm=',' DSD FIRSTOBS=2 LRECL=1000;
      Input VAR1 systemtime VAR3 :$40. filename :$30. VAR5 VAR6 VAR7 VAR8
VAR9 accelx1 accely1 accelz1 VAR13 VAR14 VAR15 speedHU;
RUN;
DATA T_100814_0746;
      INFILE "C:\EMS Naturalistic\Vibration\DAT with medic in
them\XMSU_0000_0000_MS_100814_0746.dat" dlm=',' DSD FIRSTOBS=2 LRECL=1000;
      Input VAR1 systemtime VAR3 :$40. filename :$30. VAR5 VAR6 VAR7 VAR8
VAR9 accelx1 accely1 accelz1 VAR13 VAR14 VAR15 speedHU;
RUN;
DATA T_100814_1003;
      INFILE "C:\EMS Naturalistic\Vibration\DAT with medic in
them\XMSU_0000_0000_MS_100814_1003.dat" dlm=',' DSD FIRSTOBS=2 LRECL=1000;
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      Input VAR1 systemtime VAR3 :$40. filename :$30. VAR5 VAR6 VAR7 VAR8
VAR9 accelx1 accely1 accelz1 VAR13 VAR14 VAR15 speedHU;
RUN;
DATA T_100814_1517;
      INFILE "C:\EMS Naturalistic\Vibration\DAT with medic in
them\XMSU_0000_0000_MS_100814_1517.dat" dlm=',' DSD FIRSTOBS=2 LRECL=1000;
      Input VAR1 systemtime VAR3 :$40. filename :$30. VAR5 VAR6 VAR7 VAR8
VAR9 accelx1 accely1 accelz1 VAR13 VAR14 VAR15 speedHU;
RUN;
DATA T_100815_0049;
      INFILE "C:\EMS Naturalistic\Vibration\DAT with medic in
them\XMSU_0000_0000_MS_100815_0049.dat" dlm=',' DSD FIRSTOBS=2 LRECL=1000;
      Input VAR1 systemtime VAR3 :$40. filename :$30. VAR5 VAR6 VAR7 VAR8
VAR9 accelx1 accely1 accelz1 VAR13 VAR14 VAR15 speedHU;
RUN;
DATA T_100815_1240;
      INFILE "C:\EMS Naturalistic\Vibration\DAT with medic in
them\XMSU_0000_0000_MS_100815_1240.dat" dlm=',' DSD FIRSTOBS=2 LRECL=1000;
      Input VAR1 systemtime VAR3 :$40. filename :$30. VAR5 VAR6 VAR7 VAR8
VAR9 accelx1 accely1 accelz1 VAR13 VAR14 VAR15 speedHU;
RUN;
DATA T_100815_1850;
      INFILE "C:\EMS Naturalistic\Vibration\DAT with medic in
them\XMSU_0000_0000_MS_100815_1850.dat" dlm=',' DSD FIRSTOBS=2 LRECL=1000;
      Input VAR1 systemtime VAR3 :$40. filename :$30. VAR5 VAR6 VAR7 VAR8
VAR9 accelx1 accely1 accelz1 VAR13 VAR14 VAR15 speedHU;
RUN;
DATA T_100815_2001;
      INFILE "C:\EMS Naturalistic\Vibration\DAT with medic in
them\XMSU_0000_0000_MS_100815_2001.dat" dlm=',' DSD FIRSTOBS=2 LRECL=1000;
      Input VAR1 systemtime VAR3 :$40. filename :$30. VAR5 VAR6 VAR7 VAR8
VAR9 accelx1 accely1 accelz1 VAR13 VAR14 VAR15 speedHU;
RUN;
DATA T_100816_1715;
      INFILE "C:\EMS Naturalistic\Vibration\DAT with medic in
them\XMSU_0000_0000_MS_100816_1715.dat" dlm=',' DSD FIRSTOBS=2 LRECL=1000;
      Input VAR1 systemtime VAR3 :$40. filename :$30. VAR5 VAR6 VAR7 VAR8
VAR9 accelx1 accely1 accelz1 VAR13 VAR14 VAR15 speedHU;
RUN;
DATA T_100816_2056;
      INFILE "C:\EMS Naturalistic\Vibration\DAT with medic in
them\XMSU_0000_0000_MS_100816_2056.dat" dlm=',' DSD FIRSTOBS=2 LRECL=1000;
      Input VAR1 systemtime VAR3 :$40. filename :$30. VAR5 VAR6 VAR7 VAR8
VAR9 accelx1 accely1 accelz1 VAR13 VAR14 VAR15 speedHU;
RUN;
DATA T_100817_0253;
      INFILE "C:\EMS Naturalistic\Vibration\DAT with medic in
them\XMSU_0000_0000_MS_100817_0253.dat" dlm=',' DSD FIRSTOBS=2 LRECL=1000;
      Input VAR1 systemtime VAR3 :$40. filename :$30. VAR5 VAR6 VAR7 VAR8
VAR9 accelx1 accely1 accelz1 VAR13 VAR14 VAR15 speedHU;
RUN;
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DATA T_100818_1203;
      INFILE "C:\EMS Naturalistic\Vibration\DAT with medic in
them\XMSU_0000_0000_MS_100818_1203.dat" dlm=',' DSD FIRSTOBS=2 LRECL=1000;
      Input VAR1 systemtime VAR3 :$40. filename :$30. VAR5 VAR6 VAR7 VAR8
VAR9 accelx1 accely1 accelz1 VAR13 VAR14 VAR15 speedHU;
RUN;
DATA T_100818_1533;
      INFILE "C:\EMS Naturalistic\Vibration\DAT with medic in
them\XMSU_0000_0000_MS_100818_1533.dat" dlm=',' DSD FIRSTOBS=2 LRECL=1000;
      Input VAR1 systemtime VAR3 :$40. filename :$30. VAR5 VAR6 VAR7 VAR8
VAR9 accelx1 accely1 accelz1 VAR13 VAR14 VAR15 speedHU;
RUN;
DATA T_100818_1952;
      INFILE "C:\EMS Naturalistic\Vibration\DAT with medic in
them\XMSU_0000_0000_MS_100818_1952.dat" dlm=',' DSD FIRSTOBS=2 LRECL=1000;
      Input VAR1 systemtime VAR3 :$40. filename :$30. VAR5 VAR6 VAR7 VAR8
VAR9 accelx1 accely1 accelz1 VAR13 VAR14 VAR15 speedHU;
RUN;
DATA T_100818_2240;
      INFILE "C:\EMS Naturalistic\Vibration\DAT with medic in
them\XMSU_0000_0000_MS_100818_2240.dat" dlm=',' DSD FIRSTOBS=2 LRECL=1000;
      Input VAR1 systemtime VAR3 :$40. filename :$30. VAR5 VAR6 VAR7 VAR8
VAR9 accelx1 accely1 accelz1 VAR13 VAR14 VAR15 speedHU;
RUN;
DATA T_100828_0448;
      INFILE "C:\EMS Naturalistic\Vibration\DAT with medic in
them\XMSU_0000_0000_MS_100828_0448.dat" dlm=',' DSD FIRSTOBS=2 LRECL=1000;
      Input VAR1 systemtime VAR3 :$40. filename :$30. VAR5 VAR6 VAR7 VAR8
VAR9 accelx1 accely1 accelz1 VAR13 VAR14 VAR15 speedHU;
RUN;
DATA T_100828_0617;
      INFILE "C:\EMS Naturalistic\Vibration\DAT with medic in
them\XMSU_0000_0000_MS_100828_0617.dat" dlm=',' DSD FIRSTOBS=2 LRECL=1000;
      Input VAR1 systemtime VAR3 :$40. filename :$30. VAR5 VAR6 VAR7 VAR8
VAR9 accelx1 accely1 accelz1 VAR13 VAR14 VAR15 speedHU;
RUN;
DATA T_100828_0749;
      INFILE "C:\EMS Naturalistic\Vibration\DAT with medic in
them\XMSU_0000_0000_MS_100828_0749.dat" dlm=',' DSD FIRSTOBS=2 LRECL=1000;
      Input VAR1 systemtime VAR3 :$40. filename :$30. VAR5 VAR6 VAR7 VAR8
VAR9 accelx1 accely1 accelz1 VAR13 VAR14 VAR15 speedHU;
RUN;
DATA T_100828_1114;
      INFILE "C:\EMS Naturalistic\Vibration\DAT with medic in
them\XMSU_0000_0000_MS_100828_1114.dat" dlm=',' DSD FIRSTOBS=2 LRECL=1000;
      Input VAR1 systemtime VAR3 :$40. filename :$30. VAR5 VAR6 VAR7 VAR8
VAR9 accelx1 accely1 accelz1 VAR13 VAR14 VAR15 speedHU;
RUN;
DATA T_100828_1203;
      INFILE "C:\EMS Naturalistic\Vibration\DAT with medic in
them\XMSU_0000_0000_MS_100828_1203.dat" dlm=',' DSD FIRSTOBS=2 LRECL=1000;
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      Input VAR1 systemtime VAR3 :$40. filename :$30. VAR5 VAR6 VAR7 VAR8
VAR9 accelx1 accely1 accelz1 VAR13 VAR14 VAR15 speedHU;
RUN;
DATA T_100828_1706;
      INFILE "C:\EMS Naturalistic\Vibration\DAT with medic in
them\XMSU_0000_0000_MS_100828_1706.dat" dlm=',' DSD FIRSTOBS=2 LRECL=1000;
      Input VAR1 systemtime VAR3 :$40. filename :$30. VAR5 VAR6 VAR7 VAR8
VAR9 accelx1 accely1 accelz1 VAR13 VAR14 VAR15 speedHU;
RUN;
DATA T_100828_2108;
      INFILE "C:\EMS Naturalistic\Vibration\DAT with medic in
them\XMSU_0000_0000_MS_100828_2108.dat" dlm=',' DSD FIRSTOBS=2 LRECL=1000;
      Input VAR1 systemtime VAR3 :$40. filename :$30. VAR5 VAR6 VAR7 VAR8
VAR9 accelx1 accely1 accelz1 VAR13 VAR14 VAR15 speedHU;
RUN;
DATA T_100828_2211;
      INFILE "C:\EMS Naturalistic\Vibration\DAT with medic in
them\XMSU_0000_0000_MS_100828_2211.dat" dlm=',' DSD FIRSTOBS=2 LRECL=1000;
      Input VAR1 systemtime VAR3 :$40. filename :$30. VAR5 VAR6 VAR7 VAR8
VAR9 accelx1 accely1 accelz1 VAR13 VAR14 VAR15 speedHU;
RUN;
DATA T_100829_0149;
      INFILE "C:\EMS Naturalistic\Vibration\DAT with medic in
them\XMSU_0000_0000_MS_100829_0149.dat" dlm=',' DSD FIRSTOBS=2 LRECL=1000;
      Input VAR1 systemtime VAR3 :$40. filename :$30. VAR5 VAR6 VAR7 VAR8
VAR9 accelx1 accely1 accelz1 VAR13 VAR14 VAR15 speedHU;
RUN;
DATA T_100830_1004;
      INFILE "C:\EMS Naturalistic\Vibration\DAT with medic in
them\XMSU_0000_0000_MS_100830_1004.dat" dlm=',' DSD FIRSTOBS=2 LRECL=1000;
      Input VAR1 systemtime VAR3 :$40. filename :$30. VAR5 VAR6 VAR7 VAR8
VAR9 accelx1 accely1 accelz1 VAR13 VAR14 VAR15 speedHU;
RUN;
DATA T_100831_0908;
      INFILE "C:\EMS Naturalistic\Vibration\DAT with medic in
them\XMSU_0000_0000_MS_100831_0908.dat" dlm=',' DSD FIRSTOBS=2 LRECL=1000;
      Input VAR1 systemtime VAR3 :$40. filename :$30. VAR5 VAR6 VAR7 VAR8
VAR9 accelx1 accely1 accelz1 VAR13 VAR14 VAR15 speedHU;
RUN;
DATA T_100831_2229;
      INFILE "C:\EMS Naturalistic\Vibration\DAT with medic in
them\XMSU_0000_0000_MS_100831_2229.dat" dlm=',' DSD FIRSTOBS=2 LRECL=1000;
      Input VAR1 systemtime VAR3 :$40. filename :$30. VAR5 VAR6 VAR7 VAR8
VAR9 accelx1 accely1 accelz1 VAR13 VAR14 VAR15 speedHU;
RUN;
DATA T_100831_2359;
      INFILE "C:\EMS Naturalistic\Vibration\DAT with medic in
them\XMSU_0000_0000_MS_100831_2359.dat" dlm=',' DSD FIRSTOBS=2 LRECL=1000;
      Input VAR1 systemtime VAR3 :$40. filename :$30. VAR5 VAR6 VAR7 VAR8
VAR9 accelx1 accely1 accelz1 VAR13 VAR14 VAR15 speedHU;
RUN;
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DATA T_100902_1120;
      INFILE "C:\EMS Naturalistic\Vibration\DAT with medic in
them\XMSU_0000_0000_MS_100902_1120.dat" dlm=',' DSD FIRSTOBS=2 LRECL=1000;
      Input VAR1 systemtime VAR3 :$40. filename :$30. VAR5 VAR6 VAR7 VAR8
VAR9 accelx1 accely1 accelz1 VAR13 VAR14 VAR15 speedHU;
RUN;
DATA T_100902_1816;
      INFILE "C:\EMS Naturalistic\Vibration\DAT with medic in
them\XMSU_0000_0000_MS_100902_1816.dat" dlm=',' DSD FIRSTOBS=2 LRECL=1000;
      Input VAR1 systemtime VAR3 :$40. filename :$30. VAR5 VAR6 VAR7 VAR8
VAR9 accelx1 accely1 accelz1 VAR13 VAR14 VAR15 speedHU;
RUN;
DATA T_100902_2233;
      INFILE "C:\EMS Naturalistic\Vibration\DAT with medic in
them\XMSU_0000_0000_MS_100902_2233.dat" dlm=',' DSD FIRSTOBS=2 LRECL=1000;
      Input VAR1 systemtime VAR3 :$40. filename :$30. VAR5 VAR6 VAR7 VAR8
VAR9 accelx1 accely1 accelz1 VAR13 VAR14 VAR15 speedHU;
RUN;
DATA T_100903_0506;
      INFILE "C:\EMS Naturalistic\Vibration\DAT with medic in
them\XMSU_0000_0000_MS_100903_0506.dat" dlm=',' DSD FIRSTOBS=2 LRECL=1000;
      Input VAR1 systemtime VAR3 :$40. filename :$30. VAR5 VAR6 VAR7 VAR8
VAR9 accelx1 accely1 accelz1 VAR13 VAR14 VAR15 speedHU;
RUN;
DATA T_100903_1406;
      INFILE "C:\EMS Naturalistic\Vibration\DAT with medic in
them\XMSU_0000_0000_MS_100903_1406.dat" dlm=',' DSD FIRSTOBS=2 LRECL=1000;
      Input VAR1 systemtime VAR3 :$40. filename :$30. VAR5 VAR6 VAR7 VAR8
VAR9 accelx1 accely1 accelz1 VAR13 VAR14 VAR15 speedHU;
RUN;
DATA T_100903_1739;
      INFILE "C:\EMS Naturalistic\Vibration\DAT with medic in
them\XMSU_0000_0000_MS_100903_1739.dat" dlm=',' DSD FIRSTOBS=2 LRECL=1000;
      Input VAR1 systemtime VAR3 :$40. filename :$30. VAR5 VAR6 VAR7 VAR8
VAR9 accelx1 accely1 accelz1 VAR13 VAR14 VAR15 speedHU;
RUN;
DATA T_100903_1823;
      INFILE "C:\EMS Naturalistic\Vibration\DAT with medic in
them\XMSU_0000_0000_MS_100903_1823.dat" dlm=',' DSD FIRSTOBS=2 LRECL=1000;
      Input VAR1 systemtime VAR3 :$40. filename :$30. VAR5 VAR6 VAR7 VAR8
VAR9 accelx1 accely1 accelz1 VAR13 VAR14 VAR15 speedHU;
RUN;
DATA T_100904_1953;
      INFILE "C:\EMS Naturalistic\Vibration\DAT with medic in
them\XMSU_0000_0000_MS_100904_1953.dat" dlm=',' DSD FIRSTOBS=2 LRECL=1000;
      Input VAR1 systemtime VAR3 :$40. filename :$30. VAR5 VAR6 VAR7 VAR8
VAR9 accelx1 accely1 accelz1 VAR13 VAR14 VAR15 speedHU;
RUN;
DATA T_100904_2049;
      INFILE "C:\EMS Naturalistic\Vibration\DAT with medic in
them\XMSU_0000_0000_MS_100904_2049.dat" dlm=',' DSD FIRSTOBS=2 LRECL=1000;
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      Input VAR1 systemtime VAR3 :$40. filename :$30. VAR5 VAR6 VAR7 VAR8
VAR9 accelx1 accely1 accelz1 VAR13 VAR14 VAR15 speedHU;
RUN;
DATA T_100904_2153;
      INFILE "C:\EMS Naturalistic\Vibration\DAT with medic in
them\XMSU_0000_0000_MS_100904_2153.dat" dlm=',' DSD FIRSTOBS=2 LRECL=1000;
      Input VAR1 systemtime VAR3 :$40. filename :$30. VAR5 VAR6 VAR7 VAR8
VAR9 accelx1 accely1 accelz1 VAR13 VAR14 VAR15 speedHU;
RUN;
DATA T_100905_0046;
      INFILE "C:\EMS Naturalistic\Vibration\DAT with medic in
them\XMSU_0000_0000_MS_100905_0046.dat" dlm=',' DSD FIRSTOBS=2 LRECL=1000;
      Input VAR1 systemtime VAR3 :$40. filename :$30. VAR5 VAR6 VAR7 VAR8
VAR9 accelx1 accely1 accelz1 VAR13 VAR14 VAR15 speedHU;
RUN;
DATA T_100905_0628;
      INFILE "C:\EMS Naturalistic\Vibration\DAT with medic in
them\XMSU_0000_0000_MS_100905_0628.dat" dlm=',' DSD FIRSTOBS=2 LRECL=1000;
      Input VAR1 systemtime VAR3 :$40. filename :$30. VAR5 VAR6 VAR7 VAR8
VAR9 accelx1 accely1 accelz1 VAR13 VAR14 VAR15 speedHU;
RUN;
DATA T_100905_0820;
      INFILE "C:\EMS Naturalistic\Vibration\DAT with medic in
them\XMSU_0000_0000_MS_100905_0820.dat" dlm=',' DSD FIRSTOBS=2 LRECL=1000;
      Input VAR1 systemtime VAR3 :$40. filename :$30. VAR5 VAR6 VAR7 VAR8
VAR9 accelx1 accely1 accelz1 VAR13 VAR14 VAR15 speedHU;
RUN;
DATA T_100905_2204;
      INFILE "C:\EMS Naturalistic\Vibration\DAT with medic in
them\XMSU_0000_0000_MS_100905_2204.dat" dlm=',' DSD FIRSTOBS=2 LRECL=1000;
      Input VAR1 systemtime VAR3 :$40. filename :$30. VAR5 VAR6 VAR7 VAR8
VAR9 accelx1 accely1 accelz1 VAR13 VAR14 VAR15 speedHU;
RUN;
DATA T_100906_0708;
      INFILE "C:\EMS Naturalistic\Vibration\DAT with medic in
them\XMSU_0000_0000_MS_100906_0708.dat" dlm=',' DSD FIRSTOBS=2 LRECL=1000;
      Input VAR1 systemtime VAR3 :$40. filename :$30. VAR5 VAR6 VAR7 VAR8
VAR9 accelx1 accely1 accelz1 VAR13 VAR14 VAR15 speedHU;
RUN;
DATA T_100906_1417;
      INFILE "C:\EMS Naturalistic\Vibration\DAT with medic in
them\XMSU_0000_0000_MS_100906_1417.dat" dlm=',' DSD FIRSTOBS=2 LRECL=1000;
      Input VAR1 systemtime VAR3 :$40. filename :$30. VAR5 VAR6 VAR7 VAR8
VAR9 accelx1 accely1 accelz1 VAR13 VAR14 VAR15 speedHU;
RUN;
DATA T_100907_0003;
      INFILE "C:\EMS Naturalistic\Vibration\DAT with medic in
them\XMSU_0000_0000_MS_100907_0003.dat" dlm=',' DSD FIRSTOBS=2 LRECL=1000;
      Input VAR1 systemtime VAR3 :$40. filename :$30. VAR5 VAR6 VAR7 VAR8
VAR9 accelx1 accely1 accelz1 VAR13 VAR14 VAR15 speedHU;
RUN;
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DATA T_100907_1405;
      INFILE "C:\EMS Naturalistic\Vibration\DAT with medic in
them\XMSU_0000_0000_MS_100907_1405.dat" dlm=',' DSD FIRSTOBS=2 LRECL=1000;
      Input VAR1 systemtime VAR3 :$40. filename :$30. VAR5 VAR6 VAR7 VAR8
VAR9 accelx1 accely1 accelz1 VAR13 VAR14 VAR15 speedHU;
RUN;
DATA T_100909_0007;
      INFILE "C:\EMS Naturalistic\Vibration\DAT with medic in
them\XMSU_0000_0000_MS_100909_0007.dat" dlm=',' DSD FIRSTOBS=2 LRECL=1000;
      Input VAR1 systemtime VAR3 :$40. filename :$30. VAR5 VAR6 VAR7 VAR8
VAR9 accelx1 accely1 accelz1 VAR13 VAR14 VAR15 speedHU;
RUN;
DATA T_100909_1217;
      INFILE "C:\EMS Naturalistic\Vibration\DAT with medic in
them\XMSU_0000_0000_MS_100909_1217.dat" dlm=',' DSD FIRSTOBS=2 LRECL=1000;
      Input VAR1 systemtime VAR3 :$40. filename :$30. VAR5 VAR6 VAR7 VAR8
VAR9 accelx1 accely1 accelz1 VAR13 VAR14 VAR15 speedHU;
RUN;
DATA T_100909_1345;
      INFILE "C:\EMS Naturalistic\Vibration\DAT with medic in
them\XMSU_0000_0000_MS_100909_1345.dat" dlm=',' DSD FIRSTOBS=2 LRECL=1000;
      Input VAR1 systemtime VAR3 :$40. filename :$30. VAR5 VAR6 VAR7 VAR8
VAR9 accelx1 accely1 accelz1 VAR13 VAR14 VAR15 speedHU;
RUN;
DATA T_100909_1442;
      INFILE "C:\EMS Naturalistic\Vibration\DAT with medic in
them\XMSU_0000_0000_MS_100909_1442.dat" dlm=',' DSD FIRSTOBS=2 LRECL=1000;
      Input VAR1 systemtime VAR3 :$40. filename :$30. VAR5 VAR6 VAR7 VAR8
VAR9 accelx1 accely1 accelz1 VAR13 VAR14 VAR15 speedHU;
RUN;
DATA T_100909_1737;
      INFILE "C:\EMS Naturalistic\Vibration\DAT with medic in
them\XMSU_0000_0000_MS_100909_1737.dat" dlm=',' DSD FIRSTOBS=2 LRECL=1000;
      Input VAR1 systemtime VAR3 :$40. filename :$30. VAR5 VAR6 VAR7 VAR8
VAR9 accelx1 accely1 accelz1 VAR13 VAR14 VAR15 speedHU;
RUN;
DATA T_100909_1837;
      INFILE "C:\EMS Naturalistic\Vibration\DAT with medic in
them\XMSU_0000_0000_MS_100909_1837.dat" dlm=',' DSD FIRSTOBS=2 LRECL=1000;
      Input VAR1 systemtime VAR3 :$40. filename :$30. VAR5 VAR6 VAR7 VAR8
VAR9 accelx1 accely1 accelz1 VAR13 VAR14 VAR15 speedHU;
RUN;
DATA T_100909_1938;
      INFILE "C:\EMS Naturalistic\Vibration\DAT with medic in
them\XMSU_0000_0000_MS_100909_1938.dat" dlm=',' DSD FIRSTOBS=2 LRECL=1000;
      Input VAR1 systemtime VAR3 :$40. filename :$30. VAR5 VAR6 VAR7 VAR8
VAR9 accelx1 accely1 accelz1 VAR13 VAR14 VAR15 speedHU;
RUN;
DATA T_100909_2156;
      INFILE "C:\EMS Naturalistic\Vibration\DAT with medic in
them\XMSU_0000_0000_MS_100909_2156.dat" dlm=',' DSD FIRSTOBS=2 LRECL=1000;
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      Input VAR1 systemtime VAR3 :$40. filename :$30. VAR5 VAR6 VAR7 VAR8
VAR9 accelx1 accely1 accelz1 VAR13 VAR14 VAR15 speedHU;
RUN;
DATA T_100911_1803;
      INFILE "C:\EMS Naturalistic\Vibration\DAT with medic in
them\XMSU_0000_0000_MS_100911_1803.dat" dlm=',' DSD FIRSTOBS=2 LRECL=1000;
      Input VAR1 systemtime VAR3 :$40. filename :$30. VAR5 VAR6 VAR7 VAR8
VAR9 accelx1 accely1 accelz1 VAR13 VAR14 VAR15 speedHU;
RUN;
DATA T_100911_1834;
      INFILE "C:\EMS Naturalistic\Vibration\DAT with medic in
them\XMSU_0000_0000_MS_100911_1834.dat" dlm=',' DSD FIRSTOBS=2 LRECL=1000;
      Input VAR1 systemtime VAR3 :$40. filename :$30. VAR5 VAR6 VAR7 VAR8
VAR9 accelx1 accely1 accelz1 VAR13 VAR14 VAR15 speedHU;
RUN;
DATA T_100913_2255;
      INFILE "C:\EMS Naturalistic\Vibration\DAT with medic in
them\XMSU_0000_0000_MS_100913_2255.dat" dlm=',' DSD FIRSTOBS=2 LRECL=1000;
      Input VAR1 systemtime VAR3 :$40. filename :$30. VAR5 VAR6 VAR7 VAR8
VAR9 accelx1 accely1 accelz1 VAR13 VAR14 VAR15 speedHU;
RUN;
DATA T_100914_1708;
      INFILE "C:\EMS Naturalistic\Vibration\DAT with medic in
them\XMSU_0000_0000_MS_100914_1708.dat" dlm=',' DSD FIRSTOBS=2 LRECL=1000;
      Input VAR1 systemtime VAR3 :$40. filename :$30. VAR5 VAR6 VAR7 VAR8
VAR9 accelx1 accely1 accelz1 VAR13 VAR14 VAR15 speedHU;
RUN;
DATA T_100922_1224;
      INFILE "C:\EMS Naturalistic\Vibration\DAT with medic in
them\XMSU_0000_0000_MS_100922_1224.dat" dlm=',' DSD FIRSTOBS=2 LRECL=1000;
      Input VAR1 systemtime VAR3 :$40. filename :$30. VAR5 VAR6 VAR7 VAR8
VAR9 accelx1 accely1 accelz1 VAR13 VAR14 VAR15 speedHU;
RUN;
DATA T_100922_1348;
      INFILE "C:\EMS Naturalistic\Vibration\DAT with medic in
them\XMSU_0000_0000_MS_100922_1348.dat" dlm=',' DSD FIRSTOBS=2 LRECL=1000;
      Input VAR1 systemtime VAR3 :$40. filename :$30. VAR5 VAR6 VAR7 VAR8
VAR9 accelx1 accely1 accelz1 VAR13 VAR14 VAR15 speedHU;
RUN;
DATA T_100922_1839;
      INFILE "C:\EMS Naturalistic\Vibration\DAT with medic in
them\XMSU_0000_0000_MS_100922_1839.dat" dlm=',' DSD FIRSTOBS=2 LRECL=1000;
      Input VAR1 systemtime VAR3 :$40. filename :$30. VAR5 VAR6 VAR7 VAR8
VAR9 accelx1 accely1 accelz1 VAR13 VAR14 VAR15 speedHU;
RUN;
DATA T_100922_1947;
      INFILE "C:\EMS Naturalistic\Vibration\DAT with medic in
them\XMSU_0000_0000_MS_100922_1947.dat" dlm=',' DSD FIRSTOBS=2 LRECL=1000;
      Input VAR1 systemtime VAR3 :$40. filename :$30. VAR5 VAR6 VAR7 VAR8
VAR9 accelx1 accely1 accelz1 VAR13 VAR14 VAR15 speedHU;
RUN;
```

```
DATA T_100927_1240;
      INFILE "C:\EMS Naturalistic\Vibration\DAT with medic in
them\XMSU_0000_0000_MS_100927_1240.dat" dlm=',' DSD FIRSTOBS=2 LRECL=1000;
      Input VAR1 systemtime VAR3 :$40. filename :$30. VAR5 VAR6 VAR7 VAR8
VAR9 accelx1 accely1 accelz1 VAR13 VAR14 VAR15 speedHU;
RUN;
DATA T_100928_1155;
      INFILE "C:\EMS Naturalistic\Vibration\DAT with medic in
them\XMSU_0000_0000_MS_100928_1155.dat" dlm=',' DSD FIRSTOBS=2 LRECL=1000;
      Input VAR1 systemtime VAR3 :$40. filename :$30. VAR5 VAR6 VAR7 VAR8
VAR9 accelx1 accely1 accelz1 VAR13 VAR14 VAR15 speedHU;
RUN;
DATA T_100928_1524;
      INFILE "C:\EMS Naturalistic\Vibration\DAT with medic in
them\XMSU_0000_0000_MS_100928_1524.dat" dlm=',' DSD FIRSTOBS=2 LRECL=1000;
      Input VAR1 systemtime VAR3 :$40. filename :$30. VAR5 VAR6 VAR7 VAR8
VAR9 accelx1 accely1 accelz1 VAR13 VAR14 VAR15 speedHU;
RUN;
DATA T_100928_2017;
      INFILE "C:\EMS Naturalistic\Vibration\DAT with medic in
them\XMSU_0000_0000_MS_100928_2017.dat" dlm=',' DSD FIRSTOBS=2 LRECL=1000;
      Input VAR1 systemtime VAR3 :$40. filename :$30. VAR5 VAR6 VAR7 VAR8
VAR9 accelx1 accely1 accelz1 VAR13 VAR14 VAR15 speedHU;
RUN;
DATA T_100929_0946;
      INFILE "C:\EMS Naturalistic\Vibration\DAT with medic in
them\XMSU_0000_0000_MS_100929_0946.dat" dlm=',' DSD FIRSTOBS=2 LRECL=1000;
      Input VAR1 systemtime VAR3 :$40. filename :$30. VAR5 VAR6 VAR7 VAR8
VAR9 accelx1 accely1 accelz1 VAR13 VAR14 VAR15 speedHU;
RUN;
DATA T_100929_2203;
      INFILE "C:\EMS Naturalistic\Vibration\DAT with medic in
them\XMSU_0000_0000_MS_100929_2203.dat" dlm=',' DSD FIRSTOBS=2 LRECL=1000;
      Input VAR1 systemtime VAR3 :$40. filename :$30. VAR5 VAR6 VAR7 VAR8
VAR9 accelx1 accely1 accelz1 VAR13 VAR14 VAR15 speedHU;
RUN;
DATA T_100930_0314;
      INFILE "C:\EMS Naturalistic\Vibration\DAT with medic in
them\XMSU_0000_0000_MS_100930_0314.dat" dlm=',' DSD FIRSTOBS=2 LRECL=1000;
      Input VAR1 systemtime VAR3 :$40. filename :$30. VAR5 VAR6 VAR7 VAR8
VAR9 accelx1 accely1 accelz1 VAR13 VAR14 VAR15 speedHU;
RUN;
DATA T_100930_0908;
      INFILE "C:\EMS Naturalistic\Vibration\DAT with medic in
them\XMSU_0000_0000_MS_100930_0908.dat" dlm=',' DSD FIRSTOBS=2 LRECL=1000;
      Input VAR1 systemtime VAR3 :$40. filename :$30. VAR5 VAR6 VAR7 VAR8
VAR9 accelx1 accely1 accelz1 VAR13 VAR14 VAR15 speedHU;
RUN;
DATA T_100930_1033;
      INFILE "C:\EMS Naturalistic\Vibration\DAT with medic in
them\XMSU_0000_0000_MS_100930_1033.dat" dlm=',' DSD FIRSTOBS=2 LRECL=1000;
```

```
      Input VAR1 systemtime VAR3 :$40. filename :$30. VAR5 VAR6 VAR7 VAR8
VAR9 accelx1 accely1 accelz1 VAR13 VAR14 VAR15 speedHU;
RUN;
DATA T_100930_1203;
      INFILE "C:\EMS Naturalistic\Vibration\DAT with medic in
them\XMSU_0000_0000_MS_100930_1203.dat" dlm=',' DSD FIRSTOBS=2 LRECL=1000;
      Input VAR1 systemtime VAR3 :$40. filename :$30. VAR5 VAR6 VAR7 VAR8
VAR9 accelx1 accely1 accelz1 VAR13 VAR14 VAR15 speedHU;
RUN;
DATA T_100930_1759;
      INFILE "C:\EMS Naturalistic\Vibration\DAT with medic in
them\XMSU_0000_0000_MS_100930_1759.dat" dlm=',' DSD FIRSTOBS=2 LRECL=1000;
      Input VAR1 systemtime VAR3 :$40. filename :$30. VAR5 VAR6 VAR7 VAR8
VAR9 accelx1 accely1 accelz1 VAR13 VAR14 VAR15 speedHU;
RUN;
DATA T_101001_1146;
      INFILE "C:\EMS Naturalistic\Vibration\DAT with medic in
them\XMSU_0000_0000_MS_101001_1146.dat" dlm=',' DSD FIRSTOBS=2 LRECL=1000;
      Input VAR1 systemtime VAR3 :$40. filename :$30. VAR5 VAR6 VAR7 VAR8
VAR9 accelx1 accely1 accelz1 VAR13 VAR14 VAR15 speedHU;
RUN;
DATA T_101001_1516;
      INFILE "C:\EMS Naturalistic\Vibration\DAT with medic in
them\XMSU_0000_0000_MS_101001_1516.dat" dlm=',' DSD FIRSTOBS=2 LRECL=1000;
      Input VAR1 systemtime VAR3 :$40. filename :$30. VAR5 VAR6 VAR7 VAR8
VAR9 accelx1 accely1 accelz1 VAR13 VAR14 VAR15 speedHU;
RUN;
DATA T_101001_1621;
      INFILE "C:\EMS Naturalistic\Vibration\DAT with medic in
them\XMSU_0000_0000_MS_101001_1621.dat" dlm=',' DSD FIRSTOBS=2 LRECL=1000;
      Input VAR1 systemtime VAR3 :$40. filename :$30. VAR5 VAR6 VAR7 VAR8
VAR9 accelx1 accely1 accelz1 VAR13 VAR14 VAR15 speedHU;
RUN;
DATA T_101001_1717;
      INFILE "C:\EMS Naturalistic\Vibration\DAT with medic in
them\XMSU_0000_0000_MS_101001_1717.dat" dlm=',' DSD FIRSTOBS=2 LRECL=1000;
      Input VAR1 systemtime VAR3 :$40. filename :$30. VAR5 VAR6 VAR7 VAR8
VAR9 accelx1 accely1 accelz1 VAR13 VAR14 VAR15 speedHU;
RUN;
DATA T_101001_2324;
      INFILE "C:\EMS Naturalistic\Vibration\DAT with medic in
them\XMSU_0000_0000_MS_101001_2324.dat" dlm=',' DSD FIRSTOBS=2 LRECL=1000;
      Input VAR1 systemtime VAR3 :$40. filename :$30. VAR5 VAR6 VAR7 VAR8
VAR9 accelx1 accely1 accelz1 VAR13 VAR14 VAR15 speedHU;
RUN;
DATA T_101002_0043;
      INFILE "C:\EMS Naturalistic\Vibration\DAT with medic in
them\XMSU_0000_0000_MS_101002_0043.dat" dlm=',' DSD FIRSTOBS=2 LRECL=1000;
      Input VAR1 systemtime VAR3 :$40. filename :$30. VAR5 VAR6 VAR7 VAR8
VAR9 accelx1 accely1 accelz1 VAR13 VAR14 VAR15 speedHU;
RUN;
```

```
DATA T_101002_1011;
      INFILE "C:\EMS Naturalistic\Vibration\DAT with medic in
them\XMSU_0000_0000_MS_101002_1011.dat" dlm=',' DSD FIRSTOBS=2 LRECL=1000;
      Input VAR1 systemtime VAR3 :$40. filename :$30. VAR5 VAR6 VAR7 VAR8
VAR9 accelx1 accely1 accelz1 VAR13 VAR14 VAR15 speedHU;
RUN;
DATA T_101002_1339;
      INFILE "C:\EMS Naturalistic\Vibration\DAT with medic in
them\XMSU_0000_0000_MS_101002_1339.dat" dlm=',' DSD FIRSTOBS=2 LRECL=1000;
      Input VAR1 systemtime VAR3 :$40. filename :$30. VAR5 VAR6 VAR7 VAR8
VAR9 accelx1 accely1 accelz1 VAR13 VAR14 VAR15 speedHU;
RUN;
DATA T_101002_1502;
      INFILE "C:\EMS Naturalistic\Vibration\DAT with medic in
them\XMSU_0000_0000_MS_101002_1502.dat" dlm=',' DSD FIRSTOBS=2 LRECL=1000;
      Input VAR1 systemtime VAR3 :$40. filename :$30. VAR5 VAR6 VAR7 VAR8
VAR9 accelx1 accely1 accelz1 VAR13 VAR14 VAR15 speedHU;
RUN;
DATA T_101002_1620;
      INFILE "C:\EMS Naturalistic\Vibration\DAT with medic in
them\XMSU_0000_0000_MS_101002_1620.dat" dlm=',' DSD FIRSTOBS=2 LRECL=1000;
      Input VAR1 systemtime VAR3 :$40. filename :$30. VAR5 VAR6 VAR7 VAR8
VAR9 accelx1 accely1 accelz1 VAR13 VAR14 VAR15 speedHU;
RUN;
DATA T_101002_2018;
      INFILE "C:\EMS Naturalistic\Vibration\DAT with medic in
them\XMSU_0000_0000_MS_101002_2018.dat" dlm=',' DSD FIRSTOBS=2 LRECL=1000;
      Input VAR1 systemtime VAR3 :$40. filename :$30. VAR5 VAR6 VAR7 VAR8
VAR9 accelx1 accely1 accelz1 VAR13 VAR14 VAR15 speedHU;
RUN;
DATA T_101002_2244;
      INFILE "C:\EMS Naturalistic\Vibration\DAT with medic in
them\XMSU_0000_0000_MS_101002_2244.dat" dlm=',' DSD FIRSTOBS=2 LRECL=1000;
      Input VAR1 systemtime VAR3 :$40. filename :$30. VAR5 VAR6 VAR7 VAR8
VAR9 accelx1 accely1 accelz1 VAR13 VAR14 VAR15 speedHU;
RUN;
DATA T_101006_0506;
      INFILE "C:\EMS Naturalistic\Vibration\DAT with medic in
them\XMSU_0000_0000_MS_101006_0506.dat" dlm=',' DSD FIRSTOBS=2 LRECL=1000;
      Input VAR1 systemtime VAR3 :$40. filename :$30. VAR5 VAR6 VAR7 VAR8
VAR9 accelx1 accely1 accelz1 VAR13 VAR14 VAR15 speedHU;
RUN;
DATA T_101009_0846;
      INFILE "C:\EMS Naturalistic\Vibration\DAT with medic in
them\XMSU_0000_0000_MS_101009_0846.dat" dlm=',' DSD FIRSTOBS=2 LRECL=1000;
      Input VAR1 systemtime VAR3 :$40. filename :$30. VAR5 VAR6 VAR7 VAR8
VAR9 accelx1 accely1 accelz1 VAR13 VAR14 VAR15 speedHU;
RUN;
DATA T_101014_1552;
      INFILE "C:\EMS Naturalistic\Vibration\DAT with medic in
them\XMSU_0000_0000_MS_101014_1552.dat" dlm=',' DSD FIRSTOBS=2 LRECL=1000;
```

```
      Input VAR1 systemtime VAR3 :$40. filename :$30. VAR5 VAR6 VAR7 VAR8
VAR9 accelx1 accely1 accelz1 VAR13 VAR14 VAR15 speedHU;
RUN;
DATA T_101014_1701;
      INFILE "C:\EMS Naturalistic\Vibration\DAT with medic in
them\XMSU_0000_0000_MS_101014_1701.dat" dlm=',' DSD FIRSTOBS=2 LRECL=1000;
      Input VAR1 systemtime VAR3 :$40. filename :$30. VAR5 VAR6 VAR7 VAR8
VAR9 accelx1 accely1 accelz1 VAR13 VAR14 VAR15 speedHU;
RUN;
DATA T_101016_2158;
      INFILE "C:\EMS Naturalistic\Vibration\DAT with medic in
them\XMSU_0000_0000_MS_101016_2158.dat" dlm=',' DSD FIRSTOBS=2 LRECL=1000;
      Input VAR1 systemtime VAR3 :$40. filename :$30. VAR5 VAR6 VAR7 VAR8
VAR9 accelx1 accely1 accelz1 VAR13 VAR14 VAR15 speedHU;
RUN;
DATA T_101017_1110;
      INFILE "C:\EMS Naturalistic\Vibration\DAT with medic in
them\XMSU_0000_0000_MS_101017_1110.dat" dlm=',' DSD FIRSTOBS=2 LRECL=1000;
      Input VAR1 systemtime VAR3 :$40. filename :$30. VAR5 VAR6 VAR7 VAR8
VAR9 accelx1 accely1 accelz1 VAR13 VAR14 VAR15 speedHU;
RUN;
DATA T_101017_1605;
      INFILE "C:\EMS Naturalistic\Vibration\DAT with medic in
them\XMSU_0000_0000_MS_101017_1605.dat" dlm=',' DSD FIRSTOBS=2 LRECL=1000;
      Input VAR1 systemtime VAR3 :$40. filename :$30. VAR5 VAR6 VAR7 VAR8
VAR9 accelx1 accely1 accelz1 VAR13 VAR14 VAR15 speedHU;
RUN;
DATA T_101018_0229;
      INFILE "C:\EMS Naturalistic\Vibration\DAT with medic in
them\XMSU_0000_0000_MS_101018_0229.dat" dlm=',' DSD FIRSTOBS=2 LRECL=1000;
      Input VAR1 systemtime VAR3 :$40. filename :$30. VAR5 VAR6 VAR7 VAR8
VAR9 accelx1 accely1 accelz1 VAR13 VAR14 VAR15 speedHU;
RUN;
DATA T_101018_0407;
      INFILE "C:\EMS Naturalistic\Vibration\DAT with medic in
them\XMSU_0000_0000_MS_101018_0407.dat" dlm=',' DSD FIRSTOBS=2 LRECL=1000;
      Input VAR1 systemtime VAR3 :$40. filename :$30. VAR5 VAR6 VAR7 VAR8
VAR9 accelx1 accely1 accelz1 VAR13 VAR14 VAR15 speedHU;
RUN;



/*Stacking the data sets into one set called "fullset" */
Data Fullset;
      Set T_100715_2042 T_100808_1339 T_100808_2241 T_100809_1725
T_100809_2046 T_100809_2202 T_100810_0019 T_100810_1443 T_100810_1714
T_100811_1414 T_100812_0050 T_100813_0949 T_100813_2007 T_100814_0746
T_100814_1003 T_100814_1517 T_100815_0049 T_100815_1240 T_100815_1850
T_100815_2001 T_100816_1715 T_100816_2056 T_100817_0253 T_100818_1203
T_100818_1533 T_100818_1952 T_100818_2240 T_100828_0448 T_100828_0617
T_100828_0749 T_100828_1114 T_100828_1203 T_100828_1706 T_100828_2108
```

```
T_100828_2211 T_100829_0149 T_100830_1004 T_100831_0908 T_100831_2229
T_100831_2359 T_100902_1120 T_100902_1816 T_100902_2233 T_100903_0506
T_100903_1406 T_100903_1739 T_100903_1823 T_100904_1953 T_100904_2049
T_100904_2153 T_100905_0046 T_100905_0628 T_100905_0820 T_100905_2204
T_100906_0708 T_100906_1417 T_100907_0003 T_100907_1405 T_100909_0007
T_100909_1217 T_100909_1345 T_100909_1442 T_100909_1737 T_100909_1837
T_100909_1938 T_100909_2156 T_100911_1803 T_100911_1834 T_100913_2255
T_100914_1708 T_100922_1224 T_100922_1348 T_100922_1839 T_100922_1947
T_100927_1240 T_100928_1155 T_100928_1524 T_100928_2017 T_100929_0946
T_100929_2203 T_100930_0314 T_100930_0908 T_100930_1033 T_100930_1203
T_100930_1759 T_101001_1146 T_101001_1516 T_101001_1621 T_101001_1717
T_101001_2324 T_101002_0043 T_101002_1011 T_101002_1339 T_101002_1502
T_101002_1620 T_101002_2018 T_101002_2244 T_101006_0506 T_101009_0846
T_101014_1552 T_101014_1701 T_101016_2158 T_101017_1110 T_101017_1605
T_101018_0229 T_101018_0407;
Run;
/*Here I am making the table which I will put all my important statistics
in*/
/*Crest factor I'll have to get by hand, that's OK. */
Proc SQL;
CREATE TABLE VibrationStats
      (
            Filename    Character(30),
            RMS_X1            Numeric,
            RMS_Y1            Numeric,
            RMS_Z1            Numeric,
            VDV_X1            Numeric,
            VDV_Y1            Numeric,
            VDV_Z1            Numeric,
            Max_X1            Numeric,
            Max_Y1            Numeric,
            Max_Z1            Numeric,
            Time        Numeric,
            Duration    Numeric
      )

;
quit;

Data vibcalcs;
      /*Here i am dropping the variables I do not want and will not use*/
      set Fullset (drop = VAR1 VAR3 VAR5 VAR6 VAR7 VAR8 VAR9 VAR13 VAR14
VAR15);

/*Converting from g's to m/s^2, and weighting it according to ISO 2361 for
seated.*/
accelX1 = accelX1 * 9.80665 * 1.4;
accelY1 = accelY1 * 9.80665 * 1.4;
accelZ1 = accelZ1 * 9.80665;

/*Accounting for gravity in the vertical direction (z)*/
```

```
accelz1 = accelz1 - 9.80665;

/*'generating colums for x,y,z^2 (RMS)*/
accelX1sq = accelX1 * accelX1;
accelY1sq = accelY1 * accelY1;
accelZ1sq = accelZ1 * accelZ1;


/*'generating colums for x,y,z^4 (VDV)*/
accelX1_4 = accelX1sq * accelX1sq;
accelY1_4 = accelY1sq * accelY1sq;
accelZ1_4 = accelZ1sq * accelZ1sq;


/*Cleaning up so that when I group by filename, the 3-5 lines without
text in them won't hang up the program.*/
if filename = '' then delete;
if filename = ' ' then delete;
RUN;

/*generates a lag accel^2 for 3 axes, and system time lag for calculating
integrals*/
proc expand data=vibcalcs out=vibcalcs_laglead method = none;
      by filename;
      id systemtime;
      convert accelX1sq = accelX1sq_lag1 /transformout=(lag 1);
      convert accelX1sq;
      convert accelY1sq = accelY1sq_lag1 /transformout=(lag 1);
      convert accelY1sq;
      convert accelZ1sq = accelZ1sq_lag1 /transformout=(lag 1);
      convert accelZ1sq;

      convert accelX1_4 = accelX1_4_lag1 /transformout=(lag 1);
      convert accelX1_4;
      convert accelY1_4 = accelY1_4_lag1 /transformout=(lag 1);
      convert accelY1_4;
      convert accelZ1_4 = accelZ1_4_lag1 /transformout=(lag 1);
      convert accelZ1_4;

      convert systemtime = systemtime_lag1 /transformout=(lag 1);
      convert systemtime;
RUN;

/*This generates for each time step the integral for acceleration in one axis
using the forumla for area of a trapezoid; this is repeated for each entry.*/
Data VibIntegralCalcs;
      Set vibcalcs_laglead;
      volumeX1_sq = 0.5 * (systemtime - systemtime_lag1) * (accelX1sq +
accelX1sq_lag1);
      volumeY1_sq = 0.5 * (systemtime - systemtime_lag1) * (accelY1sq +
accelY1sq_lag1);
```

```
      volumeZ1_sq = 0.5 * (systemtime - systemtime_lag1) * (accelZ1sq +
accelZ1sq_lag1);

      volumeX1_4 = 0.5 * (systemtime - systemtime_lag1) * (accelX1_4 +
accelX1_4_lag1);
      volumeY1_4 = 0.5 * (systemtime - systemtime_lag1) * (accelY1_4 +
accelY1_4_lag1);
      volumeZ1_4 = 0.5 * (systemtime - systemtime_lag1) * (accelZ1_4 +
accelZ1_4_lag1);

      timestep = systemtime - systemtime_lag1;

Run;


Proc SQL;
/*This populates my SQL table with relevant statistics*/

Insert into Vibrationstats
(Filename, Duration, RMS_X1, RMS_Y1, RMS_Z1, VDV_X1, VDV_Y1, VDV_Z1, Max_X1,
Max_Y1, Max_Z1, Time)

Select
/*Here am populating each column with:
<function to populate> as <columnname>*/
/*filename*/
sum(timestep) as Duration,

filename as filename,

/*RMS_X^2 (take square root once in excel)*/
(sum(volumeX1_sq) / sum(timestep)) as RMS_X1,

/*RMS_Y^2 (rememer to sqrt this!)*/
(sum(volumeY1_sq) / sum(timestep)) as RMS_Y1,

/*RMS_Z^2 (rememer to sqrt this!)*/
(sum(volumeZ1_sq) / sum(timestep)) as RMS_Z1,

/*RMS_X^4 (remember to ^.25 this!)*/
(sum(volumeX1_4) / sum(timestep)) as VDV_X1,

/*RMS_Y^4 (remember to ^.25 this!)*/
(sum(volumeY1_4) / sum(timestep)) as VDV_Y1,

/*RMS_Z^4 (remember to ^.25 this!)*/
(sum(volumeZ1_4) / sum(timestep)) as VDV_Z1,

/*Max_X1*/
max(accelx1) as Max_X1,
```

```
/*Max_Y1*/
max(accely1) as Max_Y1,

/*Max_Z1*/
max(accelz1) as Max_Z1,

/*Time*/
max(systemtime) as Time


From Vibintegralcalcs
Where speedHU > 1
group by filename
;
quit;


Data CleanVibrationStats;
      Set Vibrationstats;

RMS_X = sqrt(RMS_X1);  /*This is a_wx for the trip*/
RMS_Y = sqrt(RMS_Y1);  /*This is a_wy for the trip*/
RMS_Z = sqrt(RMS_Z1);  /*This is a_wz for the trip*/

VDV_X2 = sqrt(VDV_X1);
VDV_Y2 = sqrt(VDV_Y1);
VDV_Z2 = sqrt(VDV_Z1);

VDV_X = sqrt(VDV_X2);
VDV_Y = sqrt(VDV_Y2);
VDV_Z = sqrt(VDV_Z2);

CrestFactorX = Max_X1 / RMS_X;
CrestFactorY = Max_Y1 / RMS_Y;
CrestFactorZ = Max_Z1 / RMS_Z;

If Max_X1 > Max_Y1 and Max_X1 > Max_Z1 then SevereAxis = 'X';
If Max_X1 > Max_Y1 and Max_X1 > Max_Z1 then a_wMAX = RMS_X;

If Max_Z1 > Max_Y1 and Max_Z1 > Max_X1 then SevereAxis = 'Z';
If Max_Z1 > Max_Y1 and Max_Z1 > Max_X1 then a_wMAX = RMS_Z;

If Max_Y1 > Max_X1 and Max_Y1 > Max_Z1 then SevereAxis = 'Y';
If Max_Y1 > Max_X1 and Max_Y1 > Max_Z1 then a_wMAX = RMS_Y;

Drop RMS_X1 RMS_Y1 RMS_Z1 VDV_X1 VDV_Y1 VDV_Z1 VDV_X2 VDV_Y2 VDV_Z2;
Run;
```

APPENDIX E

SAS CODE VIBRATION OUTPUT

Filename	Time	Max_X1	Max_Y1	Max_Z1	RMS_X	RMS_Y	RMS_Z	VDV_X	VDV_Y	VDV_Z
XMSU_0000_0000_MS_100715_2042	468.792	3.836	3.029	6.057	0.917	0.944	0.716	1.313	1.246	1.306
XMSU_0000_0000_MS_100808_1339	991.905	4.765	5.371	5.769	0.921	0.842	0.806	1.549	1.401	1.281
XMSU_0000_0000_MS_100808_2241	181	3.069	2.342	3.750	0.910	0.611	0.743	1.202	0.877	1.151
XMSU_0000_0000_MS_100809_1725	437.807	6.340	2.867	6.778	0.950	0.789	0.856	1.482	1.076	1.348
XMSU_0000_0000_MS_100809_2046	1358.741	4.401	2.544	5.076	0.748	0.470	0.750	1.072	0.732	1.110
XMSU_0000_0000_MS_100809_2202	1309.866	5.209	2.827	5.711	0.821	0.456	0.868	1.254	0.730	1.278
XMSU_0000_0000_MS_100810_0019	636.313	5.613	3.675	5.048	0.890	0.873	0.737	1.396	1.314	1.156
XMSU_0000_0000_MS_100810_1443	489.102	2.504	2.423	3.923	0.569	0.677	0.553	0.906	0.948	0.870
XMSU_0000_0000_MS_100810_1714	1101.003	6.703	3.715	6.115	0.867	0.558	0.769	1.287	0.978	1.144
XMSU_0000_0000_MS_100811_1414	714.912	5.572	3.150	5.826	0.758	0.910	0.697	1.200	1.281	1.165
XMSU_0000_0000_MS_100812_0050	567.036	8.116	3.755	5.048	1.084	0.796	0.900	1.750	1.227	1.391
XMSU_0000_0000_MS_100813_0949	916.662	9.086	3.998	5.192	1.025	0.882	0.824	1.752	1.328	1.258
XMSU_0000_0000_MS_100813_2007	1134.51	4.765	4.200	4.586	0.843	0.754	0.739	1.243	1.139	1.139
XMSU_0000_0000_MS_100814_0746	780.605	5.290	2.382	6.547	0.705	0.582	0.644	1.312	0.803	1.148
XMSU_0000_0000_MS_100814_1003	481.577	3.998	3.311	5.019	0.873	0.733	0.653	1.291	1.151	1.171
XMSU_0000_0000_MS_100814_1517	723.299	4.603	3.432	7.355	0.890	0.792	0.818	1.373	1.212	1.370
XMSU_0000_0000_MS_100815_0049	354.648	5.532	2.584	5.480	0.665	0.635	0.651	1.140	0.954	1.101
XMSU_0000_0000_MS_100815_1240	543.141	2.584	2.504	5.307	0.658	0.587	0.655	1.080	0.884	1.132
XMSU_0000_0000_MS_100815_1850	623.635	5.330	2.705	4.701	0.778	0.707	0.613	1.289	1.021	0.991
XMSU_0000_0000_MS_100815_2001	1354.923	3.836	3.392	7.615	0.746	0.497	0.789	1.112	0.768	1.208
XMSU_0000_0000_MS_100816_1715	400.043	3.715	3.352	5.134	0.849	0.734	0.737	1.355	1.110	1.235
XMSU_0000_0000_MS_100816_2056	826.571	4.563	5.128	7.845	0.981	0.727	0.876	1.610	1.302	1.542
XMSU_0000_0000_MS_100817_0253	174.32	4.200	3.109	6.086	1.141	1.134	0.802	1.540	1.413	1.532
XMSU_0000_0000_MS_100818_1203	1219.885	3.796	4.119	5.509	0.904	0.592	0.827	1.299	1.064	1.269
XMSU_0000_0000_MS_100818_1533	737.31	3.634	3.634	5.711	0.889	0.568	0.773	1.407	0.956	1.217
XMSU_0000_0000_MS_100818_1952	1029.361	4.644	3.392	3.836	0.936	0.539	0.719	1.499	0.884	1.060
XMSU_0000_0000_MS_100818_2240	360.548	3.029	2.948	7.153	0.754	0.915	0.645	1.113	1.206	1.154
XMSU_0000_0000_MS_100828_0448	468.897	7.511	2.988	4.182	0.859	0.722	0.668	1.351	1.088	1.094
XMSU_0000_0000_MS_100828_0617	824.614	4.038	3.150	6.403	0.880	0.619	0.778	1.261	0.902	1.232
XMSU_0000_0000_MS_100828_0749	640.475	3.553	2.988	5.711	0.773	0.661	0.673	1.155	1.039	1.142
XMSU_0000_0000_MS_100828_1114	931.946	4.926	3.836	5.394	0.811	0.878	0.694	1.357	1.305	1.132
XMSU_0000_0000_MS_100828_1203	324.603	7.470	5.774	7.730	1.600	1.620	0.799	2.627	2.220	1.481

Filename	Time	Max_X1	Max_Y1	Max_Z1	RMS_X	RMS_Y	RMS_Z	VDV_X	VDV_Y	VDV_Z
XMSU_0000_0000_MS_100828_1706	487.965	2.423	2.342	4.355	0.554	0.720	0.572	0.894	0.984	0.926
XMSU_0000_0000_MS_100828_2108	300.06	2.059	2.302	5.134	0.701	0.638	0.623	0.959	0.908	1.069
XMSU_0000_0000_MS_100828_2211	907.901	6.299	2.100	5.221	0.871	0.500	0.698	1.381	0.713	1.041
XMSU_0000_0000_MS_100829_0149	1242.572	4.886	2.786	5.105	0.817	0.422	0.804	1.313	0.643	1.192
XMSU_0000_0000_MS_100830_1004	249.634	3.513	2.261	4.500	0.846	0.753	0.617	1.264	1.020	1.031
XMSU_0000_0000_MS_100831_0908	211.312	3.352	2.584	4.788	0.969	0.672	0.705	1.447	0.978	1.172
XMSU_0000_0000_MS_100831_2229	578.584	3.230	3.513	7.153	0.722	0.791	0.630	1.152	1.165	1.217
XMSU_0000_0000_MS_100831_2359	1281.412	4.401	2.827	9.749	0.787	0.428	0.793	1.243	0.699	1.372
XMSU_0000_0000_MS_100902_1120	376.087	1.938	1.857	3.692	0.596	0.559	0.510	0.804	0.757	0.759
XMSU_0000_0000_MS_100902_1816	633.653	2.867	2.625	3.952	0.563	0.571	0.549	0.828	0.859	0.819
XMSU_0000_0000_MS_100902_2233	534.772	3.352	2.907	5.278	0.715	0.683	0.583	1.156	1.050	0.980
XMSU_0000_0000_MS_100903_0506	818.97	5.249	2.786	7.095	0.898	0.499	0.727	1.253	0.790	1.133
XMSU_0000_0000_MS_100903_1406	739.757	4.200	2.786	5.278	0.769	0.757	0.748	1.312	1.061	1.258
XMSU_0000_0000_MS_100903_1739	470.844	4.119	2.544	4.442	0.808	0.698	0.712	1.514	0.991	1.160
XMSU_0000_0000_MS_100903_1823	481.212	5.451	3.352	7.845	0.978	0.781	0.822	1.515	1.125	1.427
XMSU_0000_0000_MS_100904_1953	307.947	4.240	3.796	11.306	0.766	1.097	0.956	1.652	1.543	2.070
XMSU_0000_0000_MS_100904_2049	326.459	7.188	3.352	5.105	0.958	0.742	0.958	1.777	1.152	1.463
XMSU_0000_0000_MS_100904_2153	628.714	3.190	2.867	5.192	0.636	0.744	0.588	1.009	1.078	0.970
XMSU_0000_0000_MS_100905_0046	483.869	2.100	2.544	2.942	0.579	0.616	0.569	0.836	0.912	0.823
XMSU_0000_0000_MS_100905_0628	787.454	6.663	3.069	5.769	0.963	0.726	0.903	1.385	1.083	1.386
XMSU_0000_0000_MS_100905_0820	530.675	4.442	2.746	4.384	0.588	0.603	0.617	0.872	0.907	1.020
XMSU_0000_0000_MS_100905_2204	945.696	5.936	2.867	5.192	0.883	0.526	0.716	1.336	0.820	1.129
XMSU_0000_0000_MS_100906_0708	461.68	3.715	3.715	5.567	0.916	0.872	0.747	1.467	1.329	1.276
XMSU_0000_0000_MS_100906_1417	516.757	4.240	3.069	4.557	0.838	0.771	0.742	1.349	1.098	1.240
XMSU_0000_0000_MS_100907_0003	1254.6	6.865	3.392	5.221	0.991	0.571	0.849	1.519	0.918	1.237
XMSU_0000_0000_MS_100907_1405	864.264	2.504	2.827	3.750	0.541	0.551	0.585	0.878	0.819	0.876
XMSU_0000_0000_MS_100909_0007	656.046	3.311	3.029	5.394	0.778	0.602	0.644	1.211	0.916	1.038
XMSU_0000_0000_MS_100909_1217	576.322	3.917	2.544	5.076	0.746	0.763	0.723	1.191	1.021	1.185
XMSU_0000_0000_MS_100909_1345	463.535	4.038	2.221	4.701	0.818	0.643	0.642	1.249	0.918	1.052
XMSU_0000_0000_MS_100909_1442	451.124	5.290	3.109	5.624	0.741	0.710	0.707	1.194	1.084	1.230
XMSU_0000_0000_MS_100909_1737	660	3.069	3.029	3.721	0.528	0.763	0.544	0.849	1.106	0.862
XMSU_0000_0000_MS_100909_1837	540.884	3.957	2.625	5.278	0.725	0.646	0.691	1.069	0.895	1.206

Filename	Time	Max_X1	Max_Y1	Max_Z1	RMS_X	RMS_Y	RMS_Z	VDV_X	VDV_Y	VDV_Z
XMSU_0000_0000_MS_100909_1938	600.076	3.069	2.705	9.518	0.662	0.701	0.701	1.160	1.035	1.374
XMSU_0000_0000_MS_100909_2156	1098.093	5.653	3.109	4.153	0.667	0.511	0.711	1.046	0.795	1.064
XMSU_0000_0000_MS_100911_1803	467.334	4.482	2.988	5.221	0.609	0.735	0.688	0.900	1.089	1.087
XMSU_0000_0000_MS_100911_1834	564.828	2.181	3.029	3.461	0.551	0.654	0.592	0.810	1.021	0.940
XMSU_0000_0000_MS_100913_2255	448.375	3.392	2.584	4.586	0.829	0.750	0.666	1.271	1.057	1.032
XMSU_0000_0000_MS_100914_1708	454.924	4.401	2.705	6.086	0.908	0.727	0.764	1.353	0.997	1.311
XMSU_0000_0000_MS_100922_1224	464.338	2.827	2.463	3.836	0.608	0.705	0.625	0.994	0.985	1.075
XMSU_0000_0000_MS_100922_1348	1449.125	7.390	4.078	8.105	0.743	0.724	0.662	1.303	1.067	1.170
XMSU_0000_0000_MS_100922_1839	478.805	3.715	2.705	4.269	0.742	0.591	0.706	1.073	0.904	1.114
XMSU_0000_0000_MS_100922_1947	1454.871	7.349	2.625	9.086	0.776	0.532	0.696	1.272	0.855	1.140
XMSU_0000_0000_MS_100927_1240	624.973	7.793	2.463	4.471	0.689	0.579	0.608	1.269	0.877	1.012
XMSU_0000_0000_MS_100928_1155	490.009	4.846	3.836	5.913	0.906	0.739	0.754	1.664	1.123	1.295
XMSU_0000_0000_MS_100928_1524	418.448	2.827	2.786	4.932	0.706	0.760	0.638	1.101	1.123	1.049
XMSU_0000_0000_MS_100928_2017	404.904	3.513	2.544	5.048	0.770	0.689	0.704	1.100	0.983	1.202
XMSU_0000_0000_MS_100929_0946	900.036	5.411	3.029	4.788	0.625	0.662	0.648	1.052	0.985	1.087
XMSU_0000_0000_MS_100929_2203	1196.091	8.924	3.432	4.644	0.714	0.569	0.742	1.177	0.951	1.086
XMSU_0000_0000_MS_100930_0314	774.603	3.594	2.827	7.124	0.571	0.559	0.612	0.846	0.846	1.038
XMSU_0000_0000_MS_100930_0908	810.682	4.078	3.917	4.673	0.806	0.881	0.688	1.315	1.238	1.155
XMSU_0000_0000_MS_100930_1033	818.037	4.563	4.038	6.115	1.127	0.881	0.880	1.634	1.218	1.471
XMSU_0000_0000_MS_100930_1203	800.253	5.371	6.542	6.057	0.882	1.018	0.717	1.520	1.507	1.214
XMSU_0000_0000_MS_100930_1759	654.055	4.159	3.150	5.076	0.843	0.801	0.708	1.849	1.132	1.177
XMSU_0000_0000_MS_101001_1146	991.881	5.128	3.675	8.682	0.833	0.731	0.663	1.474	1.058	1.258
XMSU_0000_0000_MS_101001_1516	773.694	4.038	3.432	8.047	0.761	0.709	0.702	1.231	1.087	1.324
XMSU_0000_0000_MS_101001_1621	297.728	4.038	2.625	4.586	0.962	0.771	0.667	1.349	1.064	1.095
XMSU_0000_0000_MS_101001_1717	448.954	4.401	3.755	5.480	0.910	0.961	0.670	1.415	1.342	1.145
XMSU_0000_0000_MS_101001_2324	1219.822	4.321	2.665	6.519	0.768	0.455	0.805	1.180	0.725	1.236
XMSU_0000_0000_MS_101002_0043	394.679	3.029	2.544	4.932	0.732	0.697	0.697	1.120	0.996	1.195
XMSU_0000_0000_MS_101002_1011	1458.825	4.240	2.988	6.547	0.744	0.686	0.678	1.185	0.997	1.146
XMSU_0000_0000_MS_101002_1339	580.793	5.774	2.907	5.538	0.738	0.808	0.659	1.181	1.169	1.254
XMSU_0000_0000_MS_101002_1502	369.064	3.029	3.150	4.730	0.830	0.784	0.683	1.219	1.124	1.112
XMSU_0000_0000_MS_101002_1620	466.006	6.138	3.029	6.807	0.958	0.728	0.797	1.468	1.028	1.376
XMSU_0000_0000_MS_101002_2018	1032.075	4.401	2.463	6.634	0.813	0.535	0.697	1.254	0.799	1.139

Filename	Time	Max_X1	Max_Y1	Max_Z1	RMS_X	RMS_Y	RMS_Z	VDV_X	VDV_Y	VDV_Z
XMSU_0000_0000_MS_101002_2244	844.7	4.563	3.069	4.817	0.780	0.629	0.666	1.207	0.938	1.068
XMSU_0000_0000_MS_101006_0506	924.401	6.663	5.855	6.115	0.922	0.847	0.721	1.595	1.496	1.238
XMSU_0000_0000_MS_101009_0846	690.196	4.240	5.209	6.720	0.737	0.769	0.698	1.272	1.236	1.240
XMSU_0000_0000_MS_101014_1552	94.871	4.119	3.109	3.663	0.846	1.188	0.627	1.363	1.589	1.024
XMSU_0000_0000_MS_101018_0229	474.966	7.834	3.352	6.259	0.985	0.830	0.768	1.564	1.238	1.365
XMSU_0000_0000_MS_101018_0407	451.905	5.209	4.805	6.172	1.018	0.992	0.714	1.621	1.510	1.212

Filename	CrestFactorX	CrestFactorY	CrestFactorZ	SevereAxis	a_wMAX	a_wTOTAL	VDV_TOTAL
XMSU_0000_0000_MS_100715_2042	4.183	3.209	8.458	Z	0.716	1.498	2.232
XMSU_0000_0000_MS_100808_1339	5.174	6.376	7.154	Z	0.806	1.486	2.450
XMSU_0000_0000_MS_100808_2241	3.374	3.832	5.047	Z	0.743	1.324	1.881
XMSU_0000_0000_MS_100809_1725	6.676	3.632	7.921	Z	0.856	1.502	2.274
XMSU_0000_0000_MS_100809_2046	5.881	5.411	6.771	Z	0.750	1.159	1.708
XMSU_0000_0000_MS_100809_2202	6.343	6.195	6.577	Z	0.868	1.279	1.933
XMSU_0000_0000_MS_100810_0019	6.305	4.211	6.852	X	0.890	1.448	2.239
XMSU_0000_0000_MS_100810_1443	4.401	3.580	7.095	Z	0.553	1.043	1.573
XMSU_0000_0000_MS_100810_1714	7.732	6.659	7.948	X	0.867	1.286	1.981
XMSU_0000_0000_MS_100811_1414	7.350	3.463	8.362	Z	0.697	1.374	2.106
XMSU_0000_0000_MS_100812_0050	7.487	4.716	5.609	X	1.084	1.618	2.550
XMSU_0000_0000_MS_100813_0949	8.867	4.531	6.300	X	1.025	1.583	2.533
XMSU_0000_0000_MS_100813_2007	5.654	5.570	6.208	X	0.843	1.351	2.035
XMSU_0000_0000_MS_100814_0746	7.504	4.097	10.165	Z	0.644	1.118	1.919
XMSU_0000_0000_MS_100814_1003	4.580	4.515	7.683	Z	0.653	1.314	2.089
XMSU_0000_0000_MS_100814_1517	5.170	4.331	8.990	Z	0.818	1.446	2.287
XMSU_0000_0000_MS_100815_0049	8.316	4.067	8.423	X	0.665	1.127	1.850
XMSU_0000_0000_MS_100815_1240	3.930	4.264	8.100	Z	0.655	1.098	1.797
XMSU_0000_0000_MS_100815_1850	6.852	3.829	7.675	X	0.778	1.216	1.920
XMSU_0000_0000_MS_100815_2001	5.141	6.828	9.645	Z	0.789	1.195	1.812
XMSU_0000_0000_MS_100816_1715	4.377	4.565	6.970	Z	0.737	1.343	2.143
XMSU_0000_0000_MS_100816_2056	4.653	7.058	8.958	Z	0.876	1.502	2.581
XMSU_0000_0000_MS_100817_0253	3.681	2.742	7.589	Z	0.802	1.797	2.591
XMSU_0000_0000_MS_100818_1203	4.198	6.955	6.663	Z	0.827	1.361	2.105
XMSU_0000_0000_MS_100818_1533	4.087	6.401	7.390	Z	0.773	1.308	2.091
XMSU_0000_0000_MS_100818_1952	4.961	6.293	5.333	X	0.936	1.298	2.038
XMSU_0000_0000_MS_100818_2240	4.017	3.221	11.083	Z	0.645	1.350	2.006
XMSU_0000_0000_MS_100828_0448	8.742	4.137	6.257	X	0.859	1.306	2.051
XMSU_0000_0000_MS_100828_0617	4.589	5.085	8.235	Z	0.778	1.328	1.981
XMSU_0000_0000_MS_100828_0749	4.597	4.519	8.490	Z	0.673	1.220	1.929
XMSU_0000_0000_MS_100828_1114	6.071	4.367	7.772	Z	0.694	1.383	2.197
XMSU_0000_0000_MS_100828_1203	4.668	3.564	9.678	Z	0.799	2.413	3.744

Filename	CrestFactorX	CrestFactorY	CrestFactorZ	SevereAxis	a_wMAX	a_wTOTAL	VDV_TOTAL
XMSU_0000_0000_MS_100828_1706	4.377	3.252	7.608	Z	0.572	1.074	1.621
XMSU_0000_0000_MS_100828_2108	2.936	3.607	8.237	Z	0.623	1.135	1.699
XMSU_0000_0000_MS_100828_2211	7.232	4.197	7.481	X	0.871	1.223	1.871
XMSU_0000_0000_MS_100829_0149	5.983	6.597	6.348	Z	0.804	1.222	1.887
XMSU_0000_0000_MS_100830_1004	4.154	3.004	7.296	Z	0.617	1.289	1.924
XMSU_0000_0000_MS_100831_0908	3.458	3.844	6.793	Z	0.705	1.374	2.103
XMSU_0000_0000_MS_100831_2229	4.472	4.441	11.357	Z	0.630	1.243	2.041
XMSU_0000_0000_MS_100831_2359	5.594	6.600	12.287	Z	0.793	1.197	1.979
XMSU_0000_0000_MS_100902_1120	3.254	3.321	7.243	Z	0.510	0.963	1.340
XMSU_0000_0000_MS_100902_1816	5.095	4.600	7.194	Z	0.549	0.972	1.447
XMSU_0000_0000_MS_100902_2233	4.688	4.257	9.060	Z	0.583	1.148	1.844
XMSU_0000_0000_MS_100903_0506	5.843	5.583	9.764	Z	0.727	1.259	1.865
XMSU_0000_0000_MS_100903_1406	5.459	3.682	7.054	Z	0.748	1.313	2.105
XMSU_0000_0000_MS_100903_1739	5.101	3.643	6.237	Z	0.712	1.283	2.149
XMSU_0000_0000_MS_100903_1823	5.575	4.294	9.548	Z	0.822	1.497	2.366
XMSU_0000_0000_MS_100904_1953	5.534	3.459	11.831	Z	0.956	1.645	3.065
XMSU_0000_0000_MS_100904_2049	7.499	4.519	5.331	X	0.958	1.545	2.574
XMSU_0000_0000_MS_100904_2153	5.015	3.852	8.824	Z	0.588	1.142	1.766
XMSU_0000_0000_MS_100905_0046	3.628	4.129	5.175	Z	0.569	1.019	1.486
XMSU_0000_0000_MS_100905_0628	6.922	4.226	6.386	X	0.963	1.507	2.239
XMSU_0000_0000_MS_100905_0820	7.558	4.551	7.108	X	0.588	1.044	1.620
XMSU_0000_0000_MS_100905_2204	6.726	5.452	7.246	X	0.883	1.253	1.932
XMSU_0000_0000_MS_100906_0708	4.056	4.259	7.456	Z	0.747	1.469	2.355
XMSU_0000_0000_MS_100906_1417	5.058	3.981	6.139	Z	0.742	1.359	2.137
XMSU_0000_0000_MS_100907_0003	6.930	5.944	6.147	X	0.991	1.424	2.163
XMSU_0000_0000_MS_100907_1405	4.627	5.128	6.414	Z	0.585	0.969	1.486
XMSU_0000_0000_MS_100909_0007	4.257	5.033	8.379	Z	0.644	1.175	1.840
XMSU_0000_0000_MS_100909_1217	5.253	3.333	7.021	Z	0.723	1.289	1.966
XMSU_0000_0000_MS_100909_1345	4.935	3.454	7.323	Z	0.642	1.223	1.874
XMSU_0000_0000_MS_100909_1442	7.140	4.378	7.957	Z	0.707	1.246	2.028
XMSU_0000_0000_MS_100909_1737	5.810	3.969	6.845	Z	0.544	1.076	1.640
XMSU_0000_0000_MS_100909_1837	5.455	4.060	7.643	Z	0.691	1.192	1.844

Filename	CrestFactorX	CrestFactorY	CrestFactorZ	SevereAxis	a_wMAX	a_wTOTAL	VDV_TOTAL
XMSU_0000_0000_MS_100909_1938	4.635	3.860	13.582	Z	0.701	1.192	2.075
XMSU_0000_0000_MS_100909_2156	8.479	6.087	5.841	X	0.667	1.100	1.691
XMSU_0000_0000_MS_100911_1803	7.366	4.065	7.589	Z	0.688	1.176	1.782
XMSU_0000_0000_MS_100911_1834	3.957	4.632	5.846	Z	0.592	1.040	1.607
XMSU_0000_0000_MS_100913_2255	4.092	3.446	6.883	Z	0.666	1.301	1.949
XMSU_0000_0000_MS_100914_1708	4.846	3.723	7.968	Z	0.764	1.392	2.131
XMSU_0000_0000_MS_100922_1224	4.646	3.492	6.141	Z	0.625	1.122	1.764
XMSU_0000_0000_MS_100922_1348	9.951	5.633	12.239	Z	0.662	1.231	2.050
XMSU_0000_0000_MS_100922_1839	5.007	4.579	6.043	Z	0.706	1.183	1.791
XMSU_0000_0000_MS_100922_1947	9.474	4.934	13.050	Z	0.696	1.170	1.909
XMSU_0000_0000_MS_100927_1240	11.313	4.257	7.357	X	0.689	1.086	1.845
XMSU_0000_0000_MS_100928_1155	5.347	5.194	7.841	Z	0.754	1.391	2.388
XMSU_0000_0000_MS_100928_1524	4.004	3.667	7.736	Z	0.638	1.217	1.890
XMSU_0000_0000_MS_100928_2017	4.564	3.694	7.173	Z	0.704	1.250	1.903
XMSU_0000_0000_MS_100929_0946	8.653	4.572	7.392	X	0.625	1.118	1.806
XMSU_0000_0000_MS_100929_2203	12.493	6.029	6.258	X	0.714	1.177	1.862
XMSU_0000_0000_MS_100930_0314	6.293	5.056	11.643	Z	0.612	1.006	1.585
XMSU_0000_0000_MS_100930_0908	5.063	4.445	6.791	Z	0.688	1.378	2.144
XMSU_0000_0000_MS_100930_1033	4.050	4.584	6.951	Z	0.880	1.679	2.513
XMSU_0000_0000_MS_100930_1203	6.088	6.426	8.453	Y	1.018	1.526	2.460
XMSU_0000_0000_MS_100930_1759	4.936	3.933	7.171	Z	0.708	1.361	2.467
XMSU_0000_0000_MS_101001_1146	6.158	5.030	13.104	Z	0.663	1.291	2.208
XMSU_0000_0000_MS_101001_1516	5.304	4.844	11.467	Z	0.702	1.255	2.109
XMSU_0000_0000_MS_101001_1621	4.197	3.402	6.875	Z	0.667	1.402	2.037
XMSU_0000_0000_MS_101001_1717	4.839	3.910	8.181	Z	0.670	1.483	2.262
XMSU_0000_0000_MS_101001_2324	5.623	5.853	8.097	Z	0.805	1.202	1.856
XMSU_0000_0000_MS_101002_0043	4.137	3.648	7.071	Z	0.697	1.228	1.917
XMSU_0000_0000_MS_101002_1011	5.696	4.356	9.659	Z	0.678	1.218	1.926
XMSU_0000_0000_MS_101002_1339	7.819	3.596	8.406	X	0.738	1.278	2.082
XMSU_0000_0000_MS_101002_1502	3.650	4.017	6.921	Z	0.683	1.331	1.997
XMSU_0000_0000_MS_101002_1620	6.407	4.158	8.539	Z	0.797	1.444	2.260
XMSU_0000_0000_MS_101002_2018	5.412	4.603	9.522	Z	0.697	1.197	1.873

Filename	CrestFactorX	CrestFactorY	CrestFactorZ	SevereAxis	a_wMAX	a_wTOTAL	VDV_TOTAL
XMSU_0000_0000_MS_101002_2244	5.851	4.877	7.235	Z	0.666	1.203	1.865
XMSU_0000_0000_MS_101006_0506	7.224	6.914	8.479	X	0.922	1.445	2.513
XMSU_0000_0000_MS_101009_0846	5.754	6.771	9.627	Z	0.698	1.274	2.164
XMSU_0000_0000_MS_101014_1552	4.871	2.618	5.843	X	0.846	1.587	2.330
XMSU_0000_0000_MS_101018_0229	7.951	4.037	8.154	X	0.985	1.500	2.417
XMSU_0000_0000_MS_101018_0407	5.115	4.845	8.639	Z	0.714	1.591	2.526

APPENDIX F

SAS CODE FOR PATIENT ILLNESS PREDICTORS

```
DATA Transported_PCR;
      INFILE "C:\Documents and Settings\JMueller\Desktop\PCR Analysis
Emergency Mode\PCR Transported Only.csv" dlm=',' DSD FIRSTOBS=2 LRECL=1000;
      INPUT Index FromScene012 TransMode012 Emerg_NonEmerg :$12. TransMode0_1
PrimaryInjury :$15. InjuryCode1_62 Outcome :$11. Response1-Response47;

Array Responses (47) Response1-Response47;
      Do i = 1 to 47;
            If Responses(i) = . Then Responses(i) = 0;
      End;
Drop i;
RUN;

Proc SQL;
Create Table PatientIllness
      (
            TransMode   Numeric,
            Illness1    Numeric,
            Illness2    Numeric,
            Illness3    Numeric,
            Illness4    Numeric,
            Illness5    Numeric,
            Illness6    Numeric,
            Illness7    Numeric,
            Illness8    Numeric,
            Illness9    Numeric,
            Illness10   Numeric,
            Illness11   Numeric,
            Illness12   Numeric,
            Illness13   Numeric,
            Illness14   Numeric,
            Illness15   Numeric,
            Illness16   Numeric,
            Illness17   Numeric,
            Illness18   Numeric,
            Illness19   Numeric,
            Illness20   Numeric,
            Illness21   Numeric,
            Illness22   Numeric,
            Illness23   Numeric,
            Illness24   Numeric,
            Illness25   Numeric,
            Illness26   Numeric,
            Illness27   Numeric,
            Illness28   Numeric,
            Illness29   Numeric,
            Illness30   Numeric,
            Illness31   Numeric,
            Illness32   Numeric,
            Illness33   Numeric,
            Illness34   Numeric,
```

```
            Illness35   Numeric,
            Illness36   Numeric,
            Illness37   Numeric,
            Illness38   Numeric,
            Illness39   Numeric,
            Illness40   Numeric,
            Illness41   Numeric,
            Illness42   Numeric,
            Illness43   Numeric,
            Illness44   Numeric,
            Illness45   Numeric,
            Illness46   Numeric,
            Illness47   Numeric,
            Illness48   Numeric,
            Illness49   Numeric,
            Illness50   Numeric,
            Illness51   Numeric,
            Illness52   Numeric,
            Illness53   Numeric,
            Illness54   Numeric,
            Illness55   Numeric,
            Illness56   Numeric,
            Illness57   Numeric,
            Illness58   Numeric,
            Illness59   Numeric,
            Illness60   Numeric,
            Illness61   Numeric,
            Illness62   Numeric
      )
;
quit;

/*This is to identify patient illnesses that are contributing to the
quasi-complete separation of our data.  Violating illnesses are 7, 15, 17,
18, 19, 21, 22, 24, 25, 26, 27, 32, 35, 38, 39, 40, 41, 42, 50, 53, 59 */
Proc freq data = Transported_PCR;
      TABLES InjuryCode1_62  * TransMode0_1;
      TITLE;
run;

/*Creating dummy variables and deleting those which contribute to
quasi-complete data separation*/
Data DummyIllnesses;
Set Transported_PCR (drop = FromScene012 TransMode012 Emerg_NonEmerg
PrimaryInjury Outcome Response16 Response28 Response29 Response33 Response35
Response41);

      if InjuryCode1_62 = 1 then Illness_1 = 1;
            else Illness_1 = 0;
      if InjuryCode1_62 = 2 then Illness_2 = 1;
             else Illness_2 = 0;
```

```
if InjuryCode1_62 = 3 then Illness_3 = 1;
      else Illness_3 = 0;
if InjuryCode1_62 = 4 then Illness_4 = 1;
      else Illness_4 = 0;
if InjuryCode1_62 = 5 then Illness_5 = 1;
      else Illness_5 = 0;
if InjuryCode1_62 = 6 then Illness_6 = 1;
      else Illness_6 = 0;
if InjuryCode1_62 = 7 then delete;
if InjuryCode1_62 = 8 then Illness_8 = 1;
      else Illness_8 = 0;
if InjuryCode1_62 = 9 then Illness_9 = 1;
      else Illness_9 = 0;
if InjuryCode1_62 = 10 then Illness_10 = 1;
      else Illness_10 = 0;
if InjuryCode1_62 = 11 then Illness_11 = 1;
      else Illness_11 = 0;
if InjuryCode1_62 = 12 then Illness_12 = 1;
      else Illness_12 = 0;
if InjuryCode1_62 = 13 then Illness_13 = 1;
      else Illness_13 = 0;
if InjuryCode1_62 = 14 then Illness_14 = 1;
      else Illness_14 = 0;
if InjuryCode1_62 = 15 then delete;
if InjuryCode1_62 = 16 then Illness_16 = 1;
      else Illness_16 = 0;
if InjuryCode1_62 = 17 then delete;
if InjuryCode1_62 = 18 then delete;
if InjuryCode1_62 = 19 then delete;
if InjuryCode1_62 = 20 then Illness_20 = 1;
      else Illness_20 = 0;
if InjuryCode1_62 = 21 then delete;
if InjuryCode1_62 = 22 then delete;
if InjuryCode1_62 = 23 then Illness_23 = 1;
      else Illness_23 = 0;
if InjuryCode1_62 = 24 then delete;
if InjuryCode1_62 = 25 then delete;
if InjuryCode1_62 = 26 then delete;
if InjuryCode1_62 = 27 then delete;
if InjuryCode1_62 = 28 then Illness_28 = 1;
      else Illness_28 = 0;
if InjuryCode1_62 = 29 then Illness_29 = 1;
      else Illness_29 = 0;
if InjuryCode1_62 = 30 then Illness_30 = 1;
      else Illness_30 = 0;
if InjuryCode1_62 = 31 then Illness_31 = 1;
      else Illness_31 = 0;
if InjuryCode1_62 = 32 then delete;
if InjuryCode1_62 = 33 then Illness_33 = 1;
      else Illness_33 = 0;
if InjuryCode1_62 = 34 then Illness_34 = 1;
```

```
      else Illness_34 = 0;
if InjuryCode1_62 = 35 then delete;
if InjuryCode1_62 = 36 then Illness_36 = 1;
      else Illness_36 = 0;
if InjuryCode1_62 = 37 then Illness_37 = 1;
      else Illness_37 = 0;
if InjuryCode1_62 = 38 then delete;
if InjuryCode1_62 = 39 then delete;
if InjuryCode1_62 = 40 then delete;
if InjuryCode1_62 = 41 then delete;
if InjuryCode1_62 = 42 then delete;
if InjuryCode1_62 = 43 then Illness_43 = 1;
      else Illness_43 = 0;
if InjuryCode1_62 = 44 then Illness_44 = 1;
      else Illness_44 = 0;
if InjuryCode1_62 = 45 then Illness_45 = 1;
      else Illness_45 = 0;
if InjuryCode1_62 = 46 then Illness_46 = 1;
      else Illness_46 = 0;
if InjuryCode1_62 = 47 then Illness_47 = 1;
      else Illness_47 = 0;
if InjuryCode1_62 = 48 then Illness_48 = 1;
      else Illness_48 = 0;
if InjuryCode1_62 = 49 then Illness_49 = 1;
      else Illness_49 = 0;
if InjuryCode1_62 = 50 then delete;
if InjuryCode1_62 = 51 then Illness_51 = 1;
      else Illness_51 = 0;
if InjuryCode1_62 = 52 then Illness_52 = 1;
      else Illness_52 = 0;
if InjuryCode1_62 = 53 then delete;
if InjuryCode1_62 = 54 then Illness_54 = 1;
      else Illness_54 = 0;
if InjuryCode1_62 = 55 then Illness_55 = 1;
      else Illness_55 = 0;
if InjuryCode1_62 = 56 then Illness_56 = 1;
      else Illness_56 = 0;
if InjuryCode1_62 = 57 then Illness_57 = 1;
      else Illness_57 = 0;
if InjuryCode1_62 = 58 then Illness_58 = 1;
      else Illness_58 = 0;
if InjuryCode1_62 = 59 then delete;
if InjuryCode1_62 = 60 then Illness_60 = 1;
      else Illness_60 = 0;
if InjuryCode1_62 = 61 then Illness_61 = 1;
      else Illness_61 = 0;
if InjuryCode1_62 = 62 then delete;
Run;

/*This gives us our OR, p-values, AIC values for patient illness.
Illnesses contributing to quasi-complete separation of data are not
```

```
included in the model. Violating illnesses are 7, 15, 17, 18, 19, 21, 22, 24,
25, 26, 27, 32, 35, 38, 39, 40, 41, 42, 50, 53, 59*/
PROC logistic data = DummyIllnesses descending;
      model TransMode0_1 =  Illness_1 Illness_2 Illness_3 Illness_4 Illness_5
Illness_6 Illness_8 Illness_9 Illness_10 Illness_11 Illness_12 Illness_13
Illness_14 Illness_16 Illness_20 Illness_23 Illness_28 Illness_29 Illness_30
Illness_31 Illness_33 Illness_34 Illness_36 Illness_37 Illness_43 Illness_44
Illness_45 Illness_46 Illness_47 Illness_48 Illness_49 Illness_51 Illness_52
Illness_54 Illness_55 Illness_56 Illness_57 Illness_58 Illness_60 Illness_61
/ RIDGING = None;
RUN;
```

APPENDIX G

SAS CODE OUTPUT FOR PATIENT ILLNESS PREDICTORS

The LOGISTIC Procedure

Model Information

Data Set	WORK.DUMMYILLNESSES
Response Variable	TransMode0_1
Number of Response Levels	2
Model	binary logit
Optimization Technique	Fisher's scoring

Number of Observations Read	8737
Number of Observations Used	8737

Response Profile

Ordered Value	Trans Mode0_1	Total Frequency
1	1	501
2	0	8236

Probability modeled is TransMode0_1=1.

Model Convergence Status

Convergence criterion (GCONV=1E-8) satisfied.

Model Fit Statistics

Criterion	Intercept Only	Intercept and Covariates
AIC	3839.140	3368.258
SC	3846.215	3651.271
-2 Log L	3837.140	3288.258

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	DF	Pr > ChiSq
Likelihood Ratio	548.8818	39	<.0001
Score	1202.2897	39	<.0001
Wald	380.5082	39	<.0001

NOTE: The following parameters have been set to 0, since the variables are a linear combination of other variables as shown.

The LOGISTIC Procedure

```
 Illness_61 =  Intercept - Illness_1 - Illness_2 - Illness_3 - Illness_4 - Illness_5 - Illness_6
-
               Illness_8 - Illness_9 - Illness_10 - Illness_11 - Illness_12 - Illness_13 -
               Illness_14 - Illness_16 - Illness_20 - Illness_23 - Illness_28 - Illness_29
               - Illness_30 - Illness_31 - Illness_33 - Illness_34 - Illness_36 - Illness_37
               - Illness_43 - Illness_44 - Illness_45 - Illness_46 - Illness_47
               - Illness_48 - Illness_49 - Illness_51 - Illness_52 - Illness_54
               - Illness_55 - Illness_56 - Illness_57 - Illness_58 - Illness_60
```

Analysis of Maximum Likelihood Estimates

Parameter	DF	Estimate	Standard Error	Wald Chi-Square	Pr > ChiSq
Intercept	1	-3.6079	0.3378	114.0611	<.0001
Illness_1	1	-0.3401	0.5329	0.4073	0.5233
Illness_2	1	1.7361	0.8313	4.3616	0.0368
Illness_3	1	0.1422	0.7936	0.0321	0.8578
Illness_4	1	0.8353	0.3801	4.8295	0.0280
Illness_5	1	1.4678	0.8203	3.2017	0.0736
Illness_6	1	-0.9102	0.6716	1.8368	0.1753
Illness_8	1	0.5169	0.4799	1.1601	0.2814
Illness_9	1	0.8229	0.3957	4.3244	0.0376
Illness_10	1	5.5696	0.4908	128.7893	<.0001
Illness_11	1	1.3878	0.4004	12.0138	0.0005
Illness_12	1	1.0661	0.3785	7.9326	0.0049
Illness_13	1	2.2216	0.6532	11.5689	0.0007
Illness_14	1	1.5930	0.8251	3.7275	0.0535
Illness_16	1	0.9689	1.0888	0.7918	0.3736
Illness_20	1	0.4811	0.5682	0.7170	0.3971
Illness_23	1	0.3890	1.0743	0.1311	0.7173
Illness_28	1	1.1656	0.6212	3.5208	0.0606
Illness_29	1	1.4107	1.1069	1.6242	0.2025
Illness_30	1	-1.1283	1.0597	1.1337	0.2870
Illness_31	1	2.2862	0.5220	19.1829	<.0001
Illness_33	1	1.2100	1.0977	1.2150	0.2703
Illness_34	1	0.8779	0.6850	1.6425	0.2000
Illness_36	1	-0.0975	0.6750	0.0209	0.8852
Illness_37	1	2.2216	1.1680	3.6181	0.0572
Illness_43	1	1.9985	0.7170	7.7684	0.0053
Illness_44	1	0.2668	0.6107	0.1909	0.6622
Illness_45	1	-0.2964	0.3916	0.5728	0.4491
Illness_46	1	0.5634	0.4114	1.8752	0.1709
Illness_47	1	4.1957	0.6521	41.3981	<.0001
Illness_48	1	1.6883	0.4673	13.0534	0.0003

Illness_49	1	0.7109	0.3954	3.2327	0.0722
Illness_51	1	-0.1008	0.4654	0.0469	0.8286
Illness_52	1	1.3413	0.4231	10.0476	0.0015
Illness_54	1	-1.0333	0.6713	2.3690	0.1238
Illness_55	1	-0.0297	1.0679	0.0008	0.9778
Illness_56	1	1.0188	0.3528	8.3404	0.0039

The LOGISTIC Procedure

Analysis of Maximum Likelihood Estimates

Parameter	DF	Estimate	Standard Error	Wald Chi-Square	Pr > ChiSq
Illness_57	1	2.7717	0.4737	34.2371	<.0001
Illness_58	1	1.3053	1.1019	1.4034	0.2362
Illness_60	1	-0.2941	0.7901	0.1385	0.7097
Illness_61	0	0	.	.	.

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits	
Illness_1	0.712	0.250	2.023
Illness_2	5.675	1.113	28.945
Illness_3	1.153	0.243	5.460
Illness_4	2.306	1.095	4.856
Illness_5	4.340	0.869	21.664
Illness_6	0.402	0.108	1.501
Illness_8	1.677	0.655	4.295
Illness_9	2.277	1.048	4.946
Illness_10	262.321	100.250	686.405
Illness_11	4.006	1.828	8.781
Illness_12	2.904	1.383	6.098
Illness_13	9.222	2.564	33.175
Illness_14	4.919	0.976	24.783
Illness_16	2.635	0.312	22.263
Illness_20	1.618	0.531	4.928
Illness_23	1.476	0.180	12.117
Illness_28	3.208	0.949	10.838
Illness_29	4.099	0.468	35.880
Illness_30	0.324	0.041	2.582
Illness_31	9.837	3.536	27.363
Illness_33	3.354	0.390	28.834
Illness_34	2.406	0.628	9.211
Illness_36	0.907	0.242	3.406
Illness_37	9.222	0.935	90.992

Illness_43	7.378	1.810	30.079
Illness_44	1.306	0.394	4.322
Illness_45	0.743	0.345	1.602
Illness_46	1.757	0.784	3.934
Illness_47	66.400	18.497	238.362
Illness_48	5.410	2.165	13.520
Illness_49	2.036	0.938	4.419
Illness_51	0.904	0.363	2.251
Illness_52	3.824	1.669	8.763
Illness_54	0.356	0.095	1.326
Illness_55	0.971	0.120	7.873

The LOGISTIC Procedure

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits	
Illness_56	2.770	1.387	5.531
Illness_57	15.985	6.317	40.450
Illness_58	3.689	0.426	31.975
Illness_60	0.745	0.158	3.506

Association of Predicted Probabilities and Observed Responses

Percent Concordant	68.8	Somers' D	0.453
Percent Discordant	23.4	Gamma	0.492
Percent Tied	7.8	Tau-a	0.049
Pairs	4126236	c	0.727

APPENDIX H

SAS CODE FOR MEDICAL RESPONSE ACTIVITY PREDICTORS

```
DATA Transported_PCR;
      INFILE "C:\Documents and Settings\JMueller\Desktop\PCR Analysis
Emergency Mode\PCR Transported Only.csv" dlm=',' DSD FIRSTOBS=2 LRECL=1000;
      INPUT Index FromScene012 TransMode012 Emerg_NonEmerg :$12. TransMode0_1
PrimaryInjury :$15. InjuryCode1_62 Outcome :$11. Response1-Response47;

Array Responses (47) Response1-Response47;
      Do i = 1 to 47;
            If Responses(i) = . Then Responses(i) = 0;
      End;
Drop i;

RUN;


/*This gives us our OR, p-values, AIC values for patient responses.
Responses contributing to quasi-complete separation of data are not
included in the model.  Violating responses are 16 28 29 33 35 41*/

Proc logistic data = DummyIllnesses descending;
      model TransMode0_1 = Response1-Response15 Response17-Response27
Response30-Response32 Response34 Response36-Response40 Response42-Response47
/ RIDGING = none;
Run;
```

APPENDIX I

SAS CODE OUTPUT FOR MEDICAL RESPONSE ACTIVITY PREDICTORS

The LOGISTIC Procedure

Model Information

Data Set	WORK.DUMMYILLNESSES
Response Variable	TransMode0_1
Number of Response Levels	2
Model	binary logit
Optimization Technique	Fisher's scoring

Number of Observations Read	8737
Number of Observations Used	8737

Response Profile

Ordered Value	Trans Mode0_1	Total Frequency
1	1	501
2	0	8236

Probability modeled is TransMode0_1=1.

Model Convergence Status

Convergence criterion (GCONV=1E-8) satisfied.

Model Fit Statistics

Criterion	Intercept Only	Intercept and Covariates
AIC	3839.140	2906.207
SC	3846.215	3203.370
-2 Log L	3837.140	2822.207

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	DF	Pr > ChiSq
Likelihood Ratio	1014.9329	41	<.0001
Score	2090.0463	41	<.0001
Wald	582.0620	41	<.0001

The LOGISTIC Procedure

Analysis of Maximum Likelihood Estimates

Parameter	DF	Estimate	Standard Error	Wald Chi-Square	Pr > ChiSq
Intercept	1	-5.6280	1.0352	29.5560	<.0001
Response1	1	1.2592	1.0829	1.3521	0.2449
Response2	1	-0.5975	0.5067	1.3903	0.2383
Response3	1	0.1614	0.2868	0.3165	0.5737
Response4	1	0.0852	0.1755	0.2359	0.6272
Response5	1	0.9364	1.3753	0.4636	0.4959
Response6	1	0.7745	0.3715	4.3458	0.0371
Response7	1	1.2210	0.2801	18.9964	<.0001
Response8	1	0.8108	0.2657	9.3145	0.0023
Response9	1	1.5421	0.3612	18.2233	<.0001
Response10	1	-0.6239	0.5991	1.0845	0.2977
Response11	1	-1.8085	1.0246	3.1156	0.0775
Response12	1	1.4216	0.3132	20.6041	<.0001
Response13	1	-1.2823	1.3163	0.9490	0.3300
Response14	1	-1.1702	5.0095	0.0546	0.8153
Response15	1	-8.7569	434.8	0.0004	0.9839
Response17	1	0.7292	0.3924	3.4527	0.0631
Response18	1	1.0470	0.1501	48.6337	<.0001
Response19	1	-0.3939	0.3065	1.6511	0.1988
Response20	1	1.5435	0.4950	9.7221	0.0018
Response21	1	1.7229	0.3255	28.0094	<.0001
Response22	1	0.2685	0.1459	3.3846	0.0658
Response23	1	-0.3083	0.1225	6.3368	0.0118
Response24	1	1.0238	0.8319	1.5146	0.2184
Response25	1	0.5270	0.1320	15.9463	<.0001
Response26	1	-0.7904	2.7159	0.0847	0.7710
Response27	1	0.8194	0.9457	0.7508	0.3862
Response30	1	1.7007	0.5832	8.5042	0.0035
Response31	1	1.1566	0.4110	7.9192	0.0049
Response32	1	0.0397	1.0375	0.0015	0.9695
Response34	1	-0.0789	0.1179	0.4479	0.5033
Response36	1	1.7826	1.4110	1.5962	0.2064
Response37	1	0.8041	0.5891	1.8629	0.1723
Response38	1	3.0034	0.6602	20.6975	<.0001
Response39	1	-0.5874	1.0137	0.3357	0.5623
Response40	1	1.5337	0.1838	69.6094	<.0001
Response42	1	0.3482	0.1158	9.0354	0.0026
Response43	1	2.2199	0.7254	9.3652	0.0022
Response44	1	3.0130	1.3175	5.2302	0.0222
Response45	1	0.0162	0.1442	0.0127	0.9103
Response46	1	0.6690	1.0768	0.3860	0.5344
Response47	1	1.4695	1.3755	1.1414	0.2854

The LOGISTIC Procedure

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits	
Response1	3.522	0.422	29.417
Response2	0.550	0.204	1.485
Response3	1.175	0.670	2.062
Response4	1.089	0.772	1.536
Response5	2.551	0.172	37.788
Response6	2.170	1.047	4.494
Response7	3.391	1.958	5.871
Response8	2.250	1.337	3.787
Response9	4.674	2.303	9.489
Response10	0.536	0.166	1.734
Response11	0.164	0.022	1.221
Response12	4.144	2.243	7.656
Response13	0.277	0.021	3.661
Response14	0.310	<0.001	>999.999
Response15	<0.001	<0.001	>999.999
Response17	2.073	0.961	4.474
Response18	2.849	2.123	3.824
Response19	0.674	0.370	1.230
Response20	4.681	1.774	12.351
Response21	5.601	2.959	10.601
Response22	1.308	0.983	1.741
Response23	0.735	0.578	0.934
Response24	2.784	0.545	14.216
Response25	1.694	1.308	2.194
Response26	0.454	0.002	93.011
Response27	2.269	0.356	14.483
Response30	5.478	1.747	17.181
Response31	3.179	1.421	7.115
Response32	1.041	0.136	7.950
Response34	0.924	0.733	1.164
Response36	5.945	0.374	94.454
Response37	2.235	0.704	7.090
Response38	20.154	5.526	73.504
Response39	0.556	0.076	4.053
Response40	4.635	3.233	6.646
Response42	1.416	1.129	1.777
Response43	9.206	2.221	38.155
Response44	20.349	1.539	269.147
Response45	1.016	0.766	1.348
Response46	1.952	0.237	16.111
Response47	4.347	0.293	64.428

The LOGISTIC Procedure

Association of Predicted Probabilities and Observed Responses

Percent Concordant	82.1	Somers' D	0.658
Percent Discordant	16.3	Gamma	0.669
Percent Tied	1.6	Tau-a	0.071
Pairs	4126236	c	0.829

APPENDIX J

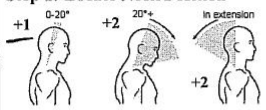
REBA ANALYSIS WORKSHEETS

REBA Employee Assessment Worksheet

based on Technical note: Rapid Entire Body Assessment (REBA), Hignett, McAtamney, Applied Ergonomics 31 (2000) 201-205

A. Neck, Trunk and Leg Analysis

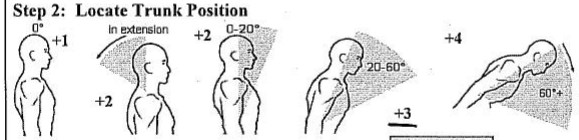
Step 1: Locate Neck Position



Step 1a: Adjust...
If neck is twisted: +1
If neck is side bending: +1

+1
Neck Score

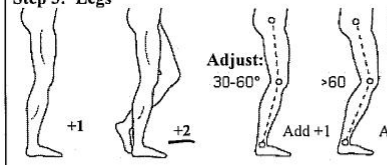
Step 2: Locate Trunk Position



Step 2a: Adjust...
If trunk is twisted: +1
If trunk is side bending: +1

+5
Trunk Score

Step 3: Legs



+2
Leg Score

Step 4: Look-up Posture Score in Table A
Using values from steps 1-3 above, locate score in Table A

6
Posture Score A

Step 5: Add Force/Load Score
If load < 11 lbs : +0
If load 11 to 22 lbs : +1
If load > 22 lbs: +2
Adjust: If shock or rapid build up of force: add +1

+0
Force/Load Score

Step 6: Score A, Find Row in Table C
Add values from steps 4 & 5 to obtain Score A.
Find Row in **Table C**.

6
Score A

Scoring:
1 = negligible risk
2 or 3 = low risk, change may be needed
4 to 7 = medium risk, further investigation, change soon
8 to 10 = high risk, investigate and implement change
11+ = very high risk, implement change

SCORES

Table A		Neck											
		1				2				3			
	Legs	1	2	3	4	1	2	3	4	1	2	3	4
Trunk Posture Score	1	1	2	3	4	1	2	3	4	3	3	5	6
	2	2	3	4	5	3	4	5	6	4	5	6	7
	3	2	4	5	6	4	5	6	7	5	6	7	8
	4	3	5	6	7	5	6	7	8	6	7	8	9
	5	4	6	7	8	6	7	8	9	7	8	9	9

Table B		Lower Arm					
		1			2		
	Wrist	1	2	3	1	2	3
Upper Arm Score	1	1	2	2	1	2	3
	2	1	2	3	2	3	4
	3	3	4	5	4	5	5
	4	4	5	5	5	6	7
	5	6	7	8	7	8	8
	6	7	8	8	8	9	9

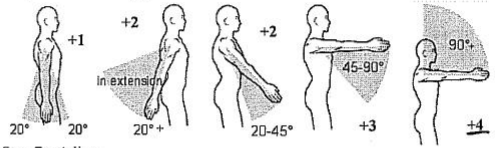
Score A (score from table A +load/force score)	Table C: Score B (table B value +coupling score)											
	1	2	3	4	5	6	7	8	9	10	11	12
1	1	1	1	2	3	3	4	5	6	7	7	7
2	1	2	2	3	4	4	5	6	6	7	7	8
3	2	3	3	3	4	5	6	7	7	8	8	8
4	3	4	4	4	5	6	7	8	8	9	9	9
5	4	4	4	5	6	7	8	8	9	9	9	9
6	6	6	6	7	8	8	9	9	10	10	10	10
7	7	7	7	8	9	9	9	10	10	11	11	11
8	8	8	8	9	10	10	10	10	10	11	11	11
9	9	9	9	10	10	10	11	11	11	12	12	12
10	10	10	10	11	11	11	11	12	12	12	12	12
11	11	11	11	11	12	12	12	12	12	12	12	12
12	12	12	12	12	12	12	12	12	12	12	12	12

9 (Table C Score) + +1 (Activity Score)

10
Final REBA Score

B. Arm and Wrist Analysis

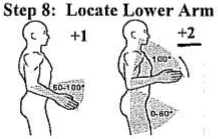
Step 7: Locate Upper Arm Position:



Step 7a: Adjust...
If shoulder is raised: +1
If upper arm is abducted: +1
If arm is supported or person is leaning: -1

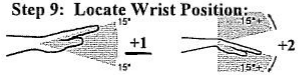
+5
Upper Arm Score

Step 8: Locate Lower Arm Position:



+2
Lower Arm Score

Step 9: Locate Wrist Position:



+1
Wrist Score

Step 9a: Adjust...
If wrist is bent from midline or twisted : Add +1

Step 10: Look-up Posture Score in Table B
Using values from steps 7-9 above, locate score in Table B

7
Posture Score B

+

Step 11: Add Coupling Score
Well fitting Handle and mid rang power grip, ***good: +0***
Acceptable but not ideal hand hold or coupling acceptable with another body part, ***fair: +1***
Hand hold not acceptable but possible, ***poor: +2***
No handles, awkward, unsafe with any body part, ***Unacceptable: +3***

0
Coupling Score

=

Step 12: Score B, Find Column in Table C
Add values from steps 10 &11 to obtain Score B. Find column in **Table C** and match with Score A in row from step 6 to obtain Table C Score.

7
Score B

Step 13: Activity Score
+1 1 or more body parts are held for longer than 1 minute (static)
+1 Repeated small range actions (more than 4x per minute)
+1 Action causes rapid large range changes in postures or unstable base

Task name: Bench to Top Rear Cab(2) Reviewer: Jesse Mueller Date: 2 / 7 / 11

provided by Practical Ergonomics

rbarker@ergosmart.com (816) 444-1667

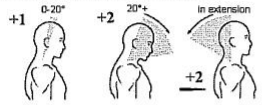
2

REBA Employee Assessment Worksheet

based on Technical note: Rapid Entire Body Assessment (REBA), Hignett, McAtamney, Applied Ergonomics 31 (2000) 201-205

A. Neck, Trunk and Leg Analysis

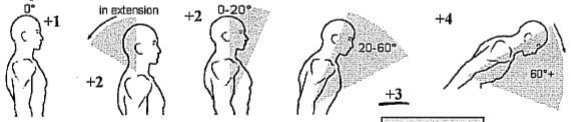
Step 1: Locate Neck Position



Step 1a: Adjust...
If neck is twisted: +1
If neck is side bending: +1

+3
Neck Score

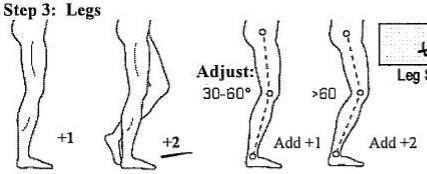
Step 2: Locate Trunk Position



Step 2a: Adjust...
If trunk is twisted: +1
If trunk is side bending: +1

+3
Trunk Score

Step 3: Legs



+2
Leg Score

Step 4: Look-up Posture Score in Table A
Using values from steps 1-3 above, locate score in Table A

6
Posture Score A

+

Step 5: Add Force/Load Score
If load < 11 lbs : +0
If load 11 to 22 lbs : +1
If load > 22 lbs: +2
Adjust: If shock or rapid build up of force: add +1

0
Force/Load Score

=

Step 6: Score A, Find Row in Table C
Add values from steps 4 & 5 to obtain Score A.
Find Row in **Table C**.

6
Score A

Scoring:
1 = negligible risk
2 or 3 = low risk, change may be needed
4 to 7 = medium risk, further investigation, change soon
8 to 10 = high risk, investigate and implement change
11+ = very high risk, implement change

SCORES

Table A		Neck											
		1				2				3			
	Legs	1	2	3	4	1	2	3	4	1	2	3	4
Trunk Posture Score	1	1	2	3	4	1	2	3	4	3	3	5	6
	2	2	3	4	5	3	4	5	6	4	5	6	7
	3	2	4	5	6	4	5	6	7	5	6	7	8
	4	3	5	6	7	5	6	7	8	6	7	8	9
	5	4	6	7	8	6	7	8	9	7	8	9	9

Table B		Lower Arm					
		1			2		
	Wrist	1	2	3	1	2	3
Upper Arm Score	1	1	2	2	1	2	3
	2	1	2	3	2	3	4
	3	3	4	5	4	5	5
	4	4	5	5	5	6	7
	5	6	7	8	7	8	8
	6	7	8	8	8	9	9

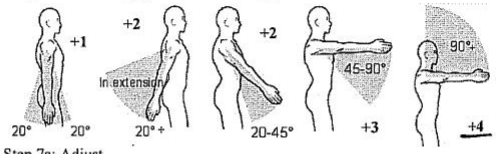
Score A (score from table A +load/force score)	Table C: Score B (table B value +coupling score)											
	1	2	3	4	5	6	7	8	9	10	11	12
1	1	1	1	2	3	3	4	5	6	7	7	7
2	1	2	2	3	4	4	5	6	6	7	7	8
3	2	3	3	3	4	5	6	7	7	8	8	8
4	3	4	4	4	5	6	7	8	8	9	9	9
5	4	4	4	5	6	7	8	8	9	9	9	9
6	6	6	6	7	8	8	9	9	10	10	10	10
7	7	7	7	8	9	9	9	10	10	11	11	11
8	8	8	8	9	10	10	10	10	10	11	11	11
9	9	9	9	10	10	10	11	11	11	12	12	12
10	10	10	10	11	11	11	11	12	12	12	12	12
11	11	11	11	11	12	12	12	12	12	12	12	12
12	12	12	12	12	12	12	12	12	12	12	12	12

9 (Table C Score) + 1 (Activity Score)

10
Final REBA Score

B. Arm and Wrist Analysis

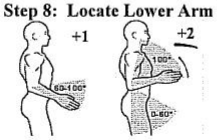
Step 7: Locate Upper Arm Position:



Step 7a: Adjust...
If shoulder is raised: +1
If upper arm is abducted: +1
If arm is supported or person is leaning: -1

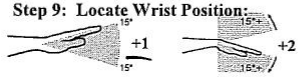
+5
Upper Arm Score

Step 8: Locate Lower Arm Position:



+2
Lower Arm Score

Step 9: Locate Wrist Position:



+1
Wrist Score

Step 9a: Adjust...
If wrist is bent from midline or twisted : Add +1

Step 10: Look-up Posture Score in Table B
Using values from steps 7-9 above, locate score in Table B

7
Posture Score B

+

Step 11: Add Coupling Score
Well fitting Handle and mid rang power grip, ***good: +0***
Acceptable but not ideal hand hold or coupling acceptable with another body part, ***fair: +1***
Hand hold not acceptable but possible, ***poor: +2***
No handles, awkward, unsafe with any body part, ***Unacceptable: +3***

0
Coupling Score

=

Step 12: Score B, Find Column in Table C
Add values from steps 10 &11 to obtain Score B. Find column in **Table C** and match with Score A in row from step 6 to obtain Table C Score.

7
Score B

Step 13: Activity Score
+1 1 or more body parts are held for longer than 1 minute (static)
+1 Repeated small range actions (more than 4x per minute)
+1 Action causes rapid large range changes in postures or unstable base

Task name: RF to Mud Cab, Rear Reviewer: Jessie Muellen Date: 2 / 7 / 11

provided by Practical Ergonomics

This tool is provided without warranty. The author has provided this tool as a simple means for applying the concepts provided in REBA .

rbarker@ergosmart.com (816) 444-1667

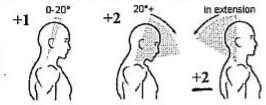
3

REBA Employee Assessment Worksheet

based on Technical note: Rapid Entire Body Assessment (REBA), Hignett, McAtamney, Applied Ergonomics 31 (2000) 201-205

A. Neck, Trunk and Leg Analysis

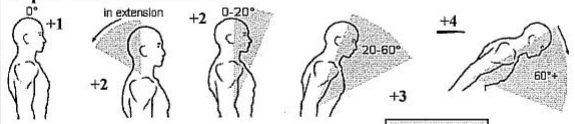
Step 1: Locate Neck Position



Step 1a: Adjust...
If neck is twisted: +1
If neck is side bending: +1

+2
Neck Score

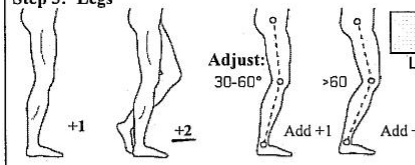
Step 2: Locate Trunk Position



Step 2a: Adjust...
If trunk is twisted: +1
If trunk is side bending: +1

+4
Trunk Score

Step 3: Legs



+2
Leg Score

Step 4: Look-up Posture Score in Table A

Using values from steps 1-3 above, locate score in Table A

6
Posture Score A

Step 5: Add Force/Load Score

If load < 11 lbs : +0
If load 11 to 22 lbs : +1
If load > 22 lbs: +2
Adjust: If shock or rapid build up of force: add +1

+
0
Force/Load Score
=

Step 6: Score A, Find Row in Table C

Add values from steps 4 & 5 to obtain Score A.
Find Row in **Table C**.

6
Score A

Scoring:
1 = negligible risk
2 or 3 = low risk, change may be needed
4 to 7 = medium risk, further investigation, change soon
8 to 10 = high risk, investigate and implement change
11+ = very high risk, implement change

SCORES

Table A		Neck											
		1				2				3			
	Legs	1	2	3	4	1	2	3	4	1	2	3	4
Trunk Posture Score	1	1	2	3	4	1	2	3	4	3	3	5	6
	2	2	3	4	5	3	4	5	6	4	5	6	7
	3	2	4	5	6	4	5	6	7	5	6	7	8
	4	3	5	6	7	5	6	7	8	6	7	8	9
	5	4	6	7	8	6	7	8	9	7	8	9	9

Table B		Lower Arm					
		1			2		
	Wrist	1	2	3	1	2	3
Upper Arm Score	1	1	2	2	1	2	3
	2	1	2	3	2	3	4
	3	3	4	5	4	5	5
	4	4	5	5	5	6	7
	5	6	7	8	7	8	8
	6	7	8	8	8	9	9

Score A (score from table A +load/force score)	Table C: Score B (table B value +coupling score)											
	1	2	3	4	5	6	7	8	9	10	11	12
1	1	1	1	2	3	3	4	5	6	7	7	7
2	1	2	2	3	4	4	5	6	6	7	7	8
3	2	3	3	3	4	5	6	7	7	8	8	8
4	3	4	4	4	5	6	7	8	8	9	9	9
5	4	4	4	5	6	7	8	8	9	9	9	9
6	6	6	6	7	8	8	9	9	10	10	10	10
7	7	7	7	8	9	9	9	10	10	11	11	11
8	8	8	8	9	10	10	10	10	10	11	11	11
9	9	9	9	10	10	10	11	11	11	12	12	12
10	10	10	10	11	11	11	11	12	12	12	12	12
11	11	11	11	11	12	12	12	12	12	12	12	12
12	12	12	12	12	12	12	12	12	12	12	12	12

9
Table C Score

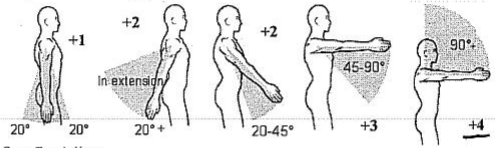
+

1
Activity Score

10
Final REBA Score

B. Arm and Wrist Analysis

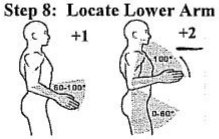
Step 7: Locate Upper Arm Position:



Step 7a: Adjust...
If shoulder is raised: +1
If upper arm is abducted: +1
If arm is supported or person is leaning: -1

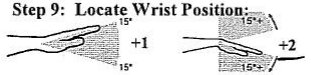
+4
Upper Arm Score

Step 8: Locate Lower Arm Position:



+2
Lower Arm Score

Step 9: Locate Wrist Position:



+3
Wrist Score

Step 9a: Adjust...
If wrist is bent from midline or twisted : Add +1

Step 10: Look-up Posture Score in Table B

Using values from steps 7-9 above, locate score in Table B

7
Posture Score B

+

Step 11: Add Coupling Score

Well fitting Handle and mid rang power grip, ***good: +0***
Acceptable but not ideal hand hold or coupling acceptable with another body part, ***fair: +1***
Hand hold not acceptable but possible, ***poor: +2***
No handles, awkward, unsafe with any body part, ***Unacceptable: +3***

0
Coupling Score

=

Step 12: Score B, Find Column in Table C

Add values from steps 10 &11 to obtain Score B. Find column in **Table C** and match with Score A in row from step 6 to obtain Table C Score.

7
Score B

Step 13: Activity Score

+1 1 or more body parts are held for longer than 1 minute (static)
+1 Repeated small range actions (more than 4x per minute)
+1 Action causes rapid large range changes in postures or unstable base

Task name: FLOOR to Mid RearCab Reviewer: Jessie Mueller Date: 2 / 7 / 11

provided by Practical Ergonomics
rbarker@ergosmart.com (816) 444-1667

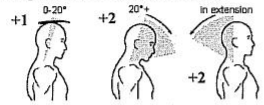
4

REBA Employee Assessment Worksheet

based on Technical note: Rapid Entire Body Assessment (REBA), Hignett, McAtamney, Applied Ergonomics 31 (2000) 201-205

A. Neck, Trunk and Leg Analysis

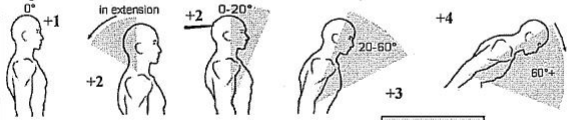
Step 1: Locate Neck Position



Step 1a: Adjust...
If neck is twisted: +1
If neck is side bending: +1

Neck Score: +1

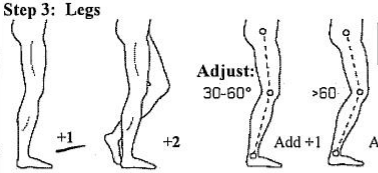
Step 2: Locate Trunk Position



Step 2a: Adjust...
If trunk is twisted: +1
If trunk is side bending: +1

Trunk Score: +3

Step 3: Legs



Leg Score: +1

Step 4: Look-up Posture Score in Table A
Using values from steps 1-3 above, locate score in Table A

Posture Score A: 2

Step 5: Add Force/Load Score
If load < 11 lbs : +0
If load 11 to 22 lbs : +1
If load > 22 lbs: +2
Adjust: If shock or rapid build up of force: add +1

Force/Load Score: 0

Step 6: Score A, Find Row in Table C
Add values from steps 4 & 5 to obtain Score A.
Find Row in **Table C**.

Score A: 2

Scoring:
1 = negligible risk
2 or 3 = low risk, change may be needed
4 to 7 = medium risk, further investigation, change soon
8 to 10 = high risk, investigate and implement change
11+ = very high risk, implement change

SCORES

Table A		Neck											
		1				2				3			
	Legs	1	2	3	4	1	2	3	4	1	2	3	4
Trunk Posture Score	1	1	2	3	4	1	2	3	4	3	3	5	6
	2	2	3	4	5	3	4	5	6	4	5	6	7
	3	2	4	5	6	4	5	6	7	5	6	7	8
	4	3	5	6	7	5	6	7	8	6	7	8	9
	5	4	6	7	8	6	7	8	9	7	8	9	9

Table B		Lower Arm					
		1			2		
	Wrist	1	2	3	1	2	3
Upper Arm Score	1	1	2	2	1	2	3
	2	1	2	3	2	3	4
	3	3	4	5	4	5	5
	4	4	5	5	5	6	7
	5	6	7	8	7	8	8
	6	7	8	8	8	9	9

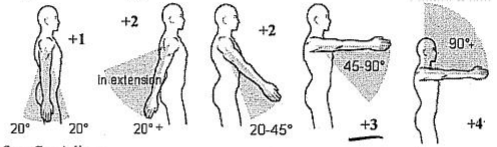
Score A (score from table A +load/force score)	Table C: Score B (table B value +coupling score)											
	1	2	3	4	5	6	7	8	9	10	11	12
1	1	1	1	2	3	3	4	5	6	7	7	7
2	1	2	2	3	4	4	5	6	6	7	7	8
3	2	3	3	3	4	5	6	7	7	8	8	8
4	3	4	4	4	5	6	7	8	8	9	9	9
5	4	4	4	5	6	7	8	8	9	9	9	9
6	6	6	6	7	8	8	9	9	10	10	10	10
7	7	7	7	8	9	9	9	10	10	11	11	11
8	8	8	8	9	10	10	10	10	10	11	11	11
9	9	9	9	10	10	10	11	11	11	12	12	12
10	10	10	10	11	11	11	11	12	12	12	12	12
11	11	11	11	11	12	12	12	12	12	12	12	12
12	12	12	12	12	12	12	12	12	12	12	12	12

Table C Score: 2 + Activity Score: 0

Final REBA Score: 2

B. Arm and Wrist Analysis

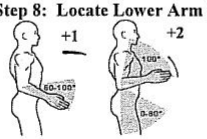
Step 7: Locate Upper Arm Position:



Step 7a: Adjust...
If shoulder is raised: +1
If upper arm is abducted: +1
If arm is supported or person is leaning: -1

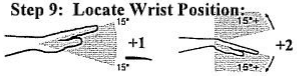
Upper Arm Score: +3

Step 8: Locate Lower Arm Position:



Lower Arm Score: +1

Step 9: Locate Wrist Position:



Wrist Score: +1

Step 9a: Adjust...
If wrist is bent from midline or twisted : Add +1

Step 10: Look-up Posture Score in Table B
Using values from steps 7-9 above, locate score in Table B

Posture Score B: 3

Step 11: Add Coupling Score
Well fitting Handle and mid rang power grip, ***good: +0***
Acceptable but not ideal hand hold or coupling acceptable with another body part, ***fair: +1***
Hand hold not acceptable but possible, ***poor: +2***
No handles, awkward, unsafe with any body part, ***Unacceptable: +3***

Coupling Score: 0

Step 12: Score B, Find Column in Table C
Add values from steps 10 &11 to obtain Score B. Find column in **Table C** and match with Score A in row from step 6 to obtain Table C Score.

Score B: 3

Step 13: Activity Score
+1 1 or more body parts are held for longer than 1 minute (static)
+1 Repeated small range actions (more than 4x per minute)
+1 Action causes rapid large range changes in postures or unstable base

Task name: Side Facing St. to Mid Rack Reviewer: Jesse Mueller Date: 2 / 7 / 11

provided by Practical Ergonomics
rbarker@ergosmart.com (816) 444-1667

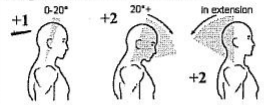
5

REBA Employee Assessment Worksheet

based on Technical note: Rapid Entire Body Assessment (REBA), Hignett, McAtamney, Applied Ergonomics 31 (2000) 201-205

A. Neck, Trunk and Leg Analysis

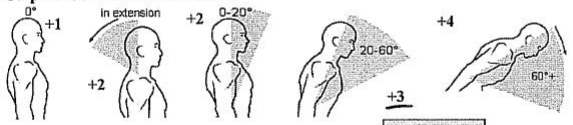
Step 1: Locate Neck Position



Step 1a: Adjust...
If neck is twisted: +1
If neck is side bending: +1

+2
Neck Score

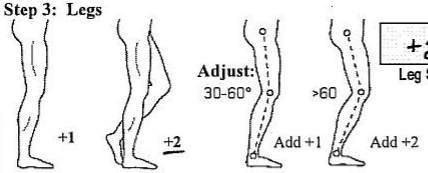
Step 2: Locate Trunk Position



Step 2a: Adjust...
If trunk is twisted: +1
If trunk is side bending: +1

+4
Trunk Score

Step 3: Legs



+2
Leg Score

Step 4: Look-up Posture Score in Table A
Using values from steps 1-3 above, locate score in Table A

6
Posture Score A

Step 5: Add Force/Load Score
If load < 11 lbs : +0
If load 11 to 22 lbs : +1
If load > 22 lbs: +2
Adjust: If shock or rapid build up of force: add +1

+
0
Force/Load Score
=
6
Score A

Step 6: Score A, Find Row in Table C
Add values from steps 4 & 5 to obtain Score A.
Find Row in **Table C**.

Scoring:
1 = negligible risk
2 or 3 = low risk, change may be needed
4 to 7 = medium risk, further investigation, change soon
8 to 10 = high risk, investigate and implement change
11+ = very high risk, implement change

SCORES

Table A		Neck											
		1				2				3			
	Legs	1	2	3	4	1	2	3	4	1	2	3	4
Trunk Posture Score	1	1	2	3	4	1	2	3	4	3	3	5	6
	2	2	3	4	5	3	4	5	6	4	5	6	7
	3	2	4	5	6	4	5	6	7	5	6	7	8
	4	3	5	6	7	5	6	7	8	6	7	8	9
	5	4	6	7	8	6	7	8	9	7	8	9	9

Table B		Lower Arm					
		1			2		
	Wrist	1	2	3	1	2	3
Upper Arm Score	1	1	2	2	1	2	3
	2	1	2	3	2	3	4
	3	3	4	5	4	5	5
	4	4	5	5	5	6	7
	5	6	7	8	7	8	8
	6	7	8	8	8	9	9

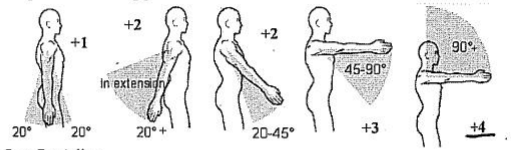
Score A (score from table A +load/force score)	Table C: Score B (table B value +coupling score)											
	1	2	3	4	5	6	7	8	9	10	11	12
1	1	1	1	2	3	3	4	5	6	7	7	7
2	1	2	2	3	4	4	5	6	6	7	7	8
3	2	3	3	3	4	5	6	7	7	8	8	8
4	3	4	4	4	5	6	7	8	8	9	9	9
5	4	4	4	5	6	7	8	8	9	9	9	9
6	6	6	6	7	8	8	9	9	10	10	10	10
7	7	7	7	8	9	9	9	10	10	11	11	11
8	8	8	8	9	10	10	10	10	10	11	11	11
9	9	9	9	10	10	10	11	11	11	12	12	12
10	10	10	10	11	11	11	11	12	12	12	12	12
11	11	11	11	11	12	12	12	12	12	12	12	12
12	12	12	12	12	12	12	12	12	12	12	12	12

8 (Table C Score) + 1 (Activity Score)

9
Final REBA Score

B. Arm and Wrist Analysis

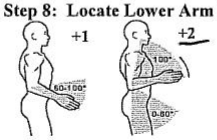
Step 7: Locate Upper Arm Position:



Step 7a: Adjust...
If shoulder is raised: +1
If upper arm is abducted: +1
If arm is supported or person is leaning: -1

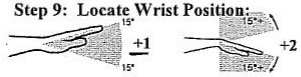
+4
Upper Arm Score

Step 8: Locate Lower Arm Position:



+2
Lower Arm Score

Step 9: Locate Wrist Position:



+2
Wrist Score

Step 9a: Adjust...
If wrist is bent from midline or twisted : Add +1

Step 10: Look-up Posture Score in Table B
Using values from steps 7-9 above, locate score in Table B

6
Posture Score B

+

Step 11: Add Coupling Score
Well fitting Handle and mid rang power grip, ***good: +0***
Acceptable but not ideal hand hold or coupling acceptable with another body part, ***fair: +1***
Hand hold not acceptable but possible, ***poor: +2***
No handles, awkward, unsafe with any body part, ***Unacceptable: +3***

0
Coupling Score

=

Step 12: Score B, Find Column in Table C
Add values from steps 10 &11 to obtain Score B. Find column in **Table C** and match with Score A in row from step 6 to obtain Table C Score.

6
Score B

Step 13: Activity Score
+1 1 or more body parts are held for longer than 1 minute (static)
+1 Repeated small range actions (more than 4x per minute)
+1 Action causes rapid large range changes in postures or unstable base

Task name: BENCH to Midcab Rear Reviewer: Jessie Mueller Date: 2 / 7 / 11

provided by Practical Ergonomics

rbarker@ergosmart.com (816) 444-1667

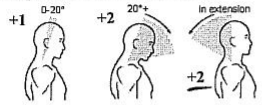
6

REBA Employee Assessment Worksheet

based on Technical note: Rapid Entire Body Assessment (REBA), Hignett, McAtamney, Applied Ergonomics 31 (2000) 201-205

A. Neck, Trunk and Leg Analysis

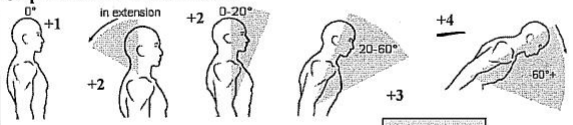
Step 1: Locate Neck Position



Step 1a: Adjust...
If neck is twisted: +1
If neck is side bending: +1

+2
Neck Score

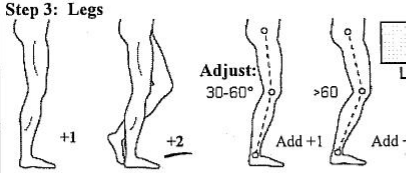
Step 2: Locate Trunk Position



Step 2a: Adjust...
If trunk is twisted: +1
If trunk is side bending: +1

+4
Trunk Score

Step 3: Legs



+2
Leg Score

Step 4: Look-up Posture Score in Table A
Using values from steps 1-3 above, locate score in Table A

6
Posture Score A

Step 5: Add Force/Load Score
If load < 11 lbs : +0
If load 11 to 22 lbs : +1
If load > 22 lbs: +2
Adjust: If shock or rapid build up of force: add +1

0
Force/Load Score

=

Step 6: Score A, Find Row in Table C
Add values from steps 4 & 5 to obtain Score A.
Find Row in **Table C**.

6
Score A

Scoring:
1 = negligible risk
2 or 3 = low risk, change may be needed
4 to 7 = medium risk, further investigation, change soon
8 to 10 = high risk, investigate and implement change
11+ = very high risk, implement change

SCORES

Table A		Neck											
		1				2				3			
	Legs	1	2	3	4	1	2	3	4	1	2	3	4
Trunk Posture Score	1	1	2	3	4	1	2	3	4	3	3	5	6
	2	2	3	4	5	3	4	5	6	4	5	6	7
	3	2	4	5	6	4	5	6	7	5	6	7	8
	4	3	5	6	7	5	6	7	8	6	7	8	9
	5	4	6	7	8	6	7	8	9	7	8	9	9

Table B		Lower Arm					
		1			2		
	Wrist	1	2	3	1	2	3
Upper Arm Score	1	1	2	2	1	2	3
	2	1	2	3	2	3	4
	3	3	4	5	4	5	5
	4	4	5	5	5	6	7
	5	6	7	8	7	8	8
	6	7	8	8	8	9	9

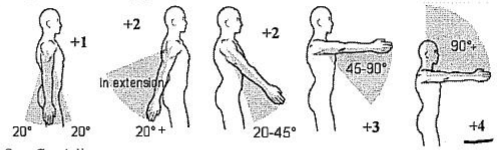
Score A (score from table A +load/force score)	Table C: Score B (table B value +coupling score)											
	1	2	3	4	5	6	7	8	9	10	11	12
1	1	1	1	2	3	3	4	5	6	7	7	7
2	1	2	2	3	4	4	5	6	6	7	7	8
3	2	3	3	3	4	5	6	7	7	8	8	8
4	3	4	4	4	5	6	7	8	8	9	9	9
5	4	4	4	5	6	7	8	8	9	9	9	9
6	6	6	6	7	8	8	9	9	10	10	10	10
7	7	7	7	8	9	9	9	10	10	11	11	11
8	8	8	8	9	10	10	10	10	10	11	11	11
9	9	9	9	10	10	10	11	11	11	12	12	12
10	10	10	10	11	11	11	11	12	12	12	12	12
11	11	11	11	11	12	12	12	12	12	12	12	12
12	12	12	12	12	12	12	12	12	12	12	12	12

10 + 1
Table C Score → Activity Score

11
Final REBA Score

B. Arm and Wrist Analysis

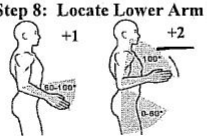
Step 7: Locate Upper Arm Position:



Step 7a: Adjust...
If shoulder is raised: +1
If upper arm is abducted: +1
If arm is supported or person is leaning: -1

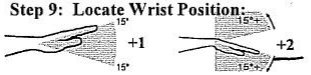
+6
Upper Arm Score

Step 8: Locate Lower Arm Position:



+2
Lower Arm Score

Step 9: Locate Wrist Position:



Step 9a: Adjust...
If wrist is bent from midline or twisted : Add +1

+3
Wrist Score

Step 10: Look-up Posture Score in Table B
Using values from steps 7-9 above, locate score in Table B

9
Posture Score B

+

Step 11: Add Coupling Score
Well fitting Handle and mid rang power grip, ***good: +0***
Acceptable but not ideal hand hold or coupling acceptable with another body part, ***fair: +1***
Hand hold not acceptable but possible, ***poor: +2***
No handles, awkward, unsafe with any body part, ***Unacceptable: +3***

0
Coupling Score

=

Step 12: Score B, Find Column in Table C
Add values from steps 10 &11 to obtain Score B. Find column in **Table C** and match with Score A in row from step 6 to obtain Table C Score.

9
Score B

Step 13: Activity Score
+1 1 or more body parts are held for longer than 1 minute (static)
+1 Repeated small range actions (more than 4x per minute)
+1 Action causes rapid large range changes in postures or unstable base

Task name: Floor to Bottom Rear Cab Reviewer: Jessie Mueller Date: 2 / 7 / 11

provided by Practical Ergonomics

This tool is provided without warranty. The author has provided this tool as a simple means for applying the concepts provided in REBA .

rbarker@ergosmart.com (816) 444-1667

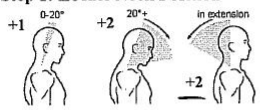
7

REBA Employee Assessment Worksheet

based on Technical note: Rapid Entire Body Assessment (REBA), Hignett, McAtamney, Applied Ergonomics 31 (2000) 201-205

A. Neck, Trunk and Leg Analysis

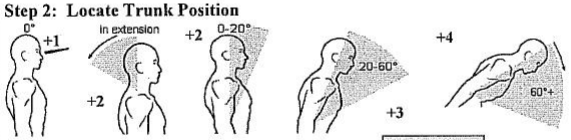
Step 1: Locate Neck Position



Step 1a: Adjust...
If neck is twisted: +1
If neck is side bending: +1

+3
Neck Score

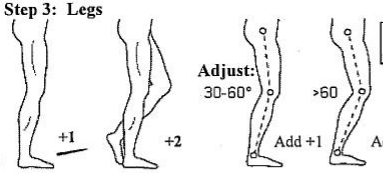
Step 2: Locate Trunk Position



Step 2a: Adjust...
If trunk is twisted: +1
If trunk is side bending: +1

+2
Trunk Score

Step 3: Legs



+1
Leg Score

Step 4: Look-up Posture Score in Table A
Using values from steps 1-3 above, locate score in Table A

4
Posture Score A

Step 5: Add Force/Load Score
If load < 11 lbs : +0
If load 11 to 22 lbs : +1
If load > 22 lbs: +2
Adjust: If shock or rapid build up of force: add +1

+
0
Force/Load Score
=

Step 6: Score A, Find Row in Table C
Add values from steps 4 & 5 to obtain Score A.
Find Row in **Table C**.

4
Score A

Scoring:
1 = negligible risk
2 or 3 = low risk, change may be needed
4 to 7 = medium risk, further investigation, change soon
8 to 10 = high risk, investigate and implement change
11+ = very high risk, implement change

SCORES

Table A		Neck											
		1				2				3			
	Legs	1	2	3	4	1	2	3	4	1	2	3	4
Trunk Posture Score	1	1	2	3	4	1	2	3	4	3	3	5	6
	2	2	3	4	5	3	4	5	6	4	5	6	7
	3	2	4	5	6	4	5	6	7	5	6	7	8
	4	3	5	6	7	5	6	7	8	6	7	8	9
	5	4	6	7	8	6	7	8	9	7	8	9	9

Table B		Lower Arm					
		1			2		
	Wrist	1	2	3	1	2	3
Upper Arm Score	1	1	2	2	1	2	3
	2	1	2	3	2	3	4
	3	3	4	5	4	5	5
	4	4	5	5	5	6	7
	5	6	7	8	7	8	8
	6	7	8	8	8	9	9

Score A (score from table A +load/force score)	Table C: Score B (table B value +coupling score)											
	1	2	3	4	5	6	7	8	9	10	11	12
1	1	1	1	2	3	3	4	5	6	7	7	7
2	1	2	2	3	4	4	5	6	6	7	7	8
3	2	3	3	3	4	5	6	7	7	8	8	8
4	3	4	4	4	5	6	7	8	8	9	9	9
5	4	4	4	5	6	7	8	8	9	9	9	9
6	6	6	6	7	8	8	9	9	10	10	10	10
7	7	7	7	8	9	9	9	10	10	11	11	11
8	8	8	8	9	10	10	10	10	10	11	11	11
9	9	9	9	10	10	10	11	11	11	12	12	12
10	10	10	10	11	11	11	11	12	12	12	12	12
11	11	11	11	11	12	12	12	12	12	12	12	12
12	12	12	12	12	12	12	12	12	12	12	12	12

6
Table C Score

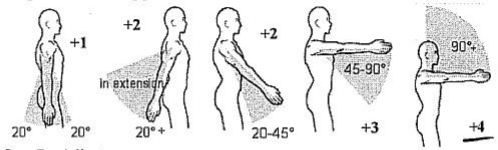
+

0
Activity Score

6
Final REBA Score

B. Arm and Wrist Analysis

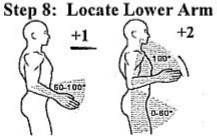
Step 7: Locate Upper Arm Position:



Step 7a: Adjust...
If shoulder is raised: +1
If upper arm is abducted: +1
If arm is supported or person is leaning: -1

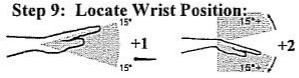
+5
Upper Arm Score

Step 8: Locate Lower Arm Position:



+1
Lower Arm Score

Step 9: Locate Wrist Position:



Step 9a: Adjust...
If wrist is bent from midline or twisted : Add +1

+1
Wrist Score

Step 10: Look-up Posture Score in Table B
Using values from steps 7-9 above, locate score in Table B

6
Posture Score B

+

Step 11: Add Coupling Score
Well fitting Handle and mid rang power grip, ***good: +0***
Acceptable but not ideal hand hold or coupling acceptable with another body part, ***fair: +1***
Hand hold not acceptable but possible, ***poor: +2***
No handles, awkward, unsafe with any body part, ***Unacceptable: +3***

0
Coupling Score

=

Step 12: Score B, Find Column in Table C
Add values from steps 10 &11 to obtain Score B. Find column in **Table C** and match with Score A in row from step 6 to obtain Table C Score.

6
Score B

Step 13: Activity Score
+1 1 or more body parts are held for longer than 1 minute (static)
+1 Repeated small range actions (more than 4x per minute)
+1 Action causes rapid large range changes in postures or unstable base

Task name: RF to TOP FRONT Cab Reviewer: Jessie Mueller Date: 2 / 7 / 11

provided by Practical Ergonomics

This tool is provided without warranty. The author has provided this tool as a simple means for applying the concepts provided in REBA .

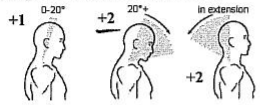
rbarker@ergosmart.com (816) 444-1667

REBA Employee Assessment Worksheet

based on Technical note: Rapid Entire Body Assessment (REBA), Hignett, McAtamney, Applied Ergonomics 31 (2000) 201-205

A. Neck, Trunk and Leg Analysis

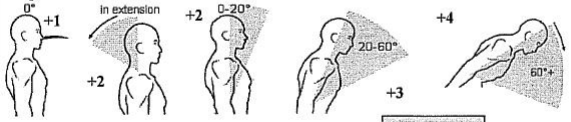
Step 1: Locate Neck Position



Step 1a: Adjust...
If neck is twisted: +1
If neck is side bending: +1

+2
Neck Score

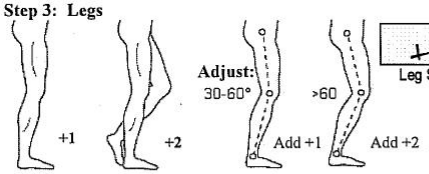
Step 2: Locate Trunk Position



Step 2a: Adjust...
If trunk is twisted: +1
If trunk is side bending: +1

+1
Trunk Score

Step 3: Legs



+1
Leg Score

Step 4: Look-up Posture Score in Table A
Using values from steps 1-3 above, locate score in Table A

1
Posture Score A

Step 5: Add Force/Load Score
If load < 11 lbs : +0
If load 11 to 22 lbs : +1
If load > 22 lbs: +2
Adjust: If shock or rapid build up of force: add +1

+
0
Force/Load Score
=
1
Score A

Step 6: Score A, Find Row in Table C
Add values from steps 4 & 5 to obtain Score A.
Find Row in **Table C**.

Scoring:
1 = negligible risk
2 or 3 = low risk, change may be needed
4 to 7 = medium risk, further investigation, change soon
8 to 10 = high risk, investigate and implement change
11+ = very high risk, implement change

SCORES

Table A		Neck											
		1				2				3			
	Legs	1	2	3	4	1	2	3	4	1	2	3	4
Trunk Posture Score	1	1	2	3	4	1	2	3	4	3	3	5	6
	2	2	3	4	5	3	4	5	6	4	5	6	7
	3	2	4	5	6	4	5	6	7	5	6	7	8
	4	3	5	6	7	5	6	7	8	6	7	8	9
	5	4	6	7	8	6	7	8	9	7	8	9	9

Table B		Lower Arm					
		1			2		
	Wrist	1	2	3	1	2	3
Upper Arm Score	1	1	2	2	1	2	3
	2	1	2	3	2	3	4
	3	3	4	5	4	5	5
	4	4	5	5	5	6	7
	5	6	7	8	7	8	8
	6	7	8	8	8	9	9

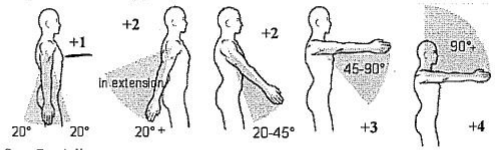
Score A (score from table A +load/force score)	Table C: Score B (table B value +coupling score)											
	1	2	3	4	5	6	7	8	9	10	11	12
1	1	1	1	2	3	3	4	5	6	7	7	7
2	1	2	2	3	4	4	5	6	6	7	7	8
3	2	3	3	3	4	5	6	7	7	8	8	8
4	3	4	4	4	5	6	7	8	8	9	9	9
5	4	4	4	5	6	7	8	8	9	9	9	9
6	6	6	6	7	8	8	9	9	10	10	10	10
7	7	7	7	8	9	9	9	10	10	11	11	11
8	8	8	8	9	10	10	10	10	10	11	11	11
9	9	9	9	10	10	10	11	11	11	12	12	12
10	10	10	10	11	11	11	11	12	12	12	12	12
11	11	11	11	11	12	12	12	12	12	12	12	12
12	12	12	12	12	12	12	12	12	12	12	12	12

1 Table C Score + 0 Activity Score

1 Final REBA Score

B. Arm and Wrist Analysis

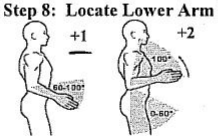
Step 7: Locate Upper Arm Position:



Step 7a: Adjust...
If shoulder is raised: +1
If upper arm is abducted: +1
If arm is supported or person is leaning: -1

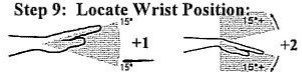
+1
Upper Arm Score

Step 8: Locate Lower Arm Position:



+1
Lower Arm Score

Step 9: Locate Wrist Position:



+2
Wrist Score

Step 9a: Adjust...
If wrist is bent from midline or twisted : Add +1

Step 10: Look-up Posture Score in Table B
Using values from steps 7-9 above, locate score in Table B

2
Posture Score B

+

Step 11: Add Coupling Score
Well fitting Handle and mid rang power grip, ***good: +0***
Acceptable but not ideal hand hold or coupling acceptable with another body part, ***fair: +1***
Hand hold not acceptable but possible, ***poor: +2***
No handles, awkward, unsafe with any body part, ***Unacceptable: +3***

0
Coupling Score

=

Step 12: Score B, Find Column in Table C
Add values from steps 10 &11 to obtain Score B. Find column in **Table C** and match with Score A in row from step 6 to obtain Table C Score.

2
Score B

Step 13: Activity Score
+1 1 or more body parts are held for longer than 1 minute (static)
+1 Repeated small range actions (more than 4x per minute)
+1 Action causes rapid large range changes in postures or unstable base

Task name: RF Seat to Electrical Panel Reviewer: Jessie Mueller Date: 2/7/11

provided by Practical Ergonomics

rbarker@ergosmart.com (816) 444-1667

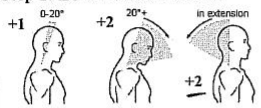
9

REBA Employee Assessment Worksheet

based on Technical note: Rapid Entire Body Assessment (REBA), Hignett, McAtamney, Applied Ergonomics 31 (2000) 201-205

A. Neck, Trunk and Leg Analysis

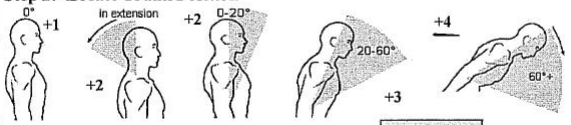
Step 1: Locate Neck Position



Step 1a: Adjust...
If neck is twisted: +1
If neck is side bending: +1

+2
Neck Score

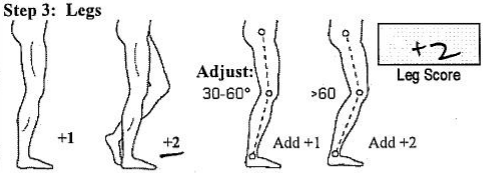
Step 2: Locate Trunk Position



Step 2a: Adjust...
If trunk is twisted: +1
If trunk is side bending: +1

4
Trunk Score

Step 3: Legs



+2
Leg Score

Step 4: Look-up Posture Score in Table A

Using values from steps 1-3 above, locate score in Table A

6
Posture Score A

+

Step 5: Add Force/Load Score

If load < 11 lbs : +0
If load 11 to 22 lbs : +1
If load > 22 lbs: +2
Adjust: If shock or rapid build up of force: add +1

0
Force/Load Score

=

Step 6: Score A, Find Row in Table C

Add values from steps 4 & 5 to obtain Score A.
Find Row in **Table C**.

6
Score A

Scoring:
1 = negligible risk
2 or 3 = low risk, change may be needed
4 to 7 = medium risk, further investigation, change soon
8 to 10 = high risk, investigate and implement change
11+ = very high risk, implement change

SCORES

Table A		Neck											
		1				2				3			
	Legs	1	2	3	4	1	2	3	4	1	2	3	4
Trunk Posture Score	1	1	2	3	4	1	2	3	4	3	3	5	6
	2	2	3	4	5	3	4	5	6	4	5	6	7
	3	2	4	5	6	4	5	6	7	5	6	7	8
	4	3	5	6	7	5	6	7	8	6	7	8	9
	5	4	6	7	8	6	7	8	9	7	8	9	9

Table B		Lower Arm					
		1			2		
	Wrist	1	2	3	1	2	3
Upper Arm Score	1	1	2	2	1	2	3
	2	1	2	3	2	3	4
	3	3	4	5	4	5	5
	4	4	5	5	5	6	7
	5	6	7	8	7	8	8
	6	7	8	8	8	9	9

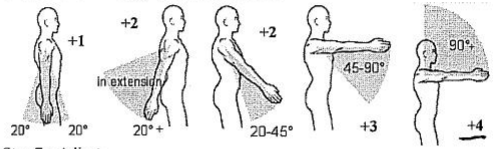
Score A (score from table A +load/force score)	Table C: Score B (table B value +coupling score)											
	1	2	3	4	5	6	7	8	9	10	11	12
1	1	1	1	2	3	3	4	5	6	7	7	7
2	1	2	2	3	4	4	5	6	6	7	7	8
3	2	3	3	3	4	5	6	7	7	8	8	8
4	3	4	4	4	5	6	7	8	8	9	9	9
5	4	4	4	5	6	7	8	8	9	9	9	9
6	6	6	6	7	8	8	9	9	10	10	10	10
7	7	7	7	8	9	9	9	10	10	11	11	11
8	8	8	8	9	10	10	10	10	10	11	11	11
9	9	9	9	10	10	10	11	11	11	12	12	12
10	10	10	10	11	11	11	11	12	12	12	12	12
11	11	11	11	11	12	12	12	12	12	12	12	12
12	12	12	12	12	12	12	12	12	12	12	12	12

9 (Table C Score) + 1 (Activity Score)

10
Final REBA Score

B. Arm and Wrist Analysis

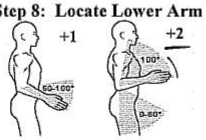
Step 7: Locate Upper Arm Position:



Step 7a: Adjust...
If shoulder is raised: +1
If upper arm is abducted: +1
If arm is supported or person is leaning: -1

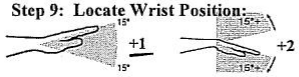
+5
Upper Arm Score

Step 8: Locate Lower Arm Position:



+2
Lower Arm Score

Step 9: Locate Wrist Position:



+2
Wrist Score

Step 9a: Adjust...
If wrist is bent from midline or twisted : Add +1

Step 10: Look-up Posture Score in Table B

Using values from steps 7-9 above, locate score in Table B

8
Posture Score B

+

Step 11: Add Coupling Score

Well fitting Handle and mid rang power grip, ***good: +0***
Acceptable but not ideal hand hold or coupling acceptable with another body part, ***fair: +1***
Hand hold not acceptable but possible, ***poor: +2***
No handles, awkward, unsafe with any body part, ***Unacceptable: +3***

0
Coupling Score

=

Step 12: Score B, Find Column in Table C

Add values from steps 10 &11 to obtain Score B. Find column in **Table C** and match with Score A in row from step 6 to obtain Table C Score.

8
Score B

Step 13: Activity Score

+1 1 or more body parts are held for longer than 1 minute (static)
+1 Repeated small range actions (more than 4x per minute)
+1 Action causes rapid large range changes in postures or unstable base

Task name: FLOOR to Elec. Panel Reviewer: Jessie Mueller Date: 2 / 7 / 11

provided by Practical Ergonomics

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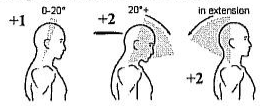
0

REBA Employee Assessment Worksheet

based on Technical note: Rapid Entire Body Assessment (REBA), Hignett, McAtamney, Applied Ergonomics 31 (2000) 201-205

A. Neck, Trunk and Leg Analysis

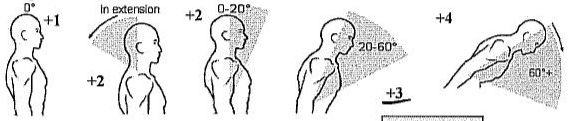
Step 1: Locate Neck Position



Step 1a: Adjust...
If neck is twisted: +1
If neck is side bending: +1

+3
Neck Score

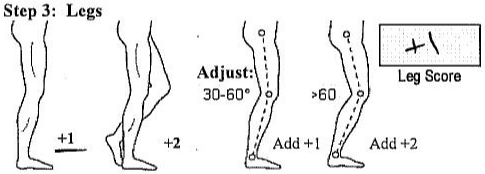
Step 2: Locate Trunk Position



Step 2a: Adjust...
If trunk is twisted: +1
If trunk is side bending: +1

+5
Trunk Score

Step 3: Legs



+1
Leg Score

Step 4: Look-up Posture Score in Table A

Using values from steps 1-3 above, locate score in Table A

+7
Posture Score A

+

Step 5: Add Force/Load Score

If load < 11 lbs : +0
If load 11 to 22 lbs : +1
If load > 22 lbs: +2
Adjust: If shock or rapid build up of force: add +1

0
Force/Load Score

=

Step 6: Score A, Find Row in Table C

Add values from steps 4 & 5 to obtain Score A.
Find Row in **Table C**.

7
Score A

Scoring:
1 = negligible risk
2 or 3 = low risk, change may be needed
4 to 7 = medium risk, further investigation, change soon
8 to 10 = high risk, investigate and implement change
11+ = very high risk, implement change

SCORES

Table A		Neck											
		1				2				3			
	Legs	1	2	3	4	1	2	3	4	1	2	3	4
Trunk Posture Score	1	1	2	3	4	1	2	3	4	3	3	5	6
	2	2	3	4	5	3	4	5	6	4	5	6	7
	3	2	4	5	6	4	5	6	7	5	6	7	8
	4	3	5	6	7	5	6	7	8	6	7	8	9
	5	4	6	7	8	6	7	8	9	7	8	9	9

Table B		Lower Arm					
		1			2		
	Wrist	1	2	3	1	2	3
Upper Arm Score	1	1	2	2	1	2	3
	2	1	2	3	2	3	4
	3	3	4	5	4	5	5
	4	4	5	5	5	6	7
	5	6	7	8	7	8	8
	6	7	8	8	8	9	9

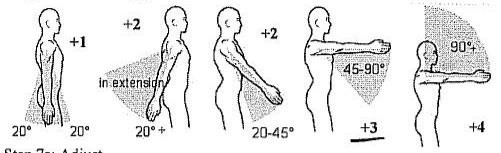
Score A (score from table A +load/force score)	Table C: Score B (table B value +coupling score)											
	1	2	3	4	5	6	7	8	9	10	11	12
1	1	1	1	2	3	3	4	5	6	7	7	7
2	1	2	2	3	4	4	5	6	6	7	7	8
3	2	3	3	3	4	5	6	7	7	8	8	8
4	3	4	4	4	5	6	7	8	8	9	9	9
5	4	4	4	5	6	7	8	8	9	9	9	9
6	6	6	6	7	8	8	9	9	10	10	10	10
7	7	7	7	8	9	9	9	10	10	11	11	11
8	8	8	8	9	10	10	10	10	10	11	11	11
9	9	9	9	10	10	10	11	11	11	12	12	12
10	10	10	10	11	11	11	11	12	12	12	12	12
11	11	11	11	11	12	12	12	12	12	12	12	12
12	12	12	12	12	12	12	12	12	12	12	12	12

7 Table C Score + 0 Activity Score

7
Final REBA Score

B. Arm and Wrist Analysis

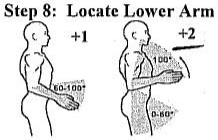
Step 7: Locate Upper Arm Position:



Step 7a: Adjust...
If shoulder is raised: +1
If upper arm is abducted: +1
If arm is supported or person is leaning: -1

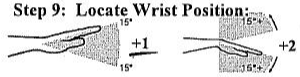
+2
Upper Arm Score

Step 8: Locate Lower Arm Position:



+2
Lower Arm Score

Step 9: Locate Wrist Position:



Step 9a: Adjust...
If wrist is bent from midline or twisted : Add +1

+1
Wrist Score

Step 10: Look-up Posture Score in Table B

Using values from steps 7-9 above, locate score in Table B

2
Posture Score B

+

Step 11: Add Coupling Score

Well fitting Handle and mid rang power grip, ***good: +0***
Acceptable but not ideal hand hold or coupling acceptable with another body part, ***fair: +1***
Hand hold not acceptable but possible, ***poor: +2***
No handles, awkward, unsafe with any body part, ***Unacceptable: +3***

0
Coupling Score

=

Step 12: Score B, Find Column in Table C

Add values from steps 10 &11 to obtain Score B. Find column in **Table C** and match with Score A in row from step 6 to obtain Table C Score.

2
Score B

Step 13: Activity Score

+1 1 or more body parts are held for longer than 1 minute (static)
+1 Repeated small range actions (more than 4x per minute)
+1 Action causes rapid large range changes in postures or unstable base

Task name: Jump Seat to Electrical Reviewer: Jessie Mueller Date: 2 / 7 / 11

provided by Practical Ergonomics

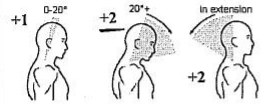
rbarker@ergosmart.com (816) 444-1667

REBA Employee Assessment Worksheet

based on Technical note: Rapid Entire Body Assessment (REBA), Hignett, McAtamney, Applied Ergonomics 31 (2000) 201-205

A. Neck, Trunk and Leg Analysis

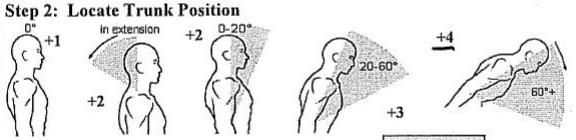
Step 1: Locate Neck Position



Step 1a: Adjust...
If neck is twisted: +1
If neck is side bending: +1

+2 Neck Score

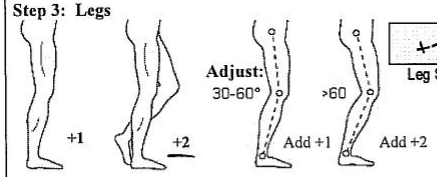
Step 2: Locate Trunk Position



Step 2a: Adjust...
If trunk is twisted: +1
If trunk is side bending: +1

+5 Trunk Score

Step 3: Legs



+2 Leg Score

Step 4: Look-up Posture Score in Table A

Using values from steps 1-3 above, locate score in Table A

7 Posture Score A

+

Step 5: Add Force/Load Score

If load < 11 lbs : +0
If load 11 to 22 lbs : +1
If load > 22 lbs: +2
Adjust: If shock or rapid build up of force: add +1

0 Force/Load Score

=

Step 6: Score A, Find Row in Table C

Add values from steps 4 & 5 to obtain Score A.
Find Row in **Table C**.

7 Score A

Scoring:
1 = negligible risk
2 or 3 = low risk, change may be needed
4 to 7 = medium risk, further investigation, change soon
8 to 10 = high risk, investigate and implement change
11+ = very high risk, implement change

SCORES

Table A		Neck											
		1				2				3			
	Legs	1	2	3	4	1	2	3	4	1	2	3	4
Trunk Posture Score	1	1	2	3	4	1	2	3	4	3	3	5	6
	2	2	3	4	5	3	4	5	6	4	5	6	7
	3	2	4	5	6	4	5	6	7	5	6	7	8
	4	3	5	6	7	5	6	7	8	6	7	8	9
	5	4	6	7	8	6	7	8	9	7	8	9	9

Table B		Lower Arm					
		1			2		
	Wrist	1	2	3	1	2	3
Upper Arm Score	1	1	2	2	1	2	3
	2	1	2	3	2	3	4
	3	3	4	5	4	5	5
	4	4	5	5	5	6	7
	5	6	7	8	7	8	8
	6	7	8	8	8	9	9

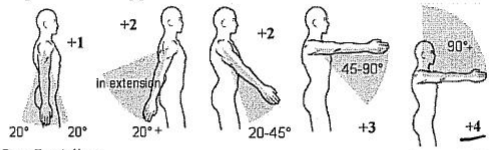
Score A (score from table A +load/force score)	Table C: Score B (table B value +coupling score)											
	1	2	3	4	5	6	7	8	9	10	11	12
1	1	1	1	2	3	3	4	5	6	7	7	7
2	1	2	2	3	4	4	5	6	6	7	7	8
3	2	3	3	3	4	5	6	7	7	8	8	8
4	3	4	4	4	5	6	7	8	8	9	9	9
5	4	4	4	5	6	7	8	8	9	9	9	9
6	6	6	6	7	8	8	9	9	10	10	10	10
7	7	7	7	8	9	9	9	10	10	11	11	11
8	8	8	8	9	10	10	10	10	10	11	11	11
9	9	9	9	10	10	10	11	11	11	12	12	12
10	10	10	10	11	11	11	11	12	12	12	12	12
11	11	11	11	11	12	12	12	12	12	12	12	12
12	12	12	12	12	12	12	12	12	12	12	12	12

9 Table C Score + **1** Activity Score

10 Final REBA Score

B. Arm and Wrist Analysis

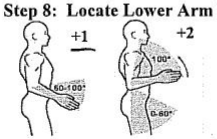
Step 7: Locate Upper Arm Position:



Step 7a: Adjust...
If shoulder is raised: +1
If upper arm is abducted: +1
If arm is supported or person is leaning: -1

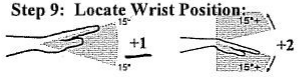
+4 Upper Arm Score

Step 8: Locate Lower Arm Position:



+1 Lower Arm Score

Step 9: Locate Wrist Position:



+2 Wrist Score

Step 9a: Adjust...
If wrist is bent from midline or twisted : Add +1

Step 10: Look-up Posture Score in Table B

Using values from steps 7-9 above, locate score in Table B

5 Posture Score B

+

Step 11: Add Coupling Score

Well fitting Handle and mid rang power grip, ***good: +0***
Acceptable but not ideal hand hold or coupling acceptable with another body part, ***fair: +1***
Hand hold not acceptable but possible, ***poor: +2***
No handles, awkward, unsafe with any body part, ***Unacceptable: +3***

0 Coupling Score

=

Step 12: Score B, Find Column in Table C

Add values from steps 10 &11 to obtain Score B. Find column in **Table C** and match with Score A in row from step 6 to obtain Table C Score.

5 Score B

Step 13: Activity Score

+1 1 or more body parts are held for longer than 1 minute (static)
+1 Repeated small range actions (more than 4x per minute)
+1 Action causes rapid large range changes in postures or unstable base

Task name: BENCH to ELEC. PANEL Reviewer: Jessie Mueller Date: 2/7/11

provided by Practical Ergonomics

This tool is provided without warranty. The author has provided this tool as a simple means for applying the concepts provided in REBA .

rbarker@ergosmart.com (816) 444-1667

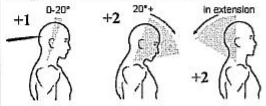
2

REBA Employee Assessment Worksheet

based on Technical note: Rapid Entire Body Assessment (REBA), Hignett, McAtamney, Applied Ergonomics 31 (2000) 201-205

A. Neck, Trunk and Leg Analysis

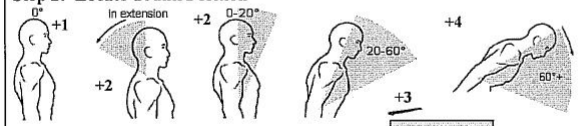
Step 1: Locate Neck Position



Step 1a: Adjust...
If neck is twisted: +1
If neck is side bending: +1

+2
Neck Score

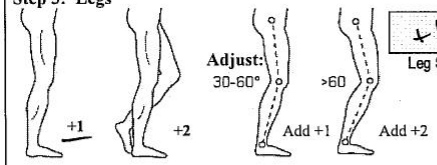
Step 2: Locate Trunk Position



Step 2a: Adjust...
If trunk is twisted: +1
If trunk is side bending: +1

+4
Trunk Score

Step 3: Legs



+1
Leg Score

Step 4: Look-up Posture Score in Table A
Using values from steps 1-3 above, locate score in Table A

5
Posture Score A

Step 5: Add Force/Load Score
If load < 11 lbs : +0
If load 11 to 22 lbs : +1
If load > 22 lbs: +2
Adjust: If shock or rapid build up of force: add +1

+
0
Force/Load Score
=

Step 6: Score A, Find Row in Table C
Add values from steps 4 & 5 to obtain Score A.
Find Row in **Table C**.

5
Score A

Scoring:
1 = negligible risk
2 or 3 = low risk, change may be needed
4 to 7 = medium risk, further investigation, change soon
8 to 10 = high risk, investigate and implement change
11+ = very high risk, implement change

SCORES

Table A		Neck											
		1				2				3			
	Legs	1	2	3	4	1	2	3	4	1	2	3	4
Trunk Posture Score	1	1	2	3	4	1	2	3	4	3	3	5	6
	2	2	3	4	5	3	4	5	6	4	5	6	7
	3	2	4	5	6	4	5	6	7	5	6	7	8
	4	3	5	6	7	5	6	7	8	6	7	8	9
	5	4	6	7	8	6	7	8	9	7	8	9	9

Table B		Lower Arm					
		1			2		
	Wrist	1	2	3	1	2	3
Upper Arm Score	1	1	2	2	1	2	3
	2	1	2	3	2	3	4
	3	3	4	5	4	5	5
	4	4	5	5	5	6	7
	5	6	7	8	7	8	8
	6	7	8	8	8	9	9

Score A (score from table A +load/force score)	Table C: Score B (table B value +coupling score)											
	1	2	3	4	5	6	7	8	9	10	11	12
1	1	1	1	2	3	3	4	5	6	7	7	7
2	1	2	2	3	4	4	5	6	6	7	7	8
3	2	3	3	3	4	5	6	7	7	8	8	8
4	3	4	4	4	5	6	7	8	8	9	9	9
5	4	4	4	5	6	7	8	8	9	9	9	9
6	6	6	6	7	8	8	9	9	10	10	10	10
7	7	7	7	8	9	9	9	10	10	11	11	11
8	8	8	8	9	10	10	10	10	10	11	11	11
9	9	9	9	10	10	10	11	11	11	12	12	12
10	10	10	10	11	11	11	11	12	12	12	12	12
11	11	11	11	11	12	12	12	12	12	12	12	12
12	12	12	12	12	12	12	12	12	12	12	12	12

4
Table C Score

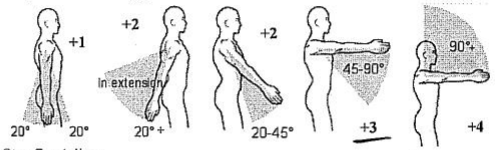
+

0
Activity Score

4
Final REBA Score

B. Arm and Wrist Analysis

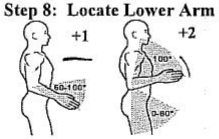
Step 7: Locate Upper Arm Position:



Step 7a: Adjust...
If shoulder is raised: +1
If upper arm is abducted: +1
If arm is supported or person is leaning: -1

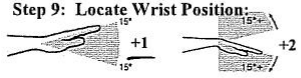
+3
Upper Arm Score

Step 8: Locate Lower Arm Position:



+1
Lower Arm Score

Step 9: Locate Wrist Position:



Step 9a: Adjust...
If wrist is bent from midline or twisted : Add +1

+1
Wrist Score

Step 10: Look-up Posture Score in Table B
Using values from steps 7-9 above, locate score in Table B

3
Posture Score B

+

Step 11: Add Coupling Score
Well fitting Handle and mid rang power grip, ***good: +0***
Acceptable but not ideal hand hold or coupling acceptable with another body part, ***fair: +1***
Hand hold not acceptable but possible, ***poor: +2***
No handles, awkward, unsafe with any body part, ***Unacceptable: +3***

0
Coupling Score

=

Step 12: Score B, Find Column in Table C
Add values from steps 10 &11 to obtain Score B. Find column in **Table C** and match with Score A in row from step 6 to obtain Table C Score.

3
Score B

Step 13: Activity Score
+1 1 or more body parts are held for longer than 1 minute (static)
+1 Repeated small range actions (more than 4x per minute)
+1 Action causes rapid large range changes in postures or unstable base

Task name: RF to Blanket/Linen Reviewer: Jessie Mueller Date: 2/7/11

provided by Practical Ergonomics

This tool is provided without warranty. The author has provided this tool as a simple means for applying the concepts provided in REBA .

rbarker@ergosmart.com (816) 444-1667

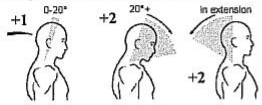
13

REBA Employee Assessment Worksheet

based on Technical note: Rapid Entire Body Assessment (REBA), Hignett, McAtamney, Applied Ergonomics 31 (2000) 201-205

A. Neck, Trunk and Leg Analysis

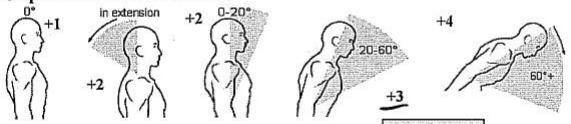
Step 1: Locate Neck Position



Step 1a: Adjust...
If neck is twisted: +1
If neck is side bending: +1

+1 Neck Score

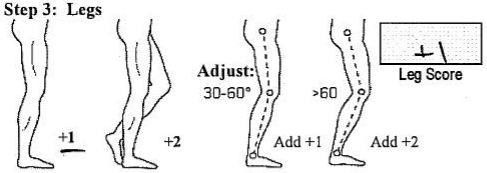
Step 2: Locate Trunk Position



Step 2a: Adjust...
If trunk is twisted: +1
If trunk is side bending: +1

+3 Trunk Score

Step 3: Legs



+1 Leg Score

Step 4: Look-up Posture Score in Table A
Using values from steps 1-3 above, locate score in Table A

2 Posture Score A

Step 5: Add Force/Load Score
If load < 11 lbs : +0
If load 11 to 22 lbs : +1
If load > 22 lbs: +2
Adjust: If shock or rapid build up of force: add +1

+ 0 Force/Load Score

= 2 Score A

Step 6: Score A, Find Row in Table C
Add values from steps 4 & 5 to obtain Score A.
Find Row in **Table C**.

Scoring:
1 = negligible risk
2 or 3 = low risk, change may be needed
4 to 7 = medium risk, further investigation, change soon
8 to 10 = high risk, investigate and implement change
11+ = very high risk, implement change

SCORES

Table A		Neck											
		1				2				3			
	Legs	1	2	3	4	1	2	3	4	1	2	3	4
Trunk Posture Score	1	1	2	3	4	1	2	3	4	3	3	5	6
	2	2	3	4	5	3	4	5	6	4	5	6	7
	3	2	4	5	6	4	5	6	7	5	6	7	8
	4	3	5	6	7	5	6	7	8	6	7	8	9
	5	4	6	7	8	6	7	8	9	7	8	9	9

Table B		Lower Arm					
		1			2		
	Wrist	1	2	3	1	2	3
Upper Arm Score	1	1	2	2	1	2	3
	2	1	2	3	2	3	4
	3	3	4	5	4	5	5
	4	4	5	5	5	6	7
	5	6	7	8	7	8	8
	6	7	8	8	8	9	9

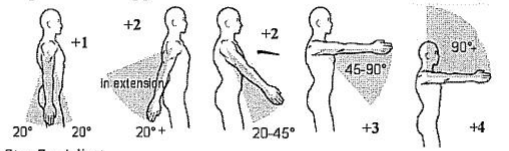
Score A (score from table A +load/force score)	Table C: Score B (table B value +coupling score)											
	1	2	3	4	5	6	7	8	9	10	11	12
1	1	1	1	2	3	3	4	5	6	7	7	7
2	1	2	2	3	4	4	5	6	6	7	7	8
3	2	3	3	3	4	5	6	7	7	8	8	8
4	3	4	4	4	5	6	7	8	8	9	9	9
5	4	4	4	5	6	7	8	8	9	9	9	9
6	6	6	6	7	8	8	9	9	10	10	10	10
7	7	7	7	8	9	9	9	10	10	11	11	11
8	8	8	8	9	10	10	10	10	10	11	11	11
9	9	9	9	10	10	10	11	11	11	12	12	12
10	10	10	10	11	11	11	11	12	12	12	12	12
11	11	11	11	11	12	12	12	12	12	12	12	12
12	12	12	12	12	12	12	12	12	12	12	12	12

3 Table C Score + 0 Activity Score

= 3 Final REBA Score

B. Arm and Wrist Analysis

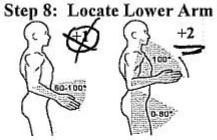
Step 7: Locate Upper Arm Position:



Step 7a: Adjust...
If shoulder is raised: +1
If upper arm is abducted: +1
If arm is supported or person is leaning: -1

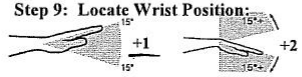
+3 Upper Arm Score

Step 8: Locate Lower Arm Position:



+2 0 Lower Arm Score

Step 9: Locate Wrist Position:



Step 9a: Adjust...
If wrist is bent from midline or twisted : Add +1

+1 Wrist Score

Step 10: Look-up Posture Score in Table B
Using values from steps 7-9 above, locate score in Table B

4 Posture Score B

Step 11: Add Coupling Score
Well fitting Handle and mid rang power grip, ***good: +0***
Acceptable but not ideal hand hold or coupling acceptable with another body part, ***fair: +1***
Hand hold not acceptable but possible, ***poor: +2***
No handles, awkward, unsafe with any body part, ***Unacceptable: +3***

+ 0 Coupling Score

= 4 Score B

Step 12: Score B, Find Column in Table C
Add values from steps 10 &11 to obtain Score B. Find column in **Table C** and match with Score A in row from step 6 to obtain Table C Score.

Step 13: Activity Score
+1 1 or more body parts are held for longer than 1 minute (static)
+1 Repeated small range actions (more than 4x per minute)
+1 Action causes rapid large range changes in postures or unstable base

Task name: Floor to Blanket/Linens Reviewer: Jessie Mueller Date: 2/11/11

provided by Practical Ergonomics
rbarker@ergosmart.com (816) 444-1667

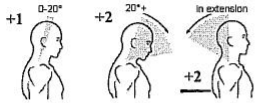
4

REBA Employee Assessment Worksheet

based on Technical note: Rapid Entire Body Assessment (REBA), Hignett, McAtamney, Applied Ergonomics 31 (2000) 201-205

A. Neck, Trunk and Leg Analysis

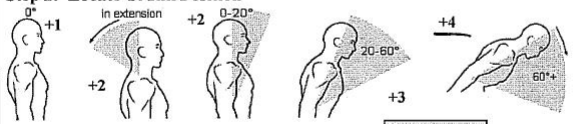
Step 1: Locate Neck Position



Step 1a: Adjust...
If neck is twisted: +1
If neck is side bending: +1

+2
Neck Score

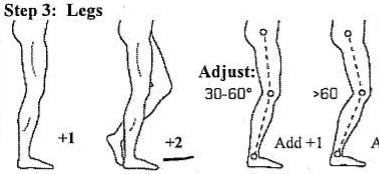
Step 2: Locate Trunk Position



Step 2a: Adjust...
If trunk is twisted: +1
If trunk is side bending: +1

+4
Trunk Score

Step 3: Legs



+2
Leg Score

Step 4: Look-up Posture Score in Table A
Using values from steps 1-3 above, locate score in Table A

6
Posture Score A

+

Step 5: Add Force/Load Score
If load < 11 lbs : +0
If load 11 to 22 lbs : +1
If load > 22 lbs: +2
Adjust: If shock or rapid build up of force: add +1

0
Force/Load Score

=

Step 6: Score A, Find Row in Table C
Add values from steps 4 & 5 to obtain Score A.
Find Row in **Table C**.

6
Score A

Scoring:
1 = negligible risk
2 or 3 = low risk, change may be needed
4 to 7 = medium risk, further investigation, change soon
8 to 10 = high risk, investigate and implement change
11+ = very high risk, implement change

SCORES

Table A		Neck											
		1				2				3			
	Legs	1	2	3	4	1	2	3	4	1	2	3	4
Trunk Posture Score	1	1	2	3	4	1	2	3	4	3	3	5	6
	2	2	3	4	5	3	4	5	6	4	5	6	7
	3	2	4	5	6	4	5	6	7	5	6	7	8
	4	3	5	6	7	5	6	7	8	6	7	8	9
	5	4	6	7	8	6	7	8	9	7	8	9	9

Table B		Lower Arm					
		1			2		
	Wrist	1	2	3	1	2	3
Upper Arm Score	1	1	2	2	1	2	3
	2	1	2	3	2	3	4
	3	3	4	5	4	5	5
	4	4	5	5	5	6	7
	5	6	7	8	7	8	8
	6	7	8	8	8	9	9

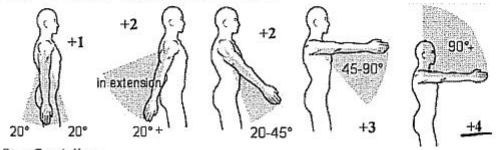
Score A (score from table A +load/force score)	Table C: Score B (table B value +coupling score)											
	1	2	3	4	5	6	7	8	9	10	11	12
1	1	1	1	2	3	3	4	5	6	7	7	7
2	1	2	2	3	4	4	5	6	6	7	7	8
3	2	3	3	3	4	5	6	7	7	8	8	8
4	3	4	4	4	5	6	7	8	8	9	9	9
5	4	4	4	5	6	7	8	8	9	9	9	9
6	6	6	6	7	8	8	9	9	10	10	10	10
7	7	7	7	8	9	9	9	10	10	11	11	11
8	8	8	8	9	10	10	10	10	10	11	11	11
9	9	9	9	10	10	10	11	11	11	12	12	12
10	10	10	10	11	11	11	11	12	12	12	12	12
11	11	11	11	11	12	12	12	12	12	12	12	12
12	12	12	12	12	12	12	12	12	12	12	12	12

9 (Table C Score) + 1 (Activity Score)

10
Final REBA Score

B. Arm and Wrist Analysis

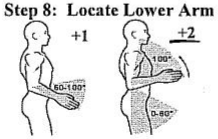
Step 7: Locate Upper Arm Position:



Step 7a: Adjust...
If shoulder is raised: +1
If upper arm is abducted: +1
If arm is supported or person is leaning: -1

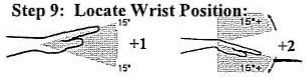
+5
Upper Arm Score

Step 8: Locate Lower Arm Position:



+2
Lower Arm Score

Step 9: Locate Wrist Position:



+2
Wrist Score

Step 9a: Adjust...
If wrist is bent from midline or twisted : Add +1

Step 10: Look-up Posture Score in Table B
Using values from steps 7-9 above, locate score in Table B

8
Posture Score B

+

Step 11: Add Coupling Score
Well fitting Handle and mid rang power grip, ***good: +0***
Acceptable but not ideal hand hold or coupling acceptable with another body part, ***fair: +1***
Hand hold not acceptable but possible, ***poor: +2***
No handles, awkward, unsafe with any body part, ***Unacceptable: +3***

0
Coupling Score

=

Step 12: Score B, Find Column in Table C
Add values from steps 10 &11 to obtain Score B. Find column in **Table C** and match with Score A in row from step 6 to obtain Table C Score.

8
Score B

Step 13: Activity Score
+1 1 or more body parts are held for longer than 1 minute (static)
+1 Repeated small range actions (more than 4x per minute)
+1 Action causes rapid large range changes in postures or unstable base

Task name: JUMP to Basketline Reviewer: Jenn Mullen Date: 2/7/11

provided by Practical Ergonomics

rbarker@ergosmart.com (816) 444-1667

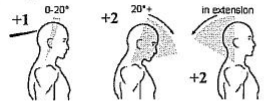
5

REBA Employee Assessment worksheet

based on Technical note: Rapid Entire Body Assessment (REBA), Hignett, McAtamney, Applied Ergonomics 31 (2000) 201-205

A. Neck, Trunk and Leg Analysis

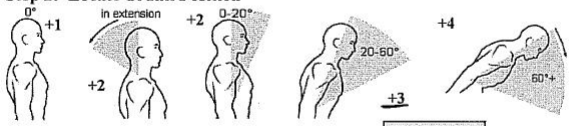
Step 1: Locate Neck Position



Step 1a: Adjust...
If neck is twisted: +1
If neck is side bending: +1

+1 Neck Score

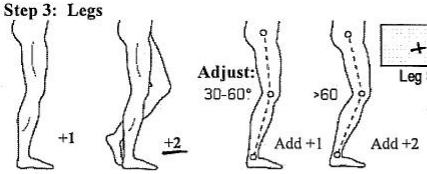
Step 2: Locate Trunk Position



Step 2a: Adjust...
If trunk is twisted: +1
If trunk is side bending: +1

+4 Trunk Score

Step 3: Legs



+2 Leg Score

Step 4: Look-up Posture Score in Table A
Using values from steps 1-3 above, locate score in Table A

5 Posture Score A

Step 5: Add Force/Load Score
If load < 11 lbs : +0
If load 11 to 22 lbs : +1
If load > 22 lbs: +2
Adjust: If shock or rapid build up of force: add +1

+

0 Force/Load Score

=

Step 6: Score A, Find Row in Table C
Add values from steps 4 & 5 to obtain Score A.
Find Row in **Table C**.

5 Score A

Scoring:
1 = negligible risk
2 or 3 = low risk, change may be needed
4 to 7 = medium risk, further investigation, change soon
8 to 10 = high risk, investigate and implement change
11+ = very high risk, implement change

SCORES

Table A		Neck											
		1				2				3			
	Legs	1	2	3	4	1	2	3	4	1	2	3	4
Trunk Posture Score	1	1	2	3	4	1	2	3	4	3	3	5	6
	2	2	3	4	5	3	4	5	6	4	5	6	7
	3	2	4	5	6	4	5	6	7	5	6	7	8
	4	3	5	6	7	5	6	7	8	6	7	8	9
	5	4	6	7	8	6	7	8	9	7	8	9	9

Table B		Lower Arm					
		1			2		
	Wrist	1	2	3	1	2	3
Upper Arm Score	1	1	2	2	1	2	3
	2	1	2	3	2	3	4
	3	3	4	5	4	5	5
	4	4	5	5	5	6	7
	5	6	7	8	7	8	8
	6	7	8	8	8	9	9

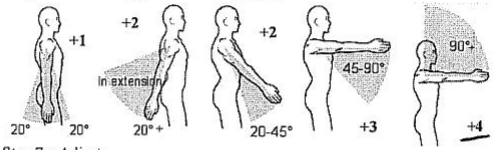
Score A (score from table A +load/force score)	Table C: Score B (table B value +coupling score)											
	1	2	3	4	5	6	7	8	9	10	11	12
1	1	1	1	2	3	3	4	5	6	7	7	7
2	1	2	2	3	4	4	5	6	6	7	7	8
3	2	3	3	3	4	5	6	7	7	8	8	8
4	3	4	4	4	5	6	7	8	8	9	9	9
5	4	4	4	5	6	7	8	8	9	9	9	9
6	6	6	6	7	8	8	9	9	10	10	10	10
7	7	7	7	8	9	9	9	10	10	11	11	11
8	8	8	8	9	10	10	10	10	10	11	11	11
9	9	9	9	10	10	10	11	11	11	12	12	12
10	10	10	10	11	11	11	11	12	12	12	12	12
11	11	11	11	11	12	12	12	12	12	12	12	12
12	12	12	12	12	12	12	12	12	12	12	12	12

8 Table C Score + 1 Activity Score

9 Final REBA Score

B. Arm and Wrist Analysis

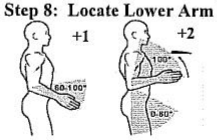
Step 7: Locate Upper Arm Position:



Step 7a: Adjust...
If shoulder is raised: +1
If upper arm is abducted: +1
If arm is supported or person is leaning: -1

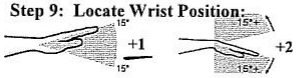
+5 Upper Arm Score

Step 8: Locate Lower Arm Position:



+2 Lower Arm Score

Step 9: Locate Wrist Position:



Step 9a: Adjust...
If wrist is bent from midline or twisted : Add +1

+1 Wrist Score

Step 10: Look-up Posture Score in Table B
Using values from steps 7-9 above, locate score in Table B

+7 Posture Score B

+

Step 11: Add Coupling Score
Well fitting Handle and mid rang power grip, ***good: +0***
Acceptable but not ideal hand hold or coupling acceptable with another body part, ***fair: +1***
Hand hold not acceptable but possible, ***poor: +2***
No handles, awkward, unsafe with any body part, ***Unacceptable: +3***

0 Coupling Score

=

Step 12: Score B, Find Column in Table C
Add values from steps 10 &11 to obtain Score B. Find column in **Table C** and match with Score A in row from step 6 to obtain Table C Score.

7 Score B

Step 13: Activity Score
+1 1 or more body parts are held for longer than 1 minute (static)
+1 Repeated small range actions (more than 4x per minute)
+1 Action causes rapid large range changes in postures or unstable base

Task name: BENCH to Blankets/Linen Reviewer: Jessie Mueller Date: 2 / 7 / 11

provided by Practical Ergonomics

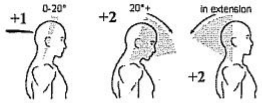
rbarker@ergosmart.com (816) 444-1667

REBA Employee Assessment Worksheet

based on Technical note: Rapid Entire Body Assessment (REBA), Hignett, McAtamney, Applied Ergonomics 31 (2000) 201-205

A. Neck, Trunk and Leg Analysis

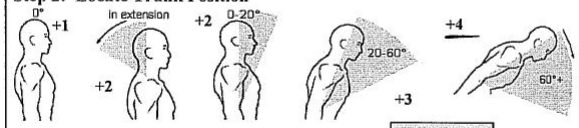
Step 1: Locate Neck Position



Step 1a: Adjust...
If neck is twisted: +1
If neck is side bending: +1

Neck Score: +1

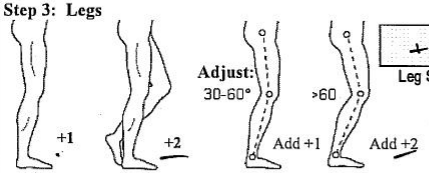
Step 2: Locate Trunk Position



Step 2a: Adjust...
If trunk is twisted: +1
If trunk is side bending: +1

Trunk Score: +5

Step 3: Legs



Leg Score: +4

Step 4: Look-up Posture Score in Table A

Using values from steps 1-3 above, locate score in Table A

Posture Score A: 8

Step 5: Add Force/Load Score

If load < 11 lbs : +0
If load 11 to 22 lbs : +1
If load > 22 lbs: +2
Adjust: If shock or rapid build up of force: add +1

Force/Load Score: 0

Step 6: Score A, Find Row in Table C

Add values from steps 4 & 5 to obtain Score A.
Find Row in **Table C**.

Score A: 8

Scoring:
1 = negligible risk
2 or 3 = low risk, change may be needed
4 to 7 = medium risk, further investigation, change soon
8 to 10 = high risk, investigate and implement change
11+ = very high risk, implement change

SCORES

Table A		Neck											
		1				2				3			
	Legs	1	2	3	4	1	2	3	4	1	2	3	4
Trunk Posture Score	1	1	2	3	4	1	2	3	4	3	3	5	6
	2	2	3	4	5	3	4	5	6	4	5	6	7
	3	2	4	5	6	4	5	6	7	5	6	7	8
	4	3	5	6	7	5	6	7	8	6	7	8	9
	5	4	6	7	8	6	7	8	9	7	8	9	9

Table B		Lower Arm					
		1			2		
	Wrist	1	2	3	1	2	3
Upper Arm Score	1	1	2	2	1	2	3
	2	1	2	3	2	3	4
	3	3	4	5	4	5	5
	4	4	5	5	5	6	7
	5	6	7	8	7	8	8
	6	7	8	8	8	9	9

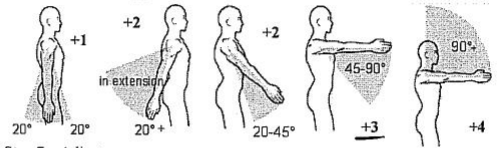
Score A (score from table A +load/force score)	Table C: Score B, (table B value +coupling score)											
	1	2	3	4	5	6	7	8	9	10	11	12
1	1	1	1	2	3	3	4	5	6	7	7	7
2	1	2	2	3	4	4	5	6	6	7	7	8
3	2	3	3	3	4	5	6	7	7	8	8	8
4	3	4	4	4	5	6	7	8	8	9	9	9
5	4	4	4	5	6	7	8	8	9	9	9	9
6	6	6	6	7	8	8	9	9	10	10	10	10
7	7	7	7	8	9	9	9	10	10	11	11	11
8	8	8	8	9	10	10	10	10	10	11	11	11
9	9	9	9	10	10	10	11	11	11	12	12	12
10	10	10	10	11	11	11	11	12	12	12	12	12
11	11	11	11	11	12	12	12	12	12	12	12	12
12	12	12	12	12	12	12	12	12	12	12	12	12

Table C Score: 9 + Activity Score: 1

Final REBA Score: 10

B. Arm and Wrist Analysis

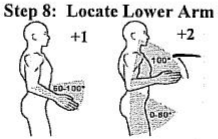
Step 7: Locate Upper Arm Position:



Step 7a: Adjust...
If shoulder is raised: +1
If upper arm is abducted: +1
If arm is supported or person is leaning: -1

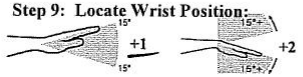
Upper Arm Score: +3

Step 8: Locate Lower Arm Position:



Lower Arm Score: +2

Step 9: Locate Wrist Position:



Step 9a: Adjust...
If wrist is bent from midline or twisted : Add +1

Wrist Score: +1

Step 10: Look-up Posture Score in Table B

Using values from steps 7-9 above, locate score in Table B

Posture Score B: 4

Step 11: Add Coupling Score

Well fitting Handle and mid rang power grip, ***good: +0***
Acceptable but not ideal hand hold or coupling acceptable with another body part, ***fair: +1***
Hand hold not acceptable but possible, ***poor: +2***
No handles, awkward, unsafe with any body part, ***Unacceptable: +3***

Coupling Score: 0

Step 12: Score B, Find Column in Table C

Add values from steps 10 &11 to obtain Score B. Find column in **Table C** and match with Score A in row from step 6 to obtain Table C Score.

Score B: 4

Step 13: Activity Score

+1 1 or more body parts are held for longer than 1 minute (static)
+1 Repeated small range actions (more than 4x per minute)
+1 Action causes rapid large range changes in postures or unstable base

Task name: RF to Bench Equip Reviewer: Jessie Mueller Date: 2/7/11

provided by Practical Ergonomics
rbarker@ergosmart.com (816) 444-1667

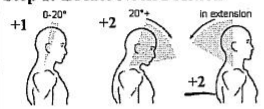
17

REBA Employee Assessment Worksheet

based on Technical note: Rapid Entire Body Assessment (REBA), Hignett, McAtamney, Applied Ergonomics 31 (2000) 201-205

A. Neck, Trunk and Leg Analysis

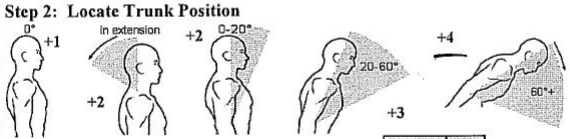
Step 1: Locate Neck Position



Step 1a: Adjust...
If neck is twisted: +1
If neck is side bending: +1

+2 Neck Score

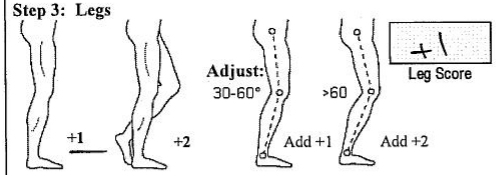
Step 2: Locate Trunk Position



Step 2a: Adjust...
If trunk is twisted: +1
If trunk is side bending: +1

+4 Trunk Score

Step 3: Legs



+1 Leg Score

Step 4: Look-up Posture Score in Table A
Using values from steps 1-3 above, locate score in Table A

5 Posture Score A

Step 5: Add Force/Load Score
If load < 11 lbs : +0
If load 11 to 22 lbs : +1
If load > 22 lbs: +2
Adjust: If shock or rapid build up of force: add +1

\+ 0 Force/Load Score

=

Step 6: Score A, Find Row in Table C
Add values from steps 4 & 5 to obtain Score A.
Find Row in **Table C**.

5 Score A

Scoring:
1 = negligible risk
2 or 3 = low risk, change may be needed
4 to 7 = medium risk, further investigation, change soon
8 to 10 = high risk, investigate and implement change
11+ = very high risk, implement change

SCORES

Table A	Neck											
		1				2				3		
	Legs	1	2	3	4	1	2	3	4	1	2	3	4
Trunk Posture Score	1	1	2	3	4	1	2	3	4	3	3	5	6
	2	2	3	4	5	3	4	5	6	4	5	6	7
	3	2	4	5	6	4	5	6	7	5	6	7	8
	4	3	5	6	7	5	6	7	8	6	7	8	9
	5	4	6	7	8	6	7	8	9	7	8	9	9

Table B	Lower Arm						
		1			2		
	Wrist	1	2	3	1	2	3
Upper Arm Score	1	1	2	2	1	2	3
	2	1	2	3	2	3	4
	3	3	4	5	4	5	5
	4	4	5	5	5	6	7
	5	6	7	8	7	8	8
	6	7	8	8	8	9	9

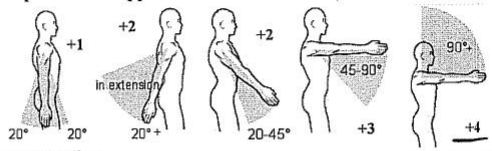
Score A (score from table A +load/force score)	Table C: Score B (table B value +coupling score)											
	1	2	3	4	5	6	7	8	9	10	11	12
1	1	1	1	2	3	3	4	5	6	7	7	7
2	1	2	2	3	4	4	5	6	6	7	7	8
3	2	3	3	3	4	5	6	7	7	8	8	8
4	3	4	4	4	5	6	7	8	8	9	9	9
5	4	4	4	5	6	7	8	8	9	9	9	9
6	6	6	6	7	8	8	9	9	10	10	10	10
7	7	7	7	8	9	9	9	10	10	11	11	11
8	8	8	8	9	10	10	10	10	10	11	11	11
9	9	9	9	10	10	10	11	11	11	12	12	12
10	10	10	10	11	11	11	11	12	12	12	12	12
11	11	11	11	11	12	12	12	12	12	12	12	12
12	12	12	12	12	12	12	12	12	12	12	12	12

8 Table C Score + 1 Activity Score

9 Final REBA Score

B. Arm and Wrist Analysis

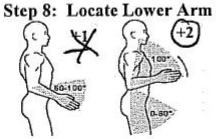
Step 7: Locate Upper Arm Position:



Step 7a: Adjust...
If shoulder is raised: +1
If upper arm is abducted: +1
If arm is supported or person is leaning: -1

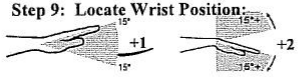
+5 Upper Arm Score

Step 8: Locate Lower Arm Position:



+2 Lower Arm Score

Step 9: Locate Wrist Position:



+1 Wrist Score

Step 9a: Adjust...
If wrist is bent from midline or twisted : Add +1

Step 10: Look-up Posture Score in Table B
Using values from steps 7-9 above, locate score in Table B

7 Posture Score B

\+

Step 11: Add Coupling Score
Well fitting Handle and mid rang power grip, ***good: +0***
Acceptable but not ideal hand hold or coupling acceptable with another body part, ***fair: +1***
Hand hold not acceptable but possible, ***poor: +2***
No handles, awkward, unsafe with any body part, ***Unacceptable: +3***

0 Coupling Score

=

Step 12: Score B, Find Column in Table C
Add values from steps 10 &11 to obtain Score B. Find column in **Table C** and match with Score A in row from step 6 to obtain Table C Score.

7 Score B

Step 13: Activity Score
+1 1 or more body parts are held for longer than 1 minute (static)
+1 Repeated small range actions (more than 4x per minute)
+1 Action causes rapid large range changes in postures or unstable base

Task name: JUMP to Bench Quip Reviewer: Jessie Mueller Date: 2 / 7 / 11

provided by Practical Ergonomics
rbarker@ergosmart.com (816) 444-1667

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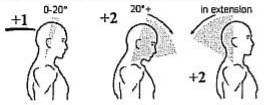
REBA Employee Assessment Worksheet

based on Technical note: Rapid Entire Body Assessment (REBA), Hignett, McAtamney, Applied Ergonomics 31 (2000) 201-205

A. Neck, Trunk and Leg Analysis

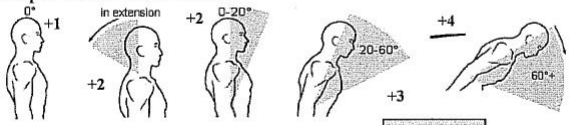
Step 1: Locate Neck Position



Step 1a: Adjust...
If neck is twisted: +1
If neck is side bending: +1

+2
Neck Score

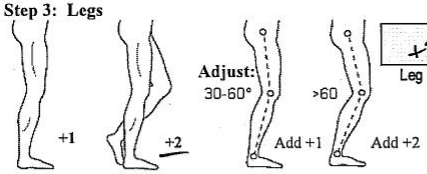
Step 2: Locate Trunk Position



Step 2a: Adjust...
If trunk is twisted: +1
If trunk is side bending: +1

+5
Trunk Score

Step 3: Legs



+2
Leg Score

Step 4: Look-up Posture Score in Table A
Using values from steps 1-3 above, locate score in Table A

7
Posture Score A

+

Step 5: Add Force/Load Score
If load < 11 lbs : +0
If load 11 to 22 lbs : +1
If load > 22 lbs: +2
Adjust: If shock or rapid build up of force: add +1

0
Force/Load Score

=

Step 6: Score A, Find Row in Table C
Add values from steps 4 & 5 to obtain Score A.
Find Row in **Table C**.

7
Score A

Scoring:
1 = negligible risk
2 or 3 = low risk, change may be needed
4 to 7 = medium risk, further investigation, change soon
8 to 10 = high risk, investigate and implement change
11+ = very high risk, implement change

SCORES

Table A		Neck											
		1				2				3			
	Legs	1	2	3	4	1	2	3	4	1	2	3	4
Trunk Posture Score	1	1	2	3	4	1	2	3	4	3	3	5	6
	2	2	3	4	5	3	4	5	6	4	5	6	7
	3	2	4	5	6	4	5	6	7	5	6	7	8
	4	3	5	6	7	5	6	7	8	6	7	8	9
	5	4	6	7	8	6	7	8	9	7	8	9	9

Table B		Lower Arm					
		1			2		
	Wrist	1	2	3	1	2	3
Upper Arm Score	1	1	2	2	1	2	3
	2	1	2	3	2	3	4
	3	3	4	5	4	5	5
	4	4	5	5	5	6	7
	5	6	7	8	7	8	8
	6	7	8	8	8	9	9

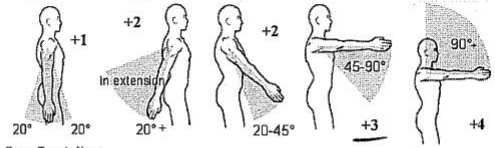
Score A (score from table A +load/force score)	Table C: Score B, (table B value +coupling score)											
	1	2	3	4	5	6	7	8	9	10	11	12
1	1	1	1	2	3	3	4	5	6	7	7	7
2	1	2	2	3	4	4	5	6	6	7	7	8
3	2	3	3	3	4	5	6	7	7	8	8	8
4	3	4	4	4	5	6	7	8	8	9	9	9
5	4	4	4	5	6	7	8	8	9	9	9	9
6	6	6	6	7	8	8	9	9	10	10	10	10
7	7	7	7	8	9	9	9	10	10	11	11	11
8	8	8	8	9	10	10	10	10	10	11	11	11
9	9	9	9	10	10	10	11	11	11	12	12	12
10	10	10	10	11	11	11	11	12	12	12	12	12
11	11	11	11	11	12	12	12	12	12	12	12	12
12	12	12	12	12	12	12	12	12	12	12	12	12

9 (Table C Score) + 1 (Activity Score)

10
Final REBA Score

B. Arm and Wrist Analysis

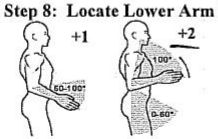
Step 7: Locate Upper Arm Position:



Step 7a: Adjust...
If shoulder is raised: +1
If upper arm is abducted: +1
If arm is supported or person is leaning: -1

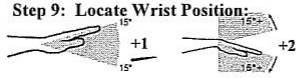
+3
Upper Arm Score

Step 8: Locate Lower Arm Position:



+2
Lower Arm Score

Step 9: Locate Wrist Position:



+2
Wrist Score

Step 9a: Adjust...
If wrist is bent from midline or twisted : Add +1

Step 10: Look-up Posture Score in Table B
Using values from steps 7-9 above, locate score in Table B

5
Posture Score B

+

Step 11: Add Coupling Score
Well fitting Handle and mid rang power grip, ***good: +0***
Acceptable but not ideal hand hold or coupling acceptable with another body part, ***fair: +1***
Hand hold not acceptable but possible, ***poor: +2***
No handles, awkward, unsafe with any body part, ***Unacceptable: +3***

0
Coupling Score

=

Step 12: Score B, Find Column in Table C
Add values from steps 10 &11 to obtain Score B. Find column in **Table C** and match with Score A in row from step 6 to obtain Table C Score.

5
Score B

Step 13: Activity Score
+1 1 or more body parts are held for longer than 1 minute (static)
+1 Repeated small range actions (more than 4x per minute)
+1 Action causes rapid large range changes in postures or unstable base

Task name: BENCH to O2 equipment Reviewer: Jessie Mueller Date: 2/7/11

provided by Practical Ergonomics

rbarker@ergosmart.com (816) 444-1667

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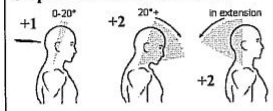
REBA Employee Assessment Worksheet

based on Technical note: Rapid Entire Body Assessment (REBA), Hignett, McAtamney, Applied Ergonomics 31 (2000) 201-205

A. Neck, Trunk and Leg Analysis

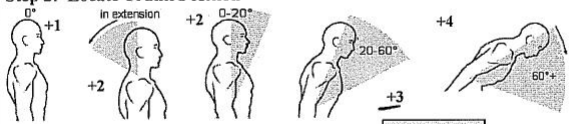
Step 1: Locate Neck Position



Step 1a: Adjust...
If neck is twisted: +1
If neck is side bending: +1

+1
Neck Score

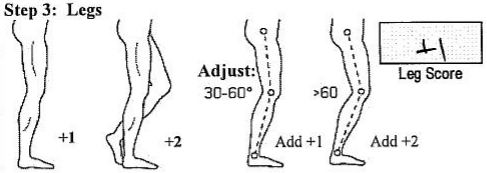
Step 2: Locate Trunk Position



Step 2a: Adjust...
If trunk is twisted: +1
If trunk is side bending: +1

+4
Trunk Score

Step 3: Legs



+1
Leg Score

Step 4: Look-up Posture Score in Table A
Using values from steps 1-3 above, locate score in Table A

3
Posture Score A

+

Step 5: Add Force/Load Score
If load < 11 lbs : +0
If load 11 to 22 lbs : +1
If load > 22 lbs: +2
Adjust: If shock or rapid build up of force: add +1

0
Force/Load Score

=

Step 6: Score A, Find Row in Table C
Add values from steps 4 & 5 to obtain Score A.
Find Row in **Table C**.

3
Score A

Scoring:
1 = negligible risk
2 or 3 = low risk, change may be needed
4 to 7 = medium risk, further investigation, change soon
8 to 10 = high risk, investigate and implement change
11+ = very high risk, implement change

SCORES

Table A		Neck											
		1				2				3			
	Legs	1	2	3	4	1	2	3	4	1	2	3	4
Trunk Posture Score	1	1	2	3	4	1	2	3	4	3	3	5	6
	2	2	3	4	5	3	4	5	6	4	5	6	7
	3	2	4	5	6	4	5	6	7	5	6	7	8
	4	3	5	6	7	5	6	7	8	6	7	8	9
	5	4	6	7	8	6	7	8	9	7	8	9	9

Table B		Lower Arm					
		1			2		
	Wrist	1	2	3	1	2	3
Upper Arm Score	1	1	2	2	1	2	3
	2	1	2	3	2	3	4
	3	3	4	5	4	5	5
	4	4	5	5	5	6	7
	5	6	7	8	7	8	8
	6	7	8	8	8	9	9

Score A (score from table A +load/force score)	Table C: Score B (table B value +coupling score)											
	1	2	3	4	5	6	7	8	9	10	11	12
1	1	1	1	2	3	3	4	5	6	7	7	7
2	1	2	2	3	4	4	5	6	6	7	7	8
3	2	3	3	3	4	5	6	7	7	8	8	8
4	3	4	4	4	5	6	7	8	8	9	9	9
5	4	4	4	5	6	7	8	8	9	9	9	9
6	6	6	6	7	8	8	9	9	10	10	10	10
7	7	7	7	8	9	9	9	10	10	11	11	11
8	8	8	8	9	10	10	10	10	10	11	11	11
9	9	9	9	10	10	10	11	11	11	12	12	12
10	10	10	10	11	11	11	11	12	12	12	12	12
11	11	11	11	11	12	12	12	12	12	12	12	12
12	12	12	12	12	12	12	12	12	12	12	12	12

3
Table C Score

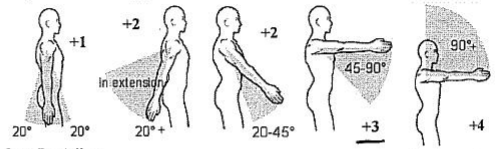
+

0
Activity Score

3
Final REBA Score

B. Arm and Wrist Analysis

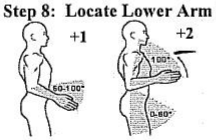
Step 7: Locate Upper Arm Position:



Step 7a: Adjust...
If shoulder is raised: +1
If upper arm is abducted: +1
If arm is supported or person is leaning: -1

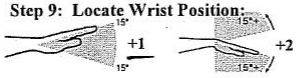
+2
Upper Arm Score

Step 8: Locate Lower Arm Position:



+2
Lower Arm Score

Step 9: Locate Wrist Position:



+1
Wrist Score

Step 9a: Adjust...
If wrist is bent from midline or twisted : Add +1

Step 10: Look-up Posture Score in Table B
Using values from steps 7-9 above, locate score in Table B

2
Posture Score B

+

Step 11: Add Coupling Score
Well fitting Handle and mid rang power grip, ***good: +0***
Acceptable but not ideal hand hold or coupling acceptable with another body part, ***fair: +1***
Hand hold not acceptable but possible, ***poor: +2***
No handles, awkward, unsafe with any body part, ***Unacceptable: +3***

0
Coupling Score

=

Step 12: Score B, Find Column in Table C
Add values from steps 10 &11 to obtain Score B. Find column in **Table C** and match with Score A in row from step 6 to obtain Table C Score.

2
Score B

Step 13: Activity Score
+1 1 or more body parts are held for longer than 1 minute (static)
+1 Repeated small range actions (more than 4x per minute)
+1 Action causes rapid large range changes in postures or unstable base

Task name: RF seat to Pass Thru Reviewer: Jessica Mueller Date: 2 / 7 / 11

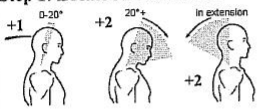
provided by Practical Ergonomics
rbarker@ergosmart.com (816) 444-1667

REBA Employee Assessment Worksheet

based on Technical note: Rapid Entire Body Assessment (REBA), Hignett, McAtamney, Applied Ergonomics 31 (2000) 201-205

A. Neck, Trunk and Leg Analysis

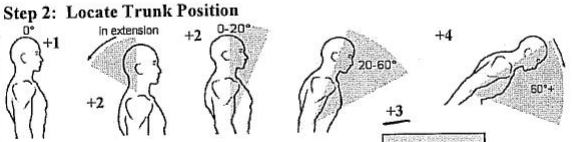
Step 1: Locate Neck Position



Step 1a: Adjust...
If neck is twisted: +1
If neck is side bending: +1

Neck Score: +2

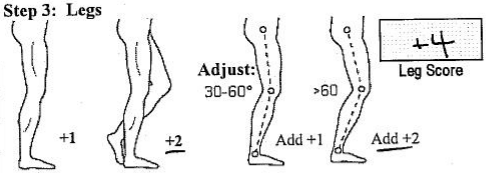
Step 2: Locate Trunk Position



Step 2a: Adjust...
If trunk is twisted: +1
If trunk is side bending: +1

Trunk Score: +4

Step 3: Legs



Leg Score: +4

Step 4: Look-up Posture Score in Table A
Using values from steps 1-3 above, locate score in Table A

Posture Score A: 8

Step 5: Add Force/Load Score
If load < 11 lbs : +0
If load 11 to 22 lbs : +1
If load > 22 lbs: +2
Adjust: If shock or rapid build up of force: add +1

Force/Load Score: 0

Step 6: Score A, Find Row in Table C
Add values from steps 4 & 5 to obtain Score A.
Find Row in **Table C**.

Score A: 8

Scoring:
1 = negligible risk
2 or 3 = low risk, change may be needed
4 to 7 = medium risk, further investigation, change soon
8 to 10 = high risk, investigate and implement change
11+ = very high risk, implement change

SCORES

Table A		Neck											
		1				2				3			
	Legs	1	2	3	4	1	2	3	4	1	2	3	4
Trunk Posture Score	1	1	2	3	4	1	2	3	4	3	3	5	6
	2	2	3	4	5	3	4	5	6	4	5	6	7
	3	2	4	5	6	4	5	6	7	5	6	7	8
	4	3	5	6	7	5	6	7	8	6	7	8	9
	5	4	6	7	8	6	7	8	9	7	8	9	9

Table B		Lower Arm					
		1			2		
	Wrist	1	2	3	1	2	3
Upper Arm Score	1	1	2	2	1	2	3
	2	1	2	3	2	3	4
	3	3	4	5	4	5	5
	4	4	5	5	5	6	7
	5	6	7	8	7	8	8
	6	7	8	8	8	9	9

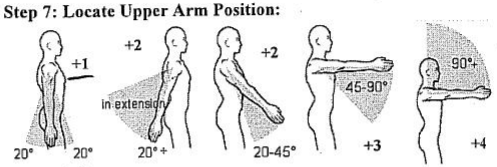
Score A (score from table A +load/force score)	Table C: Score B (table B value +coupling score)											
	1	2	3	4	5	6	7	8	9	10	11	12
1	1	1	1	2	3	3	4	5	6	7	7	7
2	1	2	2	3	4	4	5	6	6	7	7	8
3	2	3	3	3	4	5	6	7	7	8	8	8
4	3	4	4	4	5	6	7	8	8	9	9	9
5	4	4	4	5	6	7	8	8	9	9	9	9
6	6	6	6	7	8	8	9	9	10	10	10	10
7	7	7	7	8	9	9	9	10	10	11	11	11
8	8	8	8	9	10	10	10	10	10	11	11	11
9	9	9	9	10	10	10	11	11	11	12	12	12
10	10	10	10	11	11	11	11	12	12	12	12	12
11	11	11	11	11	12	12	12	12	12	12	12	12
12	12	12	12	12	12	12	12	12	12	12	12	12

Table C Score: 8 + Activity Score: 1

Final REBA Score: 9

B. Arm and Wrist Analysis

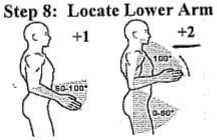
Step 7: Locate Upper Arm Position:



Step 7a: Adjust...
If shoulder is raised: +1
If upper arm is abducted: +1
If arm is supported or person is leaning: -1

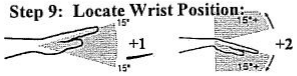
Upper Arm Score: +1

Step 8: Locate Lower Arm Position:



Lower Arm Score: +2

Step 9: Locate Wrist Position:



Step 9a: Adjust...
If wrist is bent from midline or twisted : Add +1

Wrist Score: +1

Step 10: Look-up Posture Score in Table B
Using values from steps 7-9 above, locate score in Table B

Posture Score B: 1

Step 11: Add Coupling Score
Well fitting Handle and mid rang power grip, ***good: +0***
Acceptable but not ideal hand hold or coupling acceptable with another body part, ***fair: +1***
Hand hold not acceptable but possible, ***poor: +2***
No handles, awkward, unsafe with any body part, ***Unacceptable: +3***

Coupling Score: 0

Step 12: Score B, Find Column in Table C
Add values from steps 10 &11 to obtain Score B. Find column in **Table C** and match with Score A in row from step 6 to obtain Table C Score.

Score B: 1

Step 13: Activity Score
+1 1 or more body parts are held for longer than 1 minute (static)
+1 Repeated small range actions (more than 4x per minute)
+1 Action causes rapid large range changes in postures or unstable base

Task name: BENCH to pass thru Reviewer: Jessie Mueller Date: 2/7/11

provided by Practical Ergonomics
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