ASTRONAUT INJURY SURVEILLANCE USING THE BARELL INJURY DIAGNOSIS MATRIX

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INTRODUCTION

Astronauts perform physically demanding tasks and risk incurring musculoskeletal injuries during both ground-based training and space missions. The appearance of increased injury rates has been attributed to numerous factors, including an aging astronaut corps, increased Weightless Environment Training Facility (WETF) and Neutral Buoyancy Laboratory (NBL) training, and improved clinical operations that promote injury reporting. Over the years, NASA has implemented techniques to help decrease the number of injuries, but there has not been a system-wide surveillance program to track injury rates.

The Barell Injury Diagnosis Matrix is an injury classification system that may serve as the foundation of an injury surveillance system. The Matrix was introduced in 2001 as a potential standardized method of classifying body region by nature of injury.[1] Diagnoses are coded using the International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) coding system. The purpose of this study is to assess the usefulness and complexity of the Barell Injury Diagnosis Matrix to classify and track musculoskeletal injuries among NASA astronauts.

MATERIALS & METHODS

A Certified Professional Coder through the American Academy of Professional Coders reviewed the ICD-9-CM codes used in the 2005 Barell Injury Diagnosis Matrix update to ensure it contained a comprehensive set of injury codes and to verify the inclusion of diagnoses unique to the environment of space travel. No additional codes were recommended. The Flight Medicine Clinic's Electronic Medical Record (EMR) was queried for all ICD-9-CM codes contained in the Matrix. Results were filtered to include diagnoses from 2004 to 2013 for new medical events among NASA astronauts who were active in the astronaut corps at the time of diagnosis. Injuries were categorized by body region and nature of injury according to the Matrix. To prevent inflating the total number of injuries, multiple ICD-9-CM codes per person per body region in a calendar year were counted as a single injury.

RESULTS

The Matrix classifies body regions using three levels. Level I: 36 small, well-defined categories; Level II: 9 mid-size categories; Level III: 5 broad categories. Using the Level II categories, 279 injuries were classified into 7 of 9 body regions. 'Sprains and Strains' (40.5%) was the most common injury type, and 'Upper Extremities' (30.8%) was the most common injury site. (Figure 1) 'System-wide & Late Effects' (9%) includes events such as motion sickness and toxic effects of venom. From 2004 to 2013, the number of injuries per year ranged from 15 to 35 with an average of 27.9. (Figure 2)

Figure 1. Total number of astronaut injuries, Level II body regions by injury site, 2004-2013.

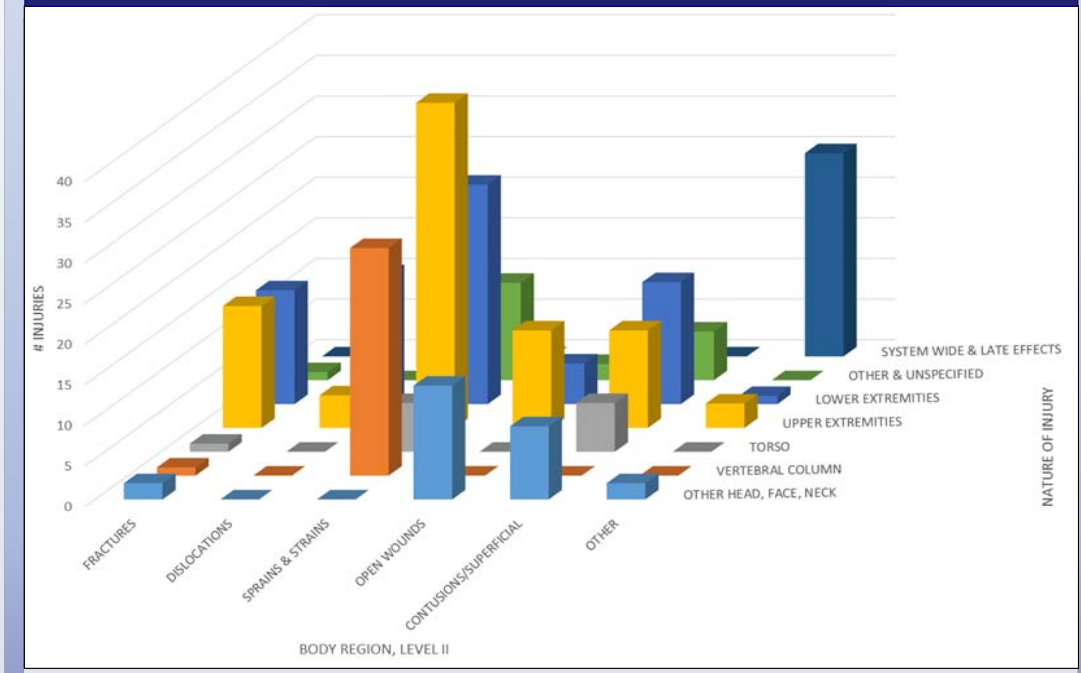
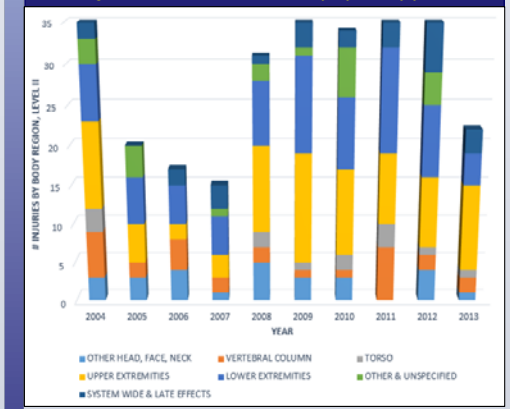


Figure 2. Number of Level II body injuries by year.



REFERENCE

1. "The Barell Injury Diagnosis Matrix, Classification by Body Region and Nature of the Injury." Centers for Disease Control and Prevention, 24 June 2010. Website: www.cdc.gov/nchs/injury/ice/barell_matrix.htm. Retrieved 01 Sept 2014.

LIMITATIONS

The EMR is currently the best source for astronaut medical data; however, its effectiveness as a surveillance system data source is limited by inaccuracies of both medical data and ICD-9-CM codes as well as delays with document approvals. The effectiveness of the Matrix is hindered by its lack of Current Procedural Terminology® (CPT) codes, which communicate information about medical services and procedures received. Injuries may be documented by ICD-9-CM and/or CPT codes, which may result in missed cases. Furthermore, the Matrix gives no indication of external cause or severity. This would give equal weight to a simple injury such as an abrasion and a more severe injury such as an amputation, for example.

CONCLUSIONS

The Barell Injury Diagnosis Matrix may be a suitable candidate on which to base an astronaut injury surveillance system when there are no other viable options that use ICD-10 or SNOMED coding systems. However, its limitations allow room for improvement. The Matrix is likely to underestimate the number of injuries, which may also differ from the number of injuries reported by other research projects, because of different injury definitions and different approaches to identifying cases. This approach is intended to be a high-level summary capable of identifying trends over time. It does not take the place of individual research projects with their own injury definitions, specific anatomical sites, and mechanisms of injury.