



US DEPARTMENT OF DEFENSE

BLAST INJURY RESEARCH PROGRAM COORDINATING OFFICE

Neurocognitive and Psychological Health Outcomes A Clustering Methodology for Describing Wounded In Actions Patients with Multimorbidity

Data mining methods can be used to extend analytic capabilities. Multimorbidity is defined as a patient condition with concomitant multiple injuries or illnesses. Teasing out clinically significant patient subsets with similar multimorbidity trends is difficult in large amounts of stratified categorical data. Researchers at the Naval Health Research Center (San Diego, California) is using cluster analysis to identify patient subpopulations with complex medical conditions to help inform better care management. This study focused on a subset of military personnel from the Wounded Warrior Recovery Project with battle trauma, most of which is blast-related. High healthcare utilization is used as an example of clustering to identify discrete subpopulations within the sample. Patients were grouped using Clinical Classification Software (CCS) categories (Figure 1). CCS was developed by the Agency for Healthcare Research and Quality and allows patient diagnoses and procedures to be grouped into 285 clinically meaningful distinct categories. One-year follow-up visits of outpatient International Classification of Diseases, Ninth Revision (ICD-9) codes were obtained and clustered into the CCS categories. Only patients with two or more ICD-9 diagnoses in more than one CCS category were used. For each cluster, quality of life (QOL) measurement scores were calculated and frequency percentage distributions were analyzed (Figure 2). A comparison of data transformation methods and clustering approaches demonstrated:

- Intracranial injuries, mental health disorders, and back problems are significantly contributing to lower QOL scores
- Low QOL can be attributed to greater prevalence of mental disorders
- High ISS contributes to low QOL scores
- ISS is based on physical trauma, which is one component of QOL; however, low Injury Severity Score (ISS) does not imply higher QOL score
- A limitation of this study was that the researchers could not determine what metrics contributed to higher QOL (*Zouris and MacGregor 2017*)

The findings of this analysis suggest a method to facilitate future planning and treatment interventions of combat trauma patients one-year post-injury, and identifying specific health problems can provide greater emphasis in improving QOL measures.

In summary, by applying more complex methodologic analysis, researchers can better distinguish and understand how multimorbidity impacts QOL and help inform better care management.

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CCS Category	CL1 (%)	CL2 (%)	CL3 (%)	CL4 (%)	CL5 (%)	CL6 (%)
Headache/migraine	2.8	57.3	15.5	6.5	21.1	92.0
Other ear disorders	9.2	24.4	5.2	13.0	37.6	61.6
Other nerve disorders	22.0	31.1	14.2	31.1	80.9	72.3
Back problem	6.4	22.6	87.1	13.0	25.1	82.1
Intracranial injury	2.6	38.8	8.4	18.6	48.2	76.8
Adjustment disorders	3.8	33.5	7.7	8.7	37.3	76.8
Anxiety disorders	6.9	46.1	35.5	9.0	42.9	82.1
Other mental health	2.3	20.9	2.6	14.0	23.4	58.9
Other joint disorders	82.6	29.9	45.8	16.5	77.9	50.9
	CL1	CL2	CL3	CL4	CL5	CL6
Mean ISS	6.81	4.35	5.65	10.00	13.09	5.71
Mean QWB score	0.53	0.50	0.49	0.53	0.48	0.42
SD QWB score	5.03	4.22	6.76	9.49	9.40	5.01
Total N-size	391	492	155	322	303	112

FIGURE 1: Main Findings among Injury-Related CCS Categories by Cluster: CL1=Cluster 1; CL2=Cluster 2; CL3=Cluster 3; CL4=Cluster 4; CL5=Cluster 5; CL6=Cluster 6; CCS=Clinical Classification Software; SD=standard deviation. (Table from Zouris and MacGregor (2017) used with permission from the authors)

CCS Categories	Low (%)	High (%)	Difference (%)
Anxiety disorders	39.8	23.3	16.4
Other nerve disorders	43.9	33.5	10.4
Adjustment disorders	28.6	18.6	10.0
Other mental disorders	21.5	12.1	9.4
Back problem	31.4	22.8	8.6
Headache/migraine	32.5	24.4	8.2
Other connective tissues	46.2	38.2	8.0
Other ear disorders	25.5	18.4	7.1
Mood disorders	13.6	7.4	6.2
Other joint disorders	52.4	47.6	4.8
	Low	High	
N-size	888	887	
QWB mean	0.39	0.61	

FIGURE 2: Top 10 CCS Categories Stratified by High and Low: CL1=Cluster 1; CL2=Cluster 2; CL3=Cluster 3; CL4=Cluster 4; CL5=Cluster 5; CL6=Cluster 6; SD=standard deviation. (Table from Zouris and MacGregor (2017) used with permission from the authors)

REFERENCES:

Zouris, J., and MacGregor, A. J. 2017. "A Clustering Methodology for Describing Wounded-in-Action Patients with Multimorbidity." 85th Military Operations Research Society (MORS) Symposium, West Point, NY, June 21, 2017.

