Public Health Potential of a Disability Tracking System: Analysis of U.S. Navy and Marine Corps Physical Evaluation Boards 2005–2006

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Clinical and demographic data in administrative disability tracking systems have the potential to support disability reduction programs. We analyzed recent Navy Physical Evaluation Board data, compared our findings with previous studies, and evaluated the quality of the case-tracking database as a public health information system. The overall rate of cases was 50% higher than in 2000 and 40% higher than the rate of new long-term group disability insurance claims. The most common diagnostic categories remain musculoskeletal disorders, injuries and poisonings, mental health conditions, and neurological syndromes. Diagnosis rates have increased in every category since 2000. The tracking system provided unprecedented timeliness and data accessibility, but fell short of its full potential as a public health tool due to poor information quality. Improved interface design and data entry processes combined with improved reporting capability will enhance its epidemiological value. Continued system improvement requires functional evaluation in conjunction with periodic data analysis.

Introduction

Military disability evaluation is service specific but includes common required elements.[1] Figure 1 illustrates the inherent complexity of the Navy disability evaluation process.[2,3] Inconsistencies and delays in case processing contribute significantly to costs, but systematic cost-reduction efforts have been limited by absent or outdated data systems.[4–6] In the early 1990s, the Navy began to develop disability case-tracking systems to reduce case-processing delays. Although not specifically designed to fulfill requirements for epidemiological analyses, these systems also captured demographic and clinical data.

Initial databases merged flat files developed at individual medical treatment facilities. In 1999, the first World Wide Web-based interface enabled direct data entry into a central database. The Medical Board Online Tri-Service Tracking (MEDBOLTT) system is an upgrade of the initial World Wide Web-based interface and entered Navy use in February 2005. (The inclusion of "Tri-Service" in the name is a misnomer. This system was developed by the Navy Medical Information Management Center and is used by Navy Medicine to track processing of disability cases at Navy treatment facilities.) The primary purpose of MEDBOLTT remains military treatment facility tracking of cases, but new features include service-wide level visibility of case status and enhanced epidemiological reporting capability.

Development of public health information systems should be an iterative process.[7] Periodic review using a structured evaluation is essential for continued improvement. Use of a framework for assessment of information and system quality provides data to support technical and program input upgrades.[8] Analyses of data from earlier Navy disability tracking systems have commented on data quality, but have not focused on evaluation of the system to provide feedback for system improvement.[9,10]

Multiple studies have focused on causes of and risk factors for disability in specific civilian occupational or demographic groups.[11–14] In the civilian workforce, poor job satisfaction, female gender, and increasing age have been identified as risk factors for disability. Two studies of causes of disability in non-U.S. military forces have shown inconsistent results. Bergman and Miller[15] studied British Army records from 1861 to 1998 and found that musculoskeletal disorders and injuries were the most frequent diagnoses leading to medical discharge in the late 20th century. Nakanishi et al.[16] reviewed records of 260 aviators on long-term (i.e., >3 months) disability from the Japanese Air Self Defense Force and found peaks in the 20 to 29 age group and the 40 to 49 age group. The younger peak mainly consisted of cases of preexisting disqualifying medical conditions while the older peak was comprised mainly of cardiovascular disease cases.

Analyses of U.S. Navy Physical Evaluation Board (PEB) data from systems predating MEDBOLTT have shown that the most frequently recorded diagnoses were musculoskeletal and psychiatric conditions.[9,10] In their evaluation of data from fiscal year 1995, Songer and LaPorte[9] noted that diagnosis coding using Veterans Administration's Schedule for Rating Disabilities codes did not distinguish between musculoskeletal conditions and injuries. Transition to use of International Classification of Diseases, Revision 9 (ICD-9) codes occurred before the analysis by Bohnker et al.[10] Limitations of both analyses included the inability to examine individuals with multiple diagnoses who had multiple cases in the database. Instead, they used each diagnosis reported as a unit of measure.

Our study analyzed MEDBOLTT data from its first year of operation, identified the most common diagnoses and demographic factors associated with PEBs, compared these findings with previous analyses of military and civilian disability data, and assessed MEDBOLTT's realization of attributes of a high-quality public health information system.

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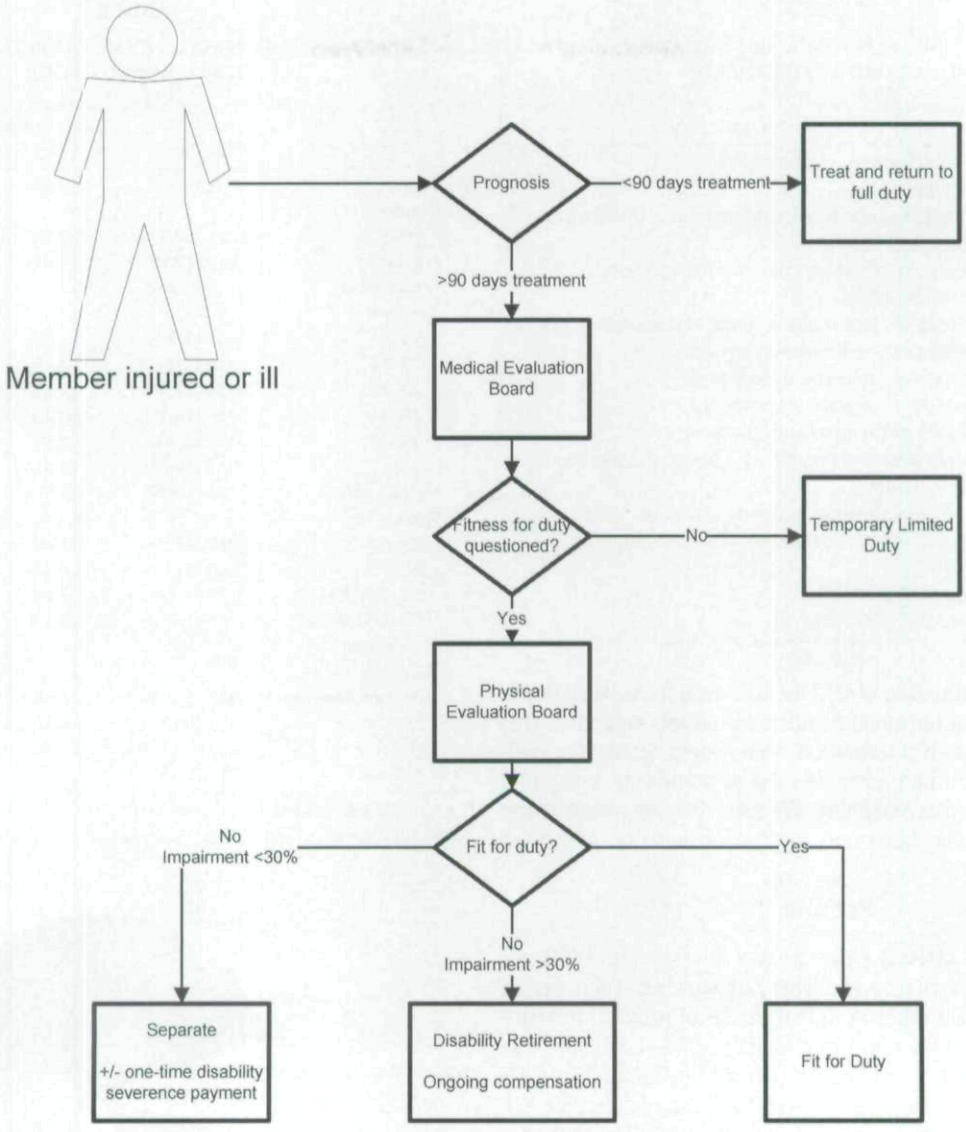

Fig. 1. U.S. Navy disability evaluation system.

Methods

After approval of our study design by the Uniformed Services University of the Health Sciences Institutional Review Board, we queried MEDBOLTT for all PEB entries between February 1, 2005 and February 1, 2006. The initial query (containing date of board, last name, first name, social security number, rank, rate, gender, branch of service, date of birth, military occupational specialty, diagnosis, and disability awarded) was exported to Microsoft Excel 2003 for analysis.[17]

In MEDBOLTT, each diagnosed condition for a single individual is stored as a separate record. Our initial query yielded 12,160 diagnoses, representing 5,150 individuals. We calculated overall rates of PEB diagnoses (n = 12,160) and PEB cases (n = 5,150) and compared these rates with the findings of Songer and LaPorte[9] and Bohnker et al.[10] We also analyzed rates of PEB cases by gender, branch of service race, age, and rank. (2005 mid-year population data for our rate calculations was obtained from the Defense Medical Epidemiology Database.[18] Mid-year population data before 2005 was obtained from the Department of Defense Statistical Analysis Division[19] and applied to numerator data from the comparison papers as necessary to calculate comparable rates.)

We sorted the dataset into diagnostic categories according to ICD-9 chapter (Table I) and identified 335 imprecise diagnoses (e.g., symptom, sign, or nonspecific V-code). Seventy-eight of these records contained sufficient detail elsewhere in MEDBOLTT for determination of a diagnostic category. This analysis excluded the remaining 257 records. We deleted individually identifiable health information (i.e., name, social security number, and date of birth) from the remaining 4,893 records used for ranking of diagnostic categories.

Military occupational specialty data were available for 4,251 of the PEB cases. The classifications used in MEDBOLTT did not correspond with those in the Defense Manpower Data Center Occupational Database, which provides conversion to standard occupational classification. We were unable to complete an analysis of PEB rates for each occupational group, as we could not obtain population data classified by occupation.

TABLE I

ICD-9 CODE RANGES FOR PHYSICAL EVALUATION BOARD DIAGNOSTIC CATEGORIES

ICD-9 Code	Diagnostic Category
001–139	Infectious and parasitic diseases
140–239	Neoplasms
240–279	Endocrine, nutritional, and metabolic diseases and immunity disorders
280–289	Diseases of blood and blood-forming organs
290–319	Mental disorders
320–389	Diseases of the nervous system and sense organs
390–459	Diseases of the circulatory system
460–519	Diseases of the respiratory system
520–579	Diseases of the digestive system
580–629	Diseases of the genitourinary system
630–677	Complications of pregnancy, childbirth, and the puerperium
680–709	Diseases of the skin and subcutaneous tissue
710–739	Diseases of the musculoskeletal and connective tissue
740–759	Congenital anomalies
800–999	Injury and poisoning

We based our evaluation of MEDBOLTT on a framework developed for assessment of public health information systems.[8] This model considered both information and system quality. Specifically, we focused on data accuracy, use of standards, completeness, timeliness, and accessibility. We recorded our observations while constructing our data query and performing our analysis.

Results

The overall rate of PEB cases in our dataset was 9.59 per 1,000 service members per year. This rate was 50% higher than the rate found by Bohnker et al.[10] from 1998 to 2000 (relative risk, 1.50; 95% confidence interval (CI), 1.44–1.57) and exceeded the U.S. rate for new long-term disability claims[20] of 6.68 per 1,000 covered lives in 2004 (relative risk, 1.44; 95% CI, 1.40–1.48). The advancement of a case to the PEB requires a determination of fitness for duty and is analogous to a new long-term group disability insurance claim. We found that the overall rate of PEB diagnoses doubled from the average rate of 11.86 per 1,000 service members per year found by Bohnker et al.[10] for the years 1998 to 2000 to 22.64 diagnoses per 1,000 per year (relative risk, 1.91; 95% CI, 1.85–197).

As presented in Table II, the following demographic subgroups appear to be overrepresented compared to the total Navy population: females (relative risk, 1.53; 95% CI, 1.42–1.64), personnel ages 25 to 29 years (relative risk, 1.28; 95% CI. 1.20–1.35), enlisted ranks E1 to E4 (relative risk. 1.23; 95% CI, 1.17–1.28), and races other than African American or Caucasian (relative risk, 1.21; 95% CI, 1.12–1.30).

The most common diagnostic categories were musculoskeletal disorders, injuries and poisonings, mental health conditions, and neurological syndromes (Fig. 2). This ranking was consistent across our analysis of first-listed diagnoses (n = 4,893) as well as all diagnoses (n = 12,160). Comparison of rates of all PEB diagnoses with previous studies of PEB data (Table III) revealed increases in each diagnostic category.

We conducted subanalyses of the four most common diagnostic categories. Back (29%) and knee (21%) conditions were the most frequently identified musculoskeletal disorders. Indeterminate anatomic sites (resulting from nonspecific coding) accounted for the third largest grouping (17%). Fractures accounted for 39% of injuries and poisonings, with sprains/strains accounting for 11% and head injuries an additional 8%. Mental health conditions predominantly consisted of mood (42%) and anxiety disorders (32%). The majority of neurological syndromes involved the central nervous system (60%), of which 75% were either headache or seizure syndromes. Peripheral nervous system disorders accounted for 20% and disorders involving sensory organs accounted for an additional 16% of this category.

TABLE II

SUBANALYSIS OF PHYSICAL EVALUATION BOARD RATES BY DEMOGRAPHIC GROUP

	PEB Cases[a]	Cases/1,000/Year[b]	Relative Risk
Total	5,150	9.59	
Gender			
Male	4,227 (82.1%)	8.90	0.93 (0.89–0.97)
Female	915 (17.8%)	14.71	1.53 (1.43–1.64)
Unknown	7 (0.1%)		
Age (years)			
<20	41 (0.8%)	0.81	0.09 (0.06–0.12)
20–24	1,914 (37.2%)	9.48	0.99 (0.94–1.04)
25–29	1,328 (27.1%)	12.81	1.28 (1.20–1.35)
30–34	715 (13.9%)	10.16	1.06 (0.98–1.14)
35–39	453 (8.8%)	7.82	0.82 (0.74–0.89)
>40	544 (10.6%)	11.31	1.18 (1.08–1.29)
Unknown	92 (1.8%)		
Rank			
E1–E4	2,982 (57.9%)	11.80	1.23 (1.17–1.29)
E5–E9	1,905 (37.0%)	8.97	0.94 (0.89–0.99)
O1–O3/W1–W3	176 (3.42%)	3.96	0.41 (0.36–0.48)
O4–O9/W4–W5	87 (1.7%)	3.14	0.33 (0.26–0.40)
Unknown	0		
Race			
African American	688 (13.4%)	7.63	0.80 (0.74–0.86)
Caucasian	3,431 (66.6%)	9.25	0.97 (0.92–1.00)
Other	751 (14.6%)	11.56	1.21 (1.12–1.30)
Unknown	271 (5.4%)		

[a] From MEDBOLTT dataset February 2005–February 2006.
[b] For total Department of Navy population mid-year 2005.

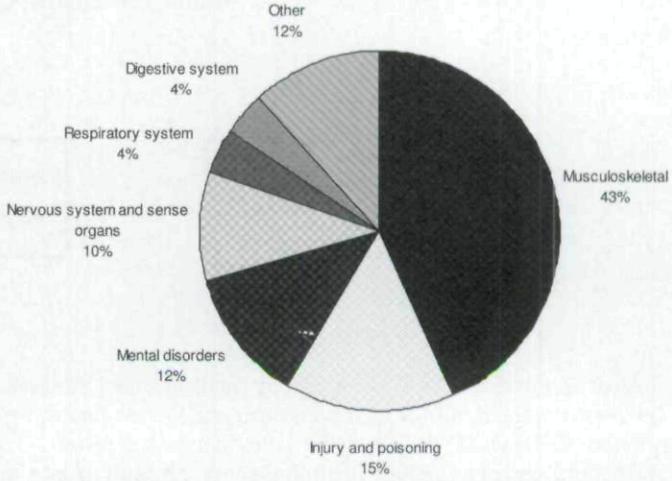

Fig. 2. PEB diagnostic categories in MEDBOLTT, February 2005–February 2006.

TABLE III

PHYSICAL EVALUATION BOARD RATES REPORTED FROM 1995 TO 2005

Diagnostic Category	Rate of PEB Diagnoses/1,000 Service Members/Year				
	1995[a]	1998	1999	2000	2005
Musculoskeletal	7.89	5.65	4.71	4.31	7.78
Injury/poisoning		1.26	0.98	0.89	3.21
Mental disorder	1.21	1.72	1.14	1.32	2.73
Neurologic	1.38	1.11	0.81	0.77	1.92
Respiratory	0.80	0.48	0.38	0.31	0.70
Digestive	0.31	0.37	0.32	0.28	0.65
Other	0.93	3.13	2.94	2.42	5.62

[a] Data from Songer and LaPorte[9] using Veterans Affairs's Schedule for Rating Disabilities codes that do not include code for injury.

Our evaluation of MEDBOLTT's information quality identified incomplete, inaccurate, and nonstandardized data in the majority of records. Although Navy policy supports capture of all PEB cases, most records contained incomplete data, particularly in the outcome (e.g., "final disposition" and "percent disability awarded") and "theater of operations" fields. Only 13 injury cases include an E-code describing the mechanism or location of the injury. A total of 166 records inappropriately contained "nonprimary" V-codes in the "primary diagnosis" field.

The data fields containing "date of birth" and "date of board" are both abbreviated "DOB," resulting in multiple errors in data entry. Although MEDBOLTT uses standard ICD-9 diagnosis coding, it does not use the standard occupational database coding system.

Overall, accessibility and timeliness of MEDBOLTT data were good given its World Wide Web-based design. Some features of the database, however, make access to specific data more cumbersome, without affecting information quality. Embedding of diagnosis codes in the "primary diagnosis" text field necessitates considerable manipulation of data fields for analysis. The inability to group records by individual identifier such as social security number results in numerous duplicate entries. Lack of integration with authoritative personnel data sources reduces access to demographic and occupational data and imposes additional data entry requirements.

Discussion

Our analysis showed increases in the overall PEB case rate and an even greater increase in PEB diagnosis rate compared with previous studies of PEB data. Analysis by diagnostic category showed that injuries and poisonings are now the second most frequent diagnostic category, up from third most frequent in previous analyses of PEB data. The observed increases in PEB cases and diagnoses since 2000 may represent a true increase in disabling impairment. Current combat operations could explain a true increase in disability evaluations resulting directly from injuries or indirectly as demand for fully deployable personnel reduced the number of available limited duty positions. The incompleteness of MEDBOLTT data, particularly lack of E-codes and theater of operations data, prevented exploration of these hypotheses.

Three policy and systems changes between 2000 and 2005 also may explain the observed increase in PEB cases and diagnoses. First, the 2005 revision of the Navy disability evaluation policy[2] reduced the maximum duration of limited duty. This change may have led to a transient increase in PEBs as preexisting limited duty cases exceeded the new time frame. The observed increase in rates across all diagnostic categories, including those not expected to increase due to combat operations, supports this premise. Second, the military electronic health record (implemented beginning in 2003) facilitates recording of multiple diagnoses. This additional documentation may be responsible for the relatively greater increase in PEB diagnosis rate versus overall PEB case rate. Third, the transition from use of Veterans Affairs's Schedule for Rating Disabilities codes to ICD-9 codes would explain an increase in the rate of injuries and poisonings, but does not explain the concomitant increase in musculoskeletal diagnoses. Continued analysis of PEB data will clarify the contribution of each of these factors.

Junior-enlisted personnel and women go to PEB more often than would be expected based on the composition of the overall Navy population. These observations are consistent with previous studies of military and civilian data.[11,12,21-24] The PEB population under represents the youngest age group when compared to the overall Navy population. We expected this finding since discovery of preexisting disqualifying medical conditions during recruit training leads to administrative separation rather than a PEB.

The MEDBOLTT system provided unprecedented timeliness and accessibility to Navy PEB data, but fell short of its full potential as a public health tool due to poor information quality, namely, incomplete, inaccurate, and nonstandard data. Data fields that are nonessential to tracking case status (e.g., theater of operations) were frequently incomplete. These deficiencies do not affect the system's primary purpose as a tracking tool, but are nonetheless essential to the public health applicability of the system. Our inability to determine whether observed increases in PEB case rates were due to combat-related injuries underscores the critical nature of this data. Interface design changes should clarify data entry requirements. Use of forced entry fields and data entry validation in the interface would further support data completeness and accuracy. Management of the data entry process should use standardized metrics and performance feedback.

Integration with authoritative personnel data sources would decrease manual data entry requirements by automating population of demographic and occupational data fields. This would improve both information quality, through better data accuracy and standardization, and system quality, through increased efficiency. In the interim, clarification of data field names and standardization of occupational codes would permit analysis of data by occupational category and comparison with civilian disability data.

Creation of separate fields for diagnosis and diagnosis codes and the addition of the ability to group records by individual rather than by PEB would further enhance system quality by supporting efficient, periodic analyses of MEDBOLTT data. Finally, database design should reflect coding guidelines by prohibiting entry of supplemental codes (e.g., E-codes and nonprimary V-codes) as first-listed diagnoses while forcing entry of an E-code for each injury diagnosis code.

Conclusions

The most common causes for PEBs remain musculoskeletal disorders, injuries and poisonings, mental health conditions, and neurological syndromes. The overall rate of PEB cases was 50% higher in 2005 than in 2000. Diagnosis-specific rates have increased in every category since 2000, with the largest increases in musculoskeletal disorders and injuries and poisonings. Compared to civilian insurance data, rates of PEB were 1.4 times higher than rates of new long-term group disability claims.

We were unable to analyze the potential contributors to increases in PEB case and diagnosis rate due to poor information quality. Continued analysis of trends in disability rates may clarify the contribution of policy and system changes to the increased rates of PEB cases and diagnoses that we observed. Increases associated with changes in limited duty policy, improved case tracking, and transition to an electronic medical record should stabilize over time. Improved theater of operations data are required to elucidate the impact of combat operations on disability rates.

Although MEDBOLTT provides timely and accessible data, shortcomings in the fundamental areas of data completeness, accuracy, and use of standards limit its use in epidemiological analyses. Changes in the interface design and the data entry process combined with improved reporting capability will address these deficiencies and enhance MEDBOLTT's potential as a public health tool. Periodic analysis providing specific feedback for information systems improvement will ultimately enhance disability reduction efforts by providing more complete, accurate, and standardized data.

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