# VATAP SHORT REPORT: *PHYSICIAN AND NURSE STAFFING IN SPINAL CORD INJURY CARE: RELATION TO OUTCOMES*

*FEBRUARY 2003*

## HTA REPORT SUMMARY



| Item | Yes | Partly | No |
|---|---|---|---|
| **Preliminary** | | | |
| 1. Appropriate contact details for further information? | √ | | |
| 2. Authors identified? | √ | | |
| 3. Statement regarding conflict of interest? | | | √ |
| 4. Statement on whether report externally reviewed? | √ | | |
| 5. Short summary in non-technical language? | √ | | |
| **Why?** | | | |
| 6. Reference to the question that is addressed and context of the assessment? | √ | | |
| 7. Scope of the assessment specified? | √ | | |
| 8. Description of the health technology? | √ | | |
| **How?** | | | |
| 9. Details on sources of information? | √ | | |
| 10. Information on selection of material for assessment? | √ | | |
| 11. Information on basis for interpretation of selected data? | √ | | |
| **What?** | | | |
| 12. Results of assessment clearly presented? | √ | | |
| 13. Interpretation of the assessment results included? | √ | | |
| **What Then?** | | | |
| 14. Findings of the assessment discussed? | √ | | |
| 15. Medico-legal implications considered? | | | √ |
| 16. Conclusions from assessment clearly stated? | √ | | |
| 17. Suggestions for further actions? | √ | | |

*VATAP uses this checklist© as a quality assurance guide to foster consistency and transparency in the health technology assessment (HTA) process. VATAP will add this checklist© to its reports produced since 2002. This summary form is intended as an aid for those who want to record the extent to which a HTA report meets the 17 questions presented in the checklist. It is NOT intended as a scorecard to rate the standard of HTA reports – reports may be valid and useful without meeting all of the criteria that have been listed.*

• VA TAP (11T) Office of Patient Care Services • Room D4-142 • 150 S. Huntington Avenue, Boston, MA 02130 •
• Tel: 617-278-4469 • Fax: 617-264-6587 •
• E-mail: VATAP@med.va.gov • Web: http://www.va.gov/vatap • http://vaww.va.gov/vatap •

Technology Assessment Program
Office of Patient Care Services

# VA Technology Assessment Program

## SHORT REPORT

## *Physician and Nurse Staffing in Spinal Cord Injury Care: Relation to Outcomes*

Number 7 | Rapidly produced brief assessments of health care technology | February, 2003

## Executive Summary

**NOTE: The Appendix to this report contains tables and figures cited in the text.**

- The Veterans Health Administration (VHA) Strategic Healthcare Group (SHG) for spinal cord injury (SCI) asked the VHA Technology Assessment Program (VATAP) to review the published research that relates physician and nurse staffing for SCI care to patient outcomes. The intent of the review would be to document available evidence in support of staffing VHA SCI units to obtain optimal patient outcomes. The segments of care specified for the review were: physicians and nurses for outpatient and extended care; and nurses only for inpatient acute care.

- VATAP conducted extensive searches of multiple literature databases using multiple key words and strategies; colleague agencies of the International Network for Health Technology Assessment (INAHTA) also were contacted, but only a single study directly relevant to the review request had been published as of February, 2003. While this study's findings are intuitively plausible, its small convenience sample from a Model Systems SCI center and uneven reporting restrict generalizability to other settings.

- Published research has only indirectly addressed the policy questions underlying the request for this report. The report on a project from a private consulting firm with which the SHG contracted also failed to completely respond to these policy issues; rather, it was restricted to a catalog of data availability within VHA and other systems of care for SCI.

- Rigorously designed and well-reported studies of nurse staffing in general adult medical surgical hospitals are available, and may contribute insights to resolving SHG staffing policy concerns. These studies provide credible evidence that nurse training and staffing influence hospital mortality and other adverse events; and that hospitals placing a high institutional priority on nursing have lower mortality rates than hospitals that do not. Hospitals with nursing as a priority are distinguished by organizational features for nursing, which include professional autonomy, control over the practice environment and well-defined mechanisms of communication between physicians and nurses.

- The slender body of literature addressing health services utilization by SCI patients is abstracted in the Appendix to this report: five studies (one conducted by VHA researchers) address service use directly while a further four (two from VHA) validate the Functional Independence Measure (FIM) or its self-report version (SRFM). Three of the five utilization studies are confined to a medical or acute rehabilitation setting. The validation studies suggest that scores on the FIM accurately predict care needs and length of acute rehabilitation stay, but do not address extended or outpatient care.

• VA TAP (11T) Office of Patient Care Services • Room D4-142 • 150 S. Huntington Avenue, Boston, MA 02130 •
• Tel: 617-278-4469 • Fax: 617-264-6587 •
• E-mail: VATAP@med.va.gov • Web: http://www.va.gov/vatap • http://vaww.va.gov/vatap •

- Although research directly addressing the issues for this review has not been published, the nursing in general adult acute care and functional independence measure (FIM) validation studies are indirectly relevant to VHA. Such research findings, coupled with VHA administrative databases and minimal new data collection could be used by the SHG to predict nursing staff needs for defined sub-populations of SCI patients in specific segments of care. FIM validation studies also could provide a basis for further research by VHA Health Services Research and Development (HSR&D) investigators to analyze and predict care needs of SCI patients. Findings regarding organizational features for nursing in hospitals with good outcomes should similarly support organization of acute SCI care within VHA.

- FIM validation studies by VHA investigators suggest that FIM scores could be used by VHA to predict inpatient utilization and extended length of stay by veterans with SCI; the scores could thus provide data for estimation of nurse staffing needs.

- Physician and nurse staffing for spinal cord injury (SCI) care remains an area in which knowledge deficiencies should be addressed by health services researchers within VHA and elsewhere. Pending such research, scores on commonly used standardized instruments of functional independence may predict care needs for subgroups of SCI patients.

## Background

**The review request**

VHA's Strategic Healthcare Group (SHG) in Spinal Cord Injury and Disability (SCI&D) asked the VA Technology Assessment Program (VATAP) to review the literature on the relationship between of physician and nurse staffing in outpatient and extended care settings to outcomes for adult patients with spinal cord injury. The SHG also requested research results for the inpatient acute care setting for nursing only.

**Spinal cord injury**

"*Spinal cord injury and disorders (SCI) …. reflect a broad constellation of altered physiology, secondary complications, impaired function, and changed social roles, all of which influence quality of life."* (Weaver, 2000)

*"By consensus, the best care (of individuals with spinal cord injury) is comprehensive, given by a staff aware of the peculiarities of spinal cord injury, a condition where much –blood pressures both high and low, pink skin, swollen hip or knee, headache, and even gooseflesh –signifies something else than usual. The care is best given in a setting where this specialized staff joins patients to one end, the best function in the best health possible so that life can proceed on the terms granted without adding time to the loss column…."* (Wisely, 1979)

**Segments of care**

Care for SCI, within VHA and elsewhere, is complex and lifelong (Weaver, 2000). For this reason, SCI care is conceptualized as a series of segments. For calculating costs of care, DeVivo (1995) suggests the following segments, with examples of areas for charges:

- **emergency medical services**: site of injury care, transportation to first acute care facility, and transportation between hospitals up to the first definitive discharge from the Model System [federally designated and supported health care systems that provide comprehensive SCI service delivery within defined geographic areas (Stover, 1999)];
- **acute care:** emergency room, room and board, laboratory and radiology, pharmacy, central supply, operating and recovery rooms, intensive care, anaesthesia, nuclear medicine, respiratory therapy, miscellaneous inpatient care;
- **rehabilitation:** room and board, radiology, laboratory, rehabilitation medicine, respiratory, physical, occupational and recreational therapies;
- **rehospitalizations:** McDonald and Sadowsky (2002) report that up to 30% of

SCI patients are re-hospitalized yearly for medical complications;
- **nursing home care.**

**Predicting outcome**
Figures 1 and 2 in the Appendix to this report present functional outcomes of SCI according to important predictors. Nursing home or other institutional placement after SCI is not inevitable: Beck (1999) reports that 37 of 41 (90%) SCI patients in that small sample were discharged from acute rehabilitation directly to their homes, three to skilled nursing facilities and one to a transitional living facility. DeVivo (1999), analyzing data from 16,633 persons with SCI, found that age was the most important variable in a discharge disposition model that also included marital status, race, employment status at injury, functional status on discharge from rehabilitation, bladder management method, and third-party sponsorship of rehabilitation.

Critical predictors of varying degrees of functional and neurologic recovery (Appendix Figures 1 and 2) after SCI include classification by the American Spinal Injury Association (ASIA) or the ASIA impairment scale (Burns and DiTunno, 2001; Waters, 1998). The ASIA scale scores from A (complete injury with no sensory or motor function preserved in the sacral segments) to D (incomplete injury, with motor function preserved below the neurologic level of injury); E indicates normal sensory and motor function, and neurologic and motor levels of injury.

Timing of the examination is important. Based on their review, Burns and DiTunno (2001) advocate the 72- hour examination as superior to that performed on the day of injury, since reflexes evolve over several days after injury and prediction within the first week is needed to justify rehabilitation services. McDonald and Sadowsky (2002) concur, noting that most individuals regain one level of motor function and most recovery of function takes place within the first 6 months.

**Outcome: neurologic recovery and ambulation**
Burns and DiTunno (2001) report that 80% of soldiers suffering SCI in World War I died within the first few weeks after injury. Today, in well-organized systems of care, 94% survive the initial hospitalization and functional concerns supplant mortality. Patients want to know: "What will I be capable of and will I be able to walk?" These authors review the literature on neurologic recovery for complete versus incomplete injuries and prognosis for ambulation. Appendix Figures 1 and 2 summarize what is known about probability of important functional recovery after SCI according to major predictive factors. Burns and DiTunno conclude: "*We are now capable of predicting with reasonable accuracy the long-term outcome for patients within a week of their initial injury.*"

ASIA criteria define SCI as complete (absence of sensory and motor function in the lowest sacral segment) or incomplete. The latter indicates the presence of sensory and/or motor function at the lowest sacral segment. ASIA criteria further define neurologic level of injury as the most caudal segment of the spinal cord above the injury site with normal sensory and motor function on both sides.

Gittler (2002) notes that the major functional status measures provide the best predictors of outcome: motor level of injury best predicts self-care. Motor level of injury is more accurate than single neurologic level. The injury type and lower extremity motor score predict the potential for community ambulation at one year (Appendix Figure 2). Community ambulation indicates that ambulation is the primary mode of mobility and most closely approximates uninjured status with ability to live independently. However, exceptional circumstances can complicate prediction: a small subset of young motivated patients with C6 ASIA class A SCI accomplish independence in self-care and are able to live independently.

**Outcome measures: functional assessment**
Goldstein and Hammond (1997) report that the Functional Independence Measure (FIM) is the

most commonly used functional assessment measure in rehabilitation research. While these authors report the FIM to be reliable and valid, this report's Table 2 (Appendix) abstracts recent additional efforts to validate and define its role as a prediction tool.

**Rehabilitation**

Rehabilitation often is the final segment of the first episode of care after injury. Gittler (2002) reports Spinal Cord Injury Model Systems data indicating that of persons discharged from inpatient rehabilitation: 30% are rehospitalized within the first year; 3.5% are discharged to nursing homes; 10% develop a pressure ulcer within a year and; only 50% leave their homes more than 4 days a week.

DeVivo (1989) lists the known determinants of rehabilitation outcomes for persons with SCI: age; sex; race; neurological level and extent of lesion; number of associated injuries; use of a mechanical ventilator; IQ; education level at injury; and employment status at injury.

**Burden of disease: epidemiology and costs**

*"Although SCI does not occur as often as many other types of injuries and debilitating diseases, its costs to both individuals and society are staggering. In fact, with advancing medical technology and increasing life expectancies, the direct costs of SCI are increasing at a rapid pace. Moreover, unlike most chronic diseases that usually occur among older persons, SCI is predominantly a scourge of youth. As a result, despite its low incidence, the indirect costs of SCI are very high and frequently exceed its direct costs."* (DeVivo, 1995)

McDonald and Sadowsky (2002) provide an overview of the causes and epidemiology of traumatic spinal cord injury (SCI): incidence rates for the United States range between 28 and 55 per million people, with about 10,000 new cases reported per year. Causes include motor vehicle accidents (36-48%), violence (5-29%), falls (17-21%), and recreational activities (7-16%). Assuming near normal lifespan, the US SCI population is estimated at 183,000-230,000. Average age at injury is 31.7 years, with the greatest frequency between 15 and 25 years, and the male to female ratio is four to one. Lifetime costs for an individual injured at 25 years have been estimated at $1,713,267 (Meyers, 2000).

Weaver (2000) provides information specific to VHA: an estimated 22% of all US individuals with SCI are veterans, and more than 40% of veterans with SCI were injured during military service. The average age of veterans at injury is 31 years. VA data sources indicate that almost 30,000 veterans meet VA diagnostic criteria to classify SCI as a special emphasis population.

"*Unlike private-sector providers, who tend to provide primary rehabilitation for new injuries, the VA provides an additional focus on ongoing, sustaining care to veterans with SCI. The VA is committed to caring for veterans with SCI over their lifetime."* (Weaver, 2000)

VHA achieves this purpose through a "hub and spoke" care delivery model centered on 23 regional SCI centers delivering primary care, acute rehabilitation, health maintenance and life long health care for persons with SCI. The "spokes" of the VHA system are 29 SCI support clinics and primary care teams (physician, nurse, and social worker) in the 120 VHA facilities without either SCI center or support clinic. All of these components together provide the full spectrum of services and access to care in a coordinated fashion (Weaver, 2000).

The ongoing SCI Quality Enhancement Research Initiative (QUERI) has identified home care and nursing home care needs among the most important knowledge gaps for veterans with SCI and their care providers (Weaver, 2000).

## Assessment Methods

Ideally, research addressing the policy issues underlying the request for this report would:

- Be prospectively designed for the purpose;
- Address the segments of care specified by the SCI SHG (outpatient and extended care for nurses and physicians; acute care for nurses only);

- Collect data on outcomes that are most important to VHA clinicians, SCI patients, and other stakeholders using standardized, reliable and valid outcomes instruments as the dependent variable;
- Collect data on physician and nurse staffing ratios and skill mixes (as the independent variables) from facilities where a variety of such ratios and mixes are in use;
- Adjust outcomes data for known determinants of SCI care outcome (Appendix Figures 1 and 2).

Under ideal circumstances, i.e., with a substantial body of published research reports from which to choose, the criteria listed above would extrapolate directly to selection criteria for published research reports included in this VATAP review.

**Search strategy**

VATAP's initial literature database searches of MEDLINE and EMBASE from 1966 through December 2001 indicated the literature on this topic to be sparse and not precisely indexed. In order to achieve the broadest possible recall of potentially appropriate articles, we performed searches on *spinal cord injuries* or *spinal cord trauma* and later broadened the search to any occurrence of the word *spinal* combined with a wide range of terms indicating staffing models and outcomes. Over 800 references were reviewed. MeSH terms and subheadings plus free text expressions of MeSH terms included: standard#, organization & administration, health services research, health services utilization, standards of care, staffing, staff model#, outcome#, personnel staffing and scheduling, workload#, practice pattern#, treatment outcome#, outcome#, and physician# role#.

The health technology assessment (HTA) database maintained by the International Network of Agencies for Health Technology Assessment (INAHTA) was searched for existing reviews and projects in progress, and the client for this report provided access to a consultant's report (Booz-Allen Hamilton, 2000) as well as to SHG-identified reference lists.

## Results

Initial VATAP literature database searches indicated a complete lack of published research relevant to this review. VATAP then attempted to expand its search focus to health services utilization in a more general sense, hoping that the broader focus might include relevant material. We also reviewed end reference lists of articles selected for background and contextual information.

However, as indicated in the Appendix tables, published studies resulting from the broader focus on health services utilization failed to yield enlightenment regarding any impact of staffing on SCI patient outcomes. While all five studies abstracted in Table 1 and summarized in the table on page 6 address SCI care, none of them do so in outpatient or extended care settings, and the same lack of insight holds for the impact of staffing on outcomes. Finally, of the nine studies in the summary table, only two included important determinants of SCI outcome in their analyses.

Thus, VATAP can only conclude that the precise components of the policy issues relevant to VA's SCI SHG have yet to be addressed by researchers, and provide a fertile field for new research. It would be heartening to report that such research is currently in progress, needing only patience in awaiting published results. However, the single indicator of ongoing research (Sochalski, 1999) reports that the international study in progress will address nurse staffing in general adult acute care, rather than SCI care, and thus will not substantially alleviate the knowledge deficiency in this area. Nurse staffing in general adult acute care is already represented by a substantial body of literature, including one review intended to be systematic (Appendix Table 3).

While VATAP was unable to identify relevant research specific to SCI, the association of nurse staffing with outcome has been documented for adult general acute care (Appendix Table 3). The studies abstracted in Table 3 provide evidence that: nurse training

and staffing influence hospital mortality and other adverse events. Table 3 also includes studies documenting that hospitals placing a high institutional priority on nursing have both low mortality rates and organizational features such as professional autonomy, control over the practice environment and well-defined mechanisms of communication between physicians and nurses.

Finally, a number of studies identified in the course of searching for research reporting health services utilization by SCI patients were conducted to further validate the Functional Independence Measure (FIM) and its self-report version (Table 2).

The published reports of VHA investigators using VHA SCI data are included in Appendix Tables 1 and 2 and are indicated by shading. These studies plus analytic assistance and VHA administrative data could assist the client for this report in using FIM scores to estimate care and nurse staffing needs for subgroups of SCI patients.

**Summary of the available literature: Frequency by classes of studies (from Tables 1 and 2 in Appendix) and segment (s) of care included**

| Reference, study purpose | Segment(s) of care studied | Design | Analysis by level and/or completeness of injury? |
|---|---|---|---|
| Health services utilization patterns, 5 studies (detailed in Table 1) | | | |
| Burnett (2000): LOS outliers | Inpatient rehab | Cross- sectional database analysis | yes |
| Eastwood (1999): LOS predictors | Medical rehab | Longitudinal | no |
| Wineman (1999): unplanned use of health services | Rehab | Cross-sectional | yes |
| Samsa (1996): pattern of inpatient hospitalization in 15 years following injury | VHA SCI centers | Cross-sectional | no |
| Richmond (1995): professional nursing care needs and costs | Acute SCI care | Cross-sectional | no |
| FIM or SRFM validation, 4 studies (detailed in Table 2) | | | |
| Heinemann (1997): FIM concurrent validity | Inpatient medical rehab | Cross-sectional | no |
| Hoenig (2001): SRFM in MS and SCI | VA hospitals and outpatient centers | Cross-sectional | no |
| Samsa (2001): SRFM and personal assistance needed | Veterans with SCI | Cross-sectional administrative database analysis | no |
| Hamilton (1999): FIM in predicting minutes of daily assistance needed and costs of durable goods | Median 6 years post-discharge from medical rehabilitation | Cross-sectional | no |

## Summary and Discussion

VATAP conducted extensive and repeated searches of multiple literature databases, but was unable to identify relevant research published as of February, 2003. The single ongoing international study of nurse staffing and patient outcomes will neither directly address spinal cord injury nor the segments of care of interest to VATAP's client for this review.

The logistical challenges of conducting an intervention on physician or nurse staffing in SCI units could be overcome by taking advantage of research settings available to researchers through existing facilities where a range of different staffing models were in use.

VHA attempted to do exactly that through a contract with Booz-Allen and Hamilton, Inc. (Booz- Allen, 2000); the ultimate aim of the consultant's project was to design a risk-adjustment model for VHA SCI outcome data collection and reporting, rather than to actually collect the data, adjust and analyze it. In this context, the consultant recorded only the extent to which outcome measurements were routinely collected at participating facilities, not the measurements themselves. Further, the consultant report provides details of physician- or nurse-to-patient staffing ratios only for the medical rehabilitation segment of care, and thus is not directly applicable to this report.

VATAP concludes the policy questions underlying the request for this report have yet to be addressed by research. These questions also failed to be completely resolved by a consultant contracted by the SCI SHG. However, other guidance is available. Based on their own research and other findings regarding nursing, Aiken (1994) notes: "*Hospitals that facilitate professional autonomy, control over practice, and comparatively good relations between nurses and physicians will be ones in which nurses are able to exercise their professional judgment on a more regular basis, with positive implications for the quality and outcomes of patient care.*"

Finally, functional independence measure (FIM) validation studies (Appendix Table 2) plus analytic assistance and VHA administrative data could assist the client for this report in using FIM scores to estimate care and nurse staffing needs for subgroups of SCI patients.

## References

Aiken LH, Clarke SP, Sloane DM, Sochalski J, Silber JH. Hospital nurse staffing and patient mortality, nurse burnout, and job dissatisfaction. *JAMA,* 2002; 288: 1987-1993. http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Citation&list_uids=12387650.

Aiken LH, Smith HL, Lake ET. Lower medicare mortality among a set of hospitals known for good nursing care. *Medical Care,* 1994; 32: 771-787. http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Citation&list_uids=8057694.

Beck LA, Harris MR, Basford J. Factors influencing functional outcome and discharge disposition after thoracic spinal cord injury. *SCI Nursing,* 1999; 16: 127-132. http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Citation&list_uids=10776332.

Booz-Allen and Hamilton I. (A Report to Veterans Health Administration, Department of Veterans Affairs). Spinal cord injury and disorders: A comparison of program data collected across four modes of care. March, 2000.

Burnett DM, Kolakowsky-Hayner SA, Gourley EV, 3rd, Cifu DX. Spinal cord injury "outliers": an analysis of etiology, outcomes, and length of stay. *J Neurotrauma,* 2000; 17: 765-772. http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Citation&list_uids=11011816

Burns D. Establishing prognosis and maximizing functional outcomes after spinal cord injury. *Spine,* 2001; 26: S137-145.

DeVivo MJ. Discharge disposition from model spinal cord injury care system rehabilitation programs. *Archives of Physical Medicine and Rehabilitation,* 1999; 80: 785-790.

DeVivo MJ, Stover SL, Fine PR. The relationship between sponsorship and rehabilitation outcome following spinal cord injury. *Paraplegia,* 1989; 27: 470-479. http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Citation&list_uids=2691959.

DeVivo MJ, Whiteneck GG, Charles ED. The economic impact of spinal cord injury. In: Stover SL, DeLisa JA, Whiteneck GG, Eds. *Spinal cord injury: Clinical outcomes from the model system*. Gaithersburg, MD: Aspen Publications, 1995.

DiTunno JF, Jr., Formal CS. Chronic spinal cord injury. *New England Journal of Medicine,* 1994; 330: 550-556. http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Citation&list_uids=8302323.

Eastwood EA, Hagglund KJ, Ragnarsson KT, Gordon WA, Marino RJ. Medical rehabilitation length of stay and outcomes for persons with traumatic spinal cord injury--1990-1997. *Archives of Physical Medicine and Rehabilitation,* 1999; 80: 1457-1463.

Evans RL, Hendricks RD, Connis RT, Haselkorn JK, Ries KR, Mennet TE. Quality of life after spinal cord injury: A literature critique and meta-analysis (1983-1992). *Journal of the American Paraplegia Society,* 1994; 17: 60-66.

Gittler MS, McKinley WO, Stiens SA, Groah SL, Kirshblum SC. Spinal cord injury medicine. 3. Rehabilitation outcomes. *Archives of Physical Medicine and Rehabilitation,* 2002; 83: S65-71, S90-68. http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Citation&list_uids=11973699.

Heinemann AW, Kirk P, Hastie BA, Semik P, Hamilton BB, Linacre JM, et al. Relationships between disability measures and nursing effort during medical rehabilitation for patients with traumatic brain and spinal cord injury. *Archives of Physical Medicine and Rehabilitation,* 1997; 78: 143-149.

Hoenig H, Hoff J, McIntyre L, Branch LG. The self-reported functional measure: Predictive validity for health care utilization in multiple sclerosis and spinal cord injury. *Arch Phys Med Rehabil,* 2001; 82: 613-618. http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Citation&list_uids=11346837

Mausner JS, Kramer S. Epidemiology: An introductory text. 2nd. Philadelphia: W.B. Saunders, 1985.

McDonald JW, Sadowsky C. Spinal-cord injury. *Lancet,* 2002; 359: 417-425. http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Citation&list_uids=11844532.

Meyers AR, Andresen EM, Hagglund KJ. A model of outcomes research: Spinal cord injury. *Archives of Physical Medicine and Rehabilitation,* 2000; 81: S81-90.

Needleman J, Buerhaus P, Mattke S, Stewart M, Zelevinsky K. Nurse-staffing levels and the quality of care in hospitals. *New England Journal of Medicine,* 2002; 346: 1715-1722. http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Citation&list_uids=12037152

Richmond TS, Metcalf J, Daly M. Requirement for nursing care services and associated costs in acute spinal cord injury. *J Neurosci Nurs,* 1995; 27: 47-52. http://www.ncbi.nlm.nih.gov/htbin-post/Entrez/query?db=m&form=6&dopt=r&uid=7769329

Samsa GP, Hoenig H, Branch LG. Relationship between self-reported disability and caregiver

hours. *American Journal of Physical Medicine and Rehabilitation,* 2001; 80: 674-684.

Samsa GP, Landsman PB, Hamilton B. Inpatient hospital utilization among veterans with traumatic spinal cord injury. *Archives of Physical Medicine and Rehabilitation,* 1996; 77: 1037-1043. http://www.ncbi.nlm.nih.gov/htbin-post/Entrez/query?db=m&form=6&dopt=r&uid=8857883.

Seago J. Chapter 39. Nurse Staffing, Models of Care Delivery, and Interventions. In: *Making Health Care Safer*: Agency for Healthcare Policy and Research, July 20, 2001.

Sochalski J, Estabrooks CA, Humphrey CK. Nurse staffing and patient outcomes: Evolution of an international study. *Canadian Journal of Nursing Research,* 1999; 31: 69-88. http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Citation&list_uids=10696170.

Stiens SA, Kirshblum SC, Groah SL, McKinley WO, Gittler MS. Spinal cord injury medicine. 4. Optimal participation in life after spinal cord injury: Physical, psychosocial, and economic reintegration into the environment. *Archives of Physical Medicine and Rehabilitation,* 2002; 83: S72-81, S90-78. http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Citation&list_uids=11973700.

Stover SL, DeVivo MJ, Go BK. History, implementation, and current status of the national spinal cord injury database. *Archives of Physical Medicine and Rehabilitation,* 1999; 80: 1365-1371.

Waters RL, Adkins R, Yakura J, Sie I. Donal munro lecture: Functional and neurologic recovery following acute sci. *Journal of Spinal Cord Medicine,* 1998; 21: 195-199. http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Citation&list_uids=9863928.

Weaver FM, Hammond MC, Guihan M, Hendricks RD. Department of veterans affairs quality enhancement research initiative for spinal cord injury. *Medical Care,* 2000; 38: I82-91.

Wineman NM, Leffler E, Radziewicz RM, Sams C. A comparative analysis of individuals with spinal cord injury who differ in unplanned utilization of health services. *SCI Nurs,* 1999; 16: 42-47.

Wiseley SF. Clinical management of spinal cord injury: Experience in a smaller state rehabilitation unit. *Bulletin of the New York Academy of Medicine,* 1979; 55: 822-828. http://www.ncbi.nlm.nih.gov/htbin-post/Entrez/query?db=m&form=6&dopt=r&uid=291453.

## Authors

Primary Author: Karen Flynn, DDS, MS, Manager, VATAP.

Contributors: Elizabeth Adams, RRT, MPH, Research Analyst, VATAP
Elaine Alligood, MLS, Information Specialist, VATAP

## Reviewers

The views expressed in this article are those of the authors and do not necessarily represent the views of the Department of Veterans Affairs. The contributions of the following reviewers are gratefully acknowledged. Participation as a reviewer does not imply endorsement.

Valerie Lawrence, MD
Physician Advisor, VATAP
Staff Physician
Audie L Murphy Division
South Texas Veterans Health Care System
San Antonio, Texas

Technology Assessment Program
Office of Patient Care Services

# Appendix: Figures and Tables

**Figure 1: Complete Spinal Cord Injuries - expected functional outcomes by level of injury**

| Level | Self-care | Transfers | Maximum mobility |
|---|---|---|---|
| High quadriplegia (C1-C4) | Dependent on others; requires respiratory support | Dependent on others | Motorized wheelchair |
| Low quadriplegia (C5-C8) | Partially independent with adaptive equipment | Dependent or independent | Manual wheelchair; Driving automobile with adaptive equipment |
| Paraplegia (below T1) | Independent | Independent | Ambulates short distances with aids |

Adapted from DiTunno and Formal (1994)

**Figure 2: Functional recovery - probability of community ambulation at one year post-injury**

| ASIA lower extremity Motor score* | Complete paraplegia | Incomplete Paraplegia | Incomplete Tetraplegia |
|---|---|---|---|
| 0 | <.01 | .33 | 0 |
| 1-9 | .45 | .70 | .02 |
| 10-19 | | 1.00 | .63 |
| ≥20 | | 1.00 | 1.00 |
| total | .05 | .76 | .46 |

*based on 5 key muscles at 30 days, with a total of 50 points possible in both lower extremities
Adapted from Waters (1998)

**Table 1: Health services utilization by SCI patients**

Note: Shaded rows indicate studies conducted by VHA investigators.

| Reference | Purpose of research | Study population | Study design | Clinical setting | Outcome measure | Results |
|---|---|---|---|---|---|---|
| Burnett (2000) | To identify risk factors for LOS outliers (patients whose LOS exceeds mean for SCI patients by 2 standard deviations) | 17,132 persons with traumatic SCI who completed inpatient rehab programs | National spinal cord injury database analysis | Inpatient rehabilitation | Rehab LOS; number of associated injuries; number of pressure ulcers; number of surgical procedures; number of medical complications during rehab period | **Clinical factors distinguishing outliers:** Number of stays from injury to rehab significantly greater (outliers took mean 17.8 days longer); more pressure ulcers and medical complications<br>**Prediction model for outliers:** age at injury; days to rehab admission; number of pressure ulcers; number of medical complications; level of injury; sponsor of initial hospitalization; correct prediction rates: outliers 46%, nonoutliers 97%<br>**Injury characteristics of LOS outliers:** mid-cervical, sports-related injury with ASIA A-C designation; less likely outliers incur injury as a result of medical complications or pedestrian accidents, in the low thoracic area, ASIA D designation<br>**Predisposition to outlier status:** pressure ulcers, medical complications, delayed entry to rehab |
| Eastwood (1999) | To examine factors related to LOS; to describe predictors of re-hospitalization LOS; to explore adverse outcomes after discharge from rehabilitation, pressure ulcers, nursing home rather than community residence, poorer QoL | 3904 individuals discharged from Model Systems, 1990-1997; outcomes at one year anniversary of injury | Longitudinal, exploratory | Model Systems medical rehabilitation | Rehab LOS; injury anniversary year: presence of pressure ulcers; incidence of re-hospitalization; community or institutional residence; days per week out of residence (proxy for QoL). | **Acute rehab LOS:** functional status at admission is strongest predictor of LOS, which declined from 74 to 60 days during the time period covered<br>**Contributors to longer LOS:** lower admission motor FIM; year of discharge from Model Systems; method of bladder management; tetraplegia; race; education; marital status; discharge disposition<br>**Rehospitalization predictors:** lower FIM scores at discharge; complete paraplegia/incomplete tetraplegia; indwelling catheter/intermittent catheterization; shorter rehab LOS<br>**Conclusions:** higher levels of functional ability, less severe injury, and social support facilitate shorter LOS and successful transition to home and community from acute medical rehabilitation; 44.4% of SCI patients experience undesirable outcomes: pressure ulcers at year 1, rehospitalization, residence in SNF, reductions in getting out of one's residence |

| Reference | Purpose of research | Study population | Study design | Clinical setting | Outcome measure | Results |
|---|---|---|---|---|---|---|
| Wineman (1999) | To describe the profile of a group of clients with SCI who frequently used health services, ultimately to identify nursing interventions to reduce service use | 78 subjects (63 male, 15 female), average age 40.4 years with traumatic SCI who received rehabilitation at MetroHealth Center, a model SCI center in northeast Ohio | Descriptive | Model SCI centers rehab center | Total number of unplanned visits in clinic, inpatient and emergency departments, 1990-1995:<br>Non user = 0 unplanned visits<br>Low user = 1-3 unplanned visits;<br>High user = 4-13 unplanned visits | **Demographic profiles:** no significant differences among user groups for age, gender, race, marital status, employment at time of injury, or employment at most recent visit<br>**Injury profiles:** Average number of years since injury = 10 (range, 1-32); differences among user groups significant for years since injury, extent of disability (quad or para), complete vs. incomplete injury, and cause of injury<br>**Rate of potential comorbid conditions:** psychiatric problems, head injury, drug or alcohol abuse, mental retardation, learning disabilities, and smoking; differences among user groups for comorbid condition NS<br>**Utilization patterns over 5 years:** high users hospitalized more often and had greater number of clinic and emergency visits<br>**LOS over 5 years:** significant differences for mean LOS:<br>Non-users = 1.91 days<br>Low users = 9.71 days<br>High users = 29.0 days |
| Samsa (1996) | To describe pattern of inpatient hospitalization up to 15 years after injury among cohort of veterans with service-connected SCI | 1250 male veterans with service-connected traumatic SCI who visited a VA inpatient facility within 1 year of injury | Cross-sectional; longitudinal follow up of large cohort over time by database linkages | VHA SCI centers | Pattern of inpatient admissions during first 15 years after injury; LOS | **Patients:** typically white males injured in their mid-20s; most common cause of injury was motor vehicle accident; injuries equally divided among paraplegia and quadriplegia<br>**Initial VA hospitalization:** began 6 weeks after injury and lasted 4-7 months, depending on injury level and completeness; 75% of patients were admitted to specialized SCI center; median LOS varied by patient type from 118 –202 days, compared to mean of 116 days in Model Systems<br>**Subsequent hospitalizations**: 90% of patients had at least 1 subsequent hospitalization in a VA facility; median LOS varied by injury type (9-11 days), but 22% > 1 month; most hospitalizations took place in SCI centers<br>**Hospital use and time since injury:** Incidence rates for rehospitalization decreased markedly with time since injury to 5 years, and then less rapidly to 15 years; proportion rehospitalized differed by patient group (30-47% during year five) during both periods; 929 patients injured before 9/30/81 had 5,676 re-hospitalizations and total LOS of 176,383 days; 5%, 10% and 20% of patients with longest LOS accounted for 12%, 46%, and 66% of total LOS, respectively; high utilization during years 1-5 predicted high utilization later |

| Reference | Purpose of research | Study population | Study design | Clinical setting | Outcome measure | Results |
|---|---|---|---|---|---|---|
| Richmond (1995) | To analyze the requirement for professional nursing care and the nursing care costs for patients with acute SCI | Convenience sample of 50 consecutively admitted SCI patients: 26 quadriplegic; 5 ventilator dependent quadriplegic; 19 paraplegic; 44% complete injuries; 56% incomplete; age 14-80 | Cross-sectional | Regional model systems SCI center in the mid-Atlantic States | Requirements for nursing care versus acuity category | **Median LOS:** ICU, 16 days; intermediate unit, 11 days **Median hours of nursing care:** 143 ($2,458) for entire acute care hospitalization; significant differences in hours of care were found for the 3 groups, with ventilator dependent patients requiring the most care |

Abbreviations:
ADL, activities of daily living
ASIA, American Spinal Injury Association
FIM, Functional Independence Measure
LOS, length of stay
NS, not statistically significant
QoL, quality of life
SCI, Spinal Cord Injury
SRFIM, self-reported Functional Independence Measure
TBI, Traumatic Brain Injury

**Table 2: Validation of the Functional Independence Measure (FIM) or Self-Report Functional Measure (SRFM) by health services utilization**

Note: Shaded rows indicate studies conducted by VHA investigators.

| Reference | Purpose of research | Study population | Study design | Clinical setting | Results | Comments |
|---|---|---|---|---|---|---|
| Hamilton (1999) | To evaluate validity of FIM in predicting number of minutes of daily assistance provided, cost of durable goods currently used, and number of paid helper hours provided daily | 109 traumatic SCI patients who had been discharged from medical centers in west and west-central New York State; median 6 years post-discharge from initial medical rehabilitation; 108 subjects lived at home, 1 in a nursing home | Cross-sectional: Independent variables: functional assessment scores; amount of assistance needed | 108 subjects lived at home, 1 in a nursing home | Significant inverse linear relationship between FIM score and square root values of cost measures | |
| Heinemann (1997) | Evaluation of concurrent validity of FIM using minutes of care reported by nursing staff | 129 patients with TBI; 53 patients with SCI; (182 total); majority were single men, mean age 38.9 years | Correlational | 8 inpatient medical rehab hospitals | Contact times declined from first to last weeks of rehab, supporting construct validity of FIM (rho values .40-.60):<br>• Median minutes of care for TBI totaled across categories during first week = 229 min out of observation period of 1440; 120 min during last week;<br>• For SCI, 929 min and 196 min, respectively;<br>• Statistically significant correlations between minutes of contact and total minutes; with same pattern for SCI<br>Correlations with FIM: Times dispensing medications, providing treatment, and teaching ADLs negatively correlated with FIM motor and cognitive measures at admission for SCI; at SCI discharge, time in other activities was negatively correlated with FIM cognitive measure | **Authors' conclusions**: success in predicting patient-nurse contact time allow for more efficient staffing and anticipation of staffing levels given patients with varying impairments and levels of disability; FIM measures patients' functional status, which determines the intensity of nursing care needed in rehabilitation<br><br>**Study limitations**: depending on nursing model used at the different hospitals, some professional activities such as formal discharge planning may have been missed if they occurred outside data collection periods, or were performed by other than nursing staff |

| Reference | Purpose of research | Study population | Study design | Clinical setting | Results | Comments |
|---|---|---|---|---|---|---|
| Hoenig (2001) | To examine predictive ability of SRFM for health care utilization in MS and SCI | 6361 veterans with SCI; 1789 veterans with MS | Cohort: mail survey, 1995; administrative records, 1996-7 | VHA hospitals and outpatient clinics | SRFM predicted inpatient but not outpatient utilization: patients in lowest SRFM quartile were over twice as likely (odds ratio, 1.91) to be hospitalized as those in highest SRFM quartile; lowest quartile patients were also > twice as likely to have LOS > 7 days, were twice as likely to die in hospital, and were 3 times as likely to be discharged to an institution | |
| Samsa (2001) | To assess the relationship between self-reported disability and care-hours given (CHGs) (personal assistance, not nursing care) | Veterans with SCI; 13,542 responses | Cross-sectional survey; outcome measure - self reported FIM (SRFIM) | | Strong relationship between caregiver hours and disability: -0.70 ($p < .01$); subjects with moderate disability had most variability in CHGs; after controlling for total SRFIM score, strongest predictors of CHGs were IADLs and individual SRFIM items, although considerable variation in CHGs remained unexplained | |

Abbreviations:
FIM, Functional Independence Measure
IADL, instrumental activities of daily living
MS, multiple sclerosis
SRFM, Self-Report Functional Measure
TBI, traumatic brain injury

**Table 3: Effect of nurse staffing on outcome in adult general medical/surgical hospitals**

| Reference | Purpose of research | Study population | Study design | Clinical setting | Outcome measure | Results |
|---|---|---|---|---|---|---|
| Aiken (1994) | In preparation for new data analysis: Do hospitals known to be good places to practice nursing (magnet hospitals) have lower Medicare mortality? | | Narrative review of existing studies | Magnet hospitals (known as settings that place a high institutional priority on nursing) | | Hospitals in which nurses prefer to work have 4.6% lower mortality rate and distinct organizational features: more professional autonomy; greater control over the practice environment; better relationships with physicians<br>Patterns of communication between nurses and physicians are the single most significant factor associated with excess mortality in ICU; board certification of physicians is uniformly associated with better quality of hospital care and lower mortality; findings on impact of teaching hospital status are inconsistent |
| Needleman (2002) | To examine the relationship between levels of staffing by nurses in hospitals and the rates of adverse outcomes among patients | 1997 administrative data for 799 hospitals in 11 states: 5,075,969 discharges of medical patients, 1,104,659 discharges of surgical patients | Regression analyses controlling for patients' risks of adverse outcomes and differences in nursing care needed | 799 adult medical-surgical general hospitals;<br>Hospital exclusions: average daily census < 20; occupancy rate < 20%; missing data on staffing; below 7.5th percentile or above 92.5 percentile staffing per patient-day | Rates of adverse events | Mean number of hours of nursing care per patient-day: 11.4 (7.8 hours provided by RNs, 1.2 hours by LPNs, 2.4 hours by nurses' aides); mean proportion of hours of care by RNs = 68%, by aides 21%<br>Among medical patients: higher proportion of hours of care per day by RNs and greater absolute amount of care by RNs were associated with shorter LOS and lower rates of UTIs and upper GI bleeding; higher proportion of care by RNs also associated with lower rates of pneumonia, shock or cardiac arrest, and failure to rescue (death from pneumonia, shock or cardiac arrest, upper GI bleeding, sepsis, or deep venous thrombosis)<br>Among surgical patients: higher proportion of care provided by RNs was associated with lower rates of UTIs; greater number of hours of care by RNs associated with lower rates of failure to rescue |
| Seago (2001) | Do "safe thresholds" exist for levels of nursing care? | Published studies addressing "safe thresholds" for levels of nursing care | Quasi systematic review (classified by TAP as quasi-systematic review due to insufficiently reported methods and article quality assessment detail) | General adult acute care; range of patient groups; acuities | Adverse hospital events | **Nurse staffing:** Mixed evidence that nurse staffing is related to 30 day mortality; scarce but positive evidence indicates that leaner nurse staffing is associated with unplanned readmission and failure to rescue; strong evidence for association of leaner nurse staffing with increased LOS, nosocomial infection, pressure sores; mixed evidence for association between richer nurse staffing and better patient outcomes, but positive associations found in studies with stronger methods; no studies specifically identified ratios or hours of care that produced the best outcomes for specific types of patients or different nursing units<br>**Models of nursing care delivery:** mixed evidence about relationship between organization of nursing and patient outcomes |