Developing Risk-Adjustment Models Using SAS® Software: An Application in Home Health Care

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ABSTRACT

Staff Builders Home Health Care (SB) developed the Staff Builders Clinical Outcomes and Resource Evaluation System (SCORES™) to assist clinicians in patient care as well as satisfy state and federal requirements for data. There are over 350 data elements collected in SCORES™. These include demographic, social, environmental, psychological, and clinical data which are used in patient assessment and developing an individualized plan of care.

The clinical data gathered from SCORES™ along with utilization data gathered from SB's billing system resides in a SQL Server Corporate data warehouse.

SAS/STAT procedures such as CATMOD, NPAR1WAY, FREQ, T-TEST will be used to determine which demographic and psychosocial variables are statistically and clinically relevant in determining patient's health status, self care knowledge, and self care skill. Multiple linear, logistic and proportional hazard models are generated using the procedures REG, PHREG AND LOGISTIC. Utilization and clinical outcomes risk-adjustment models will be generated for the mental health diagnostic (ICD9-CM 290-319) grouping.

INTRODUCTION

Staff Builders Home Health Care (SB) developed the Staff Builders Clinical Outcomes and Resource Evaluation System (SCORES™) to assist clinicians in patient care as well as satisfy state and federal requirements for data. There are over 350 data elements collected in SCORES™. These include demographic, social, environmental, psychological, and clinical data which are used in patient assessment and developing an individualized plan of care.

SCORES™ is a clinical care methodology that identifies and analyses patient potential for variances on admission to home care and customizes a transdisciplinary plan of care, leading to quantified clinical outcomes and resource use. There are three general categories that clinicians assess during a home visit: patient health status, self care knowledge, and self care skill. Under health status, there are 13 body systems that are being assessed: respiratory, cardiovascular, skin/wound, gastrointestinal, genitourinary, reproductive/obstetrics, musculoskeletal, neurological/psych, endocrine, nutrition, pain, hematologic, and parenteral drug interactions/reactions/therapeutic levels.

Self care knowledge refers to the "book learning" that the patient/caregiver needs to know in order to take care of himself/patient. The factors assessed under self care knowledge are: disease process; medication regimen, effects, side effects; nutrition; equipment; emergency measures; death/dying care; caregiver/social support; household resources; home safety instruction; lifestyle and compliance; and emotional/spiritual. Self care skill refers to the "hands-on" teaching that the patient/caregiver needs to know to take care of himself/patient. The factors assessed under self care skill are: wound/burn care, ostomy care, catheter care, diabetic care, injection administration, skin care, safe transfer, personal care, IV therapy, respiratory care, self monitoring, feeding tube, behavior, coping skills, and compensatory/cognitive skills.

Each system or factor under health status, self care knowledge, and self care skill are assessed using a 4-point scale. Clinicians undergo extensive training and re-training to learn and understand the scales and definitions used in scoring each factor.

DATA COLLECTION

SCORES™ is currently being implemented in 11 SB branches in California, New York, Pennsylvania, and Florida. These branches represent small, medium, and large volume branches - some doing as low as 50 admissions a month to almost 400 admissions a month. These branches also represent a variety of payor sources - from a high Medicare population in New York to a heavy managed care market in Florida and California.
Depending on the size, as determined by number of admissions a month, the branch will have a server or a stand-alone computer. The servers are running NT v4.0 with a SQL Server v6.5 database. Stand-alone computers run Windows 95 with a SQL Server v6.5 database. Data entry inputs completed SCORES™ paperwork into a computer system developed using Visual Basic. Basic reports like a case management/admission assessment, nutritional risk assessment, wound assessment, etc. are generated. Other regulatory forms such as the HCFA 485/487 and HCFA 486/487 forms are also generated and sent to the appropriate federal or state agency.

SCORES™ data as well as the billing/utilization data is sent to the Corporate IS department on a weekly basis. Data transmission is done via a wide area network (WAN), remote access server (RAS), or direct modem hook-up via pcAnywhere. Data is screened for missing or incomplete information using established data validation routines. Verified data are then loaded into the Corporate warehouse.

The Corporate warehouse is a SQL Server database housing both SCORES™ data and billing/utilization data. Data collected from September, 1996 through December, 1997 represents approximately 10,845 patients and 18,110 admissions.

DATA ANALYSIS

SAS is used to perform all statistical analyses of clinical and utilization data. Data are then read into SAS for analyses.

Descriptive statistics are produced using PROC FREQ and UNIVARIATE. Table 1 shows the overall primary diagnostic ICD9-CM grouping.

ICD9-CM Group	% of Patients	ICD9-CM Group	% of Patients
Circulatory System	18.1	Nervous System	4.1
Mental Disorder	14.1	Respiratory System	5.2

Endocrine Disorder	11.4	Ill Defined	4.4
Injury/Poisoning	11.6	Blood Disorder	4.9
Neoplasms	6.9	Skin Disorder	5.3
Musculoskeletal	5.5	Other	8.4

Table 1. Primary Diagnostic (ICD9-CM) Grouping

Since patient demographic, social, environmental, and psychological characteristics differ depending on their disease, further in-depth analysis of patients will be done in each diagnostic category. Preliminary results for patients with mental disorder primary diagnosis (ICD9-CM code: 290-319) are presented below. Tables 2-5 summarize demographic characteristics of these patients using PROC FREQ and UNIVARIATE. There are a total of 2547 admissions with a mental disorder diagnosis - 2309 of those admissions are adults (>= 18 years old) and the remaining 238 are children (< 18 years old). These admissions represent 1297 patients (1151 adults and 146 children).

Mental Health Diagnosis – Overall	%	Mental Health Diagnosis - Adults	%	Mental Health Diagnosis - Children	%
Major Depression	37.3	Major Depression	40.1	Impulse Control	29.0
Schizophrenia	25.3	Schizophrenia	27.5	ADHD	21.8
Dementia	10.4	Dementia	11.4	Anxiety	9.2
Bipolar	6.9	Bipolar	6.8	Autism	0.4
Anxiety	5.1	Adjustment Disorder	3.3	Adjustment Disorder	9.2
Adjustment Disorder	3.8	Anxiety	4.6	Major Depression	9.2
Impulse Control	2.8	Alcohol Abuse	0.1	Schizophrenia	3.8
ADHD	2.0	Mental Retardation	0.4	Bipolar	7.1
Alcohol Abuse	0.1	Other	5.6	Other	10.1
Mental Retardation	0.4				
Other	5.8				

Table 2. Primary Mental Health Diagnostic (ICD9-CM) Grouping

Statistic	Overall	Adults (>= 18 yrs)	Children (< 18 yrs)
Average Age	63	70	10
Median Age	73	75	10
% Males	43.0	39.1	74.0
% Females	57.0	60.9	26.0

Table 3. Patient Demographic Characteristics

ADL Deficiencies at Admission - Adults	%	IADL Deficiencies at Admission - Adults	%	Functional Limitations at Admission - Adults	%
0	29.1	0	5.2	0	0.7
1	10.2	1	3.6	1	20.8
2	14.9	2	5.5	2	25.0
3	11.7	3	8.2	3	20.6
4	9.4	4	14.2	4	10.9
5+	24.8	5+	63.2	5+	22.0

Table 4. ADL*, IADL**, Functional Limitations***[1] of Adult Patients at Admission

Relationship Status - Adults	%	Educational Level - Adults	%
Single	25.9	< 8th Grade	12.6
Married	18.2	9th-12th Grade	27.2
Divorced	10.2	HS Graduate	34.8
Domestic Partner	0.7	Some College	14.6
Widow/er	40.5	College Graduate	8.1
Common Law	0.3	Advanced Degree	1.3
Separated	1.9	Unknown	1.4
Unknown	2.3		

Table 5. Relationship Status and Education Level of Adult Patients

Overall health status, self care knowledge, and self care skill outcomes are calculated at admission and discharge from service and summarized as having improved, maintained, or declined between the two time periods. Discharge information for mental disorder patients are summarized in Tables 6-11.

Statistic	Overall	Adults (>= 18 yrs)	Children (< 18 yrs)
# of Discharges	919	829	90
Rehospitalization Rate	20.4%	21.4%	11.1%
# of Emergent Care Episodes[2]	143	124	19
Average Length of Stay	95 days	94 days	105 days
Median Length of Stay	58 days	59 days	54 days

Table 6. Patient Discharge Information

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[1] *ADL - Activities of Daily Living. These include bathing, dressing, toilet, transfer, ambulation, eating/feeding.
**IADL - Instrumental Activities of Daily Living. These include medications, handling finances, grocery shopping, transportation, meal preparation.
*** Functional limitations include ambulation, endurance, bowel control, bladder control, amputation, contracture, hearing, speech, legal blindness, paralysis, dyspnea.
[2] Emergent care episodes refer to unscheduled physician visits, unscheduled clinic visits, or emergency room visits

Length of Stay (days)	Overall	Adults	Children
<= 10	12.7%	12.2%	17.8%
11-20	8.1%	8.6%	3.3%
21-30	6.3%	6.4%	5.6%
31-60	28.7%	27.5%	40.0%
61-90	8.3%	8.0%	11.1%
91-120	13.6%	13.9%	11.1%
121-180	10.3%	10.9%	5.6%
181-365	10.1%	10.7%	4.4%
> 365	1.8%	1.9%	1.1%

Table 7. Length of Stay Distribution

Reason for Discharge	Overall	Adults	Children
Goals Met	48.3%	48.0%	51.1%
Rehospitalized	20.4%	21.4%	11.1%
Self/Family Choice	8.2%	7.9%	11.1%
Refer to Another Agency	2.2%	2.2%	2.2%
Refer to Long Term Institution	1.4%	1.5%	1.1%

Table 8. Reason for Discharge - Mental Disorder Patients

Health Status	Overall	Adults	Children
Decline	1.4%	1.4%	1.1%
Maintain	35.9%	37.5%	21.6%
Improve	62.8%	61.1%	77.3%

Table 9. Health Status Outcomes - Mental Disorder Patients

Self Care Knowledge	Overall	Adults	Children[3]
Decline	0.3%	0.4%	0.0%
Maintain	26.6%	28.2%	12.2%
Improve	73.0%	71.4%	87.8%

Table 10. Self Care Knowledge Outcomes - Mental Disorder Patients

Self Care Skill	Overall	Adults	Children[4]
Decline	1.0%	1.1%	0.0%
Maintain	35.8%	37.9%	17.0%
Improve	63.2%	60.9%	83.0%

Table 11. Self Care Skill Outcomes - Mental Disorder Patients

An initial set of demographic variables are selected to determine their relationship to health status, self care knowledge, and self care skill outcomes, as well as their relationship to rehospitalization and emergent care episodes. These demographic variables were: life losses[5], relationship status (with significant other vs. no significant other), caregiver status (with caregiver vs. no caregiver), gender, IADL deficiency at admission (no IADL deficiency vs. at least one IADL deficiency at admission), and education level (less than high school vs. at least a high school education). Chi-square

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[3] In the case of children (< 18 years old), self care knowledge outcomes refer to the caregiver's (parent) ability to care for the child.

[4] In the case of children (< 18 years old), self care skill outcomes refer to the caregiver's (parent) ability to care for the child.

[5] Life losses include: death of a loved one within the past 2 years, loss of employment, retirement within the past 2 years, divorce/separation within the past 2 years, financial worries, loss of primary health insurance, recent change to Medicare/Medicaid, family conflict, change in body image, school change

test using PROC FREQ was used to determine statistical significance. Table 12 summarizes the results of that analysis.

Factors	Life Loss	Relationship Status	Caregiver	Gender	IADL	Education
Health Status	NS	NS	0.046	NS	NS	NS
Self Care Knowledge	NS	0.046	0.035	NS	NS	NS
Self Care Skill	NS	0.044	NS	NS	NS	NS
Emergent Care	NS	NS	NS	NS	NS	0.023
Rehospitalization	NS	NS	NS	NS	0.013	NS

Table 12. Summary of Univariate Analysis

Results of the analysis indicate that mental disorder patients having one or more IADL deficiency at admission have higher rehospitalizations than patients with no IADL deficiencies at admission. Patients with less than a high school education have higher emergent care episodes than patients with at least a high school education. Patients who have significant others (spouse or domestic partner) had a higher rate of improvement in self care knowledge and self care skill. Similarly, patients who have caregivers had a higher rate of improvement in health status and self care knowledge.

All other demographic variables analyzed did not show any statistically significant (NS) effect on patient health status, self care knowledge, self care skill, emergent care episodes, and rehospitalization.

Patient length of stay (LOS) is one measure of utilization. Univariate analyses were performed on demographic, environmental, and psychosocial variables to determine statistical significance to LOS. Variables that are statistically significant in the univariate analyses along with clinically significant variables were then analyzed to come up with a risk-adjusted model for patient LOS. PROC REG with the BACKWARD option was run for both adults and children with mental disorder diagnosis. The results are presented in Tables 13-14.

Variable	Parameter Estimate
Intercept	124.1427
IADL Deficiency	1.8670
Caregiver Deficiency	-71.3606
Household Resources	-16.8934
Spirituality	10.1770

Table 13. Patient Length of Stay Model – Adult Mental Disorder Patients

Variable	Parameter Estimate
Intercept	396.8081
Cognitive Deficiency	115.1746
Age	-29.3241

Table 14. Patient Length of Stay Model – Children Mental Disorder Patients

The analysis produced some unexpected results. For adults, patients that have higher caregiver deficiencies and less household resources had shorter length of stays.

Children have longer average length of stays compared to adults. Cognition and age are better predictors of length of stay in children than IADL deficiencies, caregiver burden, household resources, or spirituality.

CONCLUSION

The analyses we presented are for patients diagnosed with a mental disorder in the Staff Builders offices implementing SCORES™. Although the data produced some interesting results, it raised more questions than answers. Results of the analysis can give our caregivers some insight on how to manage patient care. For example, we know that patients with no caregivers are less likely to improve in their health status compared to patients that have caregivers. Our skilled nurses can then look at available community resources (church groups, state organizations, etc.) for patients with no caregivers to see how these groups can help.

Patient demographic profiles can give caregivers a better understanding of the needs of the patients. Patients having a higher level of education tend to learn faster thereby reducing emergent care episodes.

Clinical outcomes need to be looked at along with utilization outcomes. Length of stay is a crude measure of patient utilization. Although longer length of stay does not necessarily correlate to higher resource utilization, it does give some insight on how clinical managers can best use the limited resources they have for these types of patients.

Further research and in-depth analysis of current data need to be done to refine some of the results presented above.

FURTHER ANALYSIS

Risk adjusted models need to be developed for each major mental disorder grouping. For example, schizophrenics may have a totally different set of predictor variables than patients with affective disorders.

Likewise, other major diagnostic categories should be analyzed to determine which demographic, environmental, and psychosocial variables are significant predictors of patient clinical and resource utilization outcomes.

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