

## Documentation of Prediction Models Used for Risk Adjustment of Home Health Agency Outcomes Reported on the CMS Home Health Compare Web Site

The tables that follow describe the outcome risk models used by the Centers for Medicare & Medicaid Services (CMS) to report quality measures for the CMS Home Health Compare Web site. With the exception of Improvement in Pain Interfering with Activity, these risk models also are used for the outcome-based quality improvement (OBQI) reports produced for home health agencies (HHAs).

The risk models take into account patient health status and other patient characteristics measured at admission to home health care (risk factors) that may affect patient outcomes. They provide the means to predict the probability that an individual patient will experience a specific outcome, and to calculate an expected outcome rate for an HHA. These risk models are based on national data from the CMS OASIS repository, including patient episodes of care that occurred during calendar year 2001. A series of data quality checks were applied to exclude cases with obvious errors and to resolve data inconsistencies where possible. A sample of up to 500,000 cases was used to develop models, while a separate sample of up to 1,000,000 cases was used for validation purposes. A detailed description of the process followed to develop and validate risk models is available online from CMS.<sup>1</sup>

Each table is organized in the following manner:

- **Table Title:** The tables are numbered consecutively. For several measures (e.g., Improvement in Transferring), the risk model consists of two or more submodels, each of which applies to a specific subpopulation. In each of these cases, the submodels are designated with their own subtitles.
- **Risk Factor Measured at SOC/ROC:** In this column, the risk factors that contribute to the prediction of a particular outcome measure are listed. These were chosen from approximately 150 candidate risk factors, based on both statistical and clinical criteria.
- **Regression Coefficient, Odds Ratio, and 90% Confidence Interval:** The logistic regression coefficient and corresponding odds ratio listed next to each risk factor indicate the strength and direction of the relationship between that risk factor and the outcome, controlling for the effects of other risk factors. When the odds ratio exceeds one, the presence of that risk factor (or a higher scale value for that risk factor) *increases* the likelihood of the outcome occurring. When the odds ratio is less than one, the presence of that risk factor *decreases* the likelihood of the outcome occurring. The 90% confidence interval is shown to indicate how much each odds ratio is likely to vary among different samples.
- **R<sup>2</sup> and C:** These measures of association indicate the predictive accuracy of the risk model, or how well the model performs in predicting patient outcomes. With both measures, higher values indicate that the model produces predicted values that are closer to the observed outcome (or more often correct). R<sup>2</sup> values tend to be substantially lower than corresponding values of the C statistic, by virtue of the manner in which these statistics are defined.
- **Footnotes:** The footnotes that follow each table provide additional technical information to assist with interpretation of the information presented in the tables.

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<sup>1</sup> Shaughnessy, Peter W. and Hittle, David F. (2002). *Overview of Risk Adjustment and Outcome Measures for Home Health Agency OBQI Reports: Highlights of Current Approaches and Outline of Planned Enhancements*. Posted December 2002 at Centers for Medicare & Medicaid Services, Home Health Care Agencies Web site: <http://www.cms.hhs.gov/providers/hha/RiskAdj1.pdf>.

**TABLE 1: Logistic Regression Model for Predicting the Outcome of Improvement in Dressing Upper Body.**

<b>Risk Factor Measured at SOC/ROC*†</b>	<b>Coefficient‡</b>	<b>Odds Ratio‡</b>	<b>(90% CI)‡</b>
Medicare as a payment source (0-1)	0.29	1.33	(1.25 - 1.42)
Inpatient discharge from hospital (0-1)	0.43	1.53	(1.49 - 1.58)
Inpatient discharge from rehab. facility (0-1)	0.49	1.63	(1.57 - 1.70)
Inpatient discharge from nursing home (0-1)	0.48	1.62	(1.55 - 1.70)
Moderate or better recovery prognosis (0-1)	0.20	1.23	(1.16 - 1.29)
Good functional status rehabilitation prognosis (0-1)	0.29	1.33	(1.29 - 1.38)
Obesity at SOC (0-1)	-0.05 <sup>a</sup>	0.96	(0.92 - 0.99)
Age (in years)	0.00	1.00	(1.00 - 1.00)
Gender: female (0-1)	-0.04 <sup>a</sup>	0.96	(0.93 - 0.99)
Patient lives alone (0-1)	0.23	1.26	(1.22 - 1.31)
Patient has unpaid live-in help (0-1)	0.24	1.27	(1.22 - 1.32)
Vision impairment (0-2)	-0.06	0.94	(0.92 - 0.96)
Speech/language impairment (0-5)	-0.10	0.91	(0.89 - 0.92)
Stage of most problematic pressure ulcer (0-4)	-0.11	0.90	(0.87 - 0.92)
Status of most problematic stasis ulcer (0-3)	-0.12	0.88	(0.85 - 0.92)
Surgical wound(s) present (0-1)	0.31	1.36	(1.29 - 1.44)
Number of surgical wounds present (0-4)	0.07	1.08	(1.05 - 1.11)
Urinary incontinence severity 1 (0-4)	-0.06	0.94	(0.93 - 0.95)
Bowel incontinence frequency (0-5)	-0.03	0.97	(0.96 - 0.99)
Demonstrated behavior: verbal disruption (0-1)	-0.23	0.80	(0.73 - 0.88)
Confusion scale (0-4)	-0.05	0.96	(0.94 - 0.97)
Disability in grooming (0-3)	-0.12	0.89	(0.87 - 0.90)
Disability in dressing upper body (0-3)	1.01	2.76	(2.68 - 2.83)
Disability in toileting (0-4)	-0.12	0.89	(0.88 - 0.91)
Disability in transferring (0-5)	-0.13	0.88	(0.86 - 0.90)
Disability in ambulation (0-5)	-0.16	0.85	(0.84 - 0.87)
Disability in eating (0-5)	-0.09	0.92	(0.90 - 0.94)
Disability in light meal preparation (0-2)	-0.12	0.89	(0.87 - 0.91)
Disability in mgt. of oral medications (0-2)	-0.23	0.79	(0.78 - 0.81)
Disability in housekeeping (0-4)	-0.04	0.96	(0.94 - 0.98)
Disability in telephone use (0-5)	-0.08	0.92	(0.91 - 0.93)
ADL assistance provided by caregiver (0-1)	-0.16	0.85	(0.83 - 0.88)
Prior (2 weeks ago) disability in dressing lower body (0-3)	-0.16	0.85	(0.83 - 0.87)
Prior (2 weeks ago) disability in bathing (0-5)	-0.05	0.95	(0.94 - 0.97)
Prior (2 weeks ago) disability in laundry (0-2)	-0.14	0.87	(0.84 - 0.90)
Prior (2 weeks ago) disability in housekeeping (0-4)	-0.03 <sup>a</sup>	0.97	(0.95 - 0.99)
Acute condition: open wound/lesion (0-1)	-0.05 <sup>b</sup>	0.95	(0.92 - 0.99)
Acute condition: terminal (0-1)	-0.28	0.75	(0.70 - 0.81)
Acute condition: oxygen therapy (0-1)	-0.14	0.87	(0.84 - 0.91)
Acute condition: IV/Infusion therapy (0-1)	-0.20	0.82	(0.75 - 0.89)
Acute condition: ventilator (0-1)	-0.46 <sup>b</sup>	0.63	(0.42 - 0.94)
Total number of chronic conditions reported (0-9)	-0.03	0.97	(0.95 - 0.98)
Diagnosis: neoplasms (0-1)	-0.25	0.78	(0.74 - 0.81)
Diagnosis: endocrine/nutritional/metabolic (0-1)	-0.04	0.96	(0.93 - 0.98)
Diagnosis: nervous system disorder (0-1)	-0.25	0.78	(0.75 - 0.81)
Diagnosis: genitourinary system diseases (0-1)	-0.08	0.92	(0.89 - 0.95)
Diagnosis: skin/subcutaneous diseases (0-1)	-0.14	0.87	(0.82 - 0.93)
Diagnosis: other injury (0-1)	-0.14	0.87	(0.83 - 0.92)
Length of stay: more than 31 days (0-1)	0.32	1.37	(1.34 - 1.41)
Constant	-0.03 <sup>b</sup>		

**TABLE 1: Logistic Regression Model for Predicting the Outcome of Improvement in Dressing Upper Body. (Cont'd)**

Number of Risk Factors: 49

Developmental Sample  $R^2 = 0.233^{\S}$

Validation Sample  $R^2 = 0.236^{\S}$

Developmental Sample C-statistic =  $0.780^{\S}$

Validation Sample C-statistic =  $0.783^{\S}$

\* SOC = Start of Care, ROC = Resumption of Care after inpatient stay. Risk factors pertain to SOC/ROC unless indicated otherwise.

† The number of values in the measurement scale for each risk factor is in parentheses. For risk factors that take on the values 0 and 1, 1 denotes the presence of the attribute and 0 denotes its absence. For risk factors reflecting health or functional status that are defined using a scale that takes on more than two values, higher values of the scale indicate greater impairment or severity of illness. Selected risk factors take on values that represent simple counts (typically the number of health problems) -- as indicated by the risk factor label. The meaning associated with specific values for each risk factor can be determined by reference to the OASIS data set.

‡ All coefficients/odds ratios are significant at  $P < .10$ , using the likelihood ratio test for the hypothesis that the coefficient is zero (i.e., the odds ratio is 1.00). Coefficients/odds ratios significant for  $.05 < P < .10$  are superscripted by "b." Those that are significant for  $.01 < P < .05$  are superscripted by "a," and the remainder are significant for  $P < .01$ . 90% CIs (confidence intervals) are given and odds ratios are considered significant at  $P < .10$ , because risk models were developed not to assess or evaluate impacts of risk factors on outcomes; rather, they are used primarily for predictive or risk adjustment purposes. Using the 10% significance level meets the need to be more inclusive for prediction/risk adjustment purposes, typically resulting in more stable models whose performance is superior under cross validation.

§ The  $R^2$  values are the squared correlations between predicted and observed values for all patients in the developmental (validation) sample. The developmental sample size for most outcomes is approximately 500,000, with some variation in this number depending on statistical attributes of the outcome measure and risk model. The validation sample is approximately 1,000,000 for all models. These sample sizes pertain to both  $R^2$ s and C-statistics. C is defined as the area under the Receiver Operating Characteristic curve. Intuitively, the C-statistic has the following interpretation: Let  $Y=1$  denote outcome attainment,  $Y=0$  denote non-attainment, and  $\hat{p}$  denote the **predicted** probability that  $Y=1$ . Construct all possible pairs of sample patients where  $Y=1$  for one member of the pair and  $Y=0$  for the other. C is the proportion of such pairs where  $\hat{p}$  for the patient with  $Y=1$  is larger than  $\hat{p}$  for the patient with  $Y=0$ . [Note that  $\hat{p}$  is obtained by substituting a patient's values for all risk factors into the risk model for the outcome under consideration.]

**TABLE 2: Logistic Regression Model for Predicting the Outcome of Improvement in Bathing.**

<b>Risk Factor Measured at SOC/ROC*†</b>	<b>Coefficient‡</b>	<b>Odds Ratio‡</b>	<b>(90% CI)‡</b>
Medicare as a payment source (0-1)	0.27	1.31	(1.21 - 1.40)
Inpatient discharge from hospital (0-1)	0.34	1.41	(1.36 - 1.45)
Inpatient discharge from rehab. facility (0-1)	0.35	1.43	(1.36 - 1.49)
Inpatient discharge from nursing home (0-1)	0.33	1.39	(1.32 - 1.46)
Moderate or better recovery prognosis (0-1)	0.20	1.23	(1.15 - 1.31)
Good functional status rehabilitation prognosis (0-1)	0.29	1.33	(1.28 - 1.39)
Obesity at SOC (0-1)	-0.10	0.91	(0.87 - 0.94)
Age (in years)	-0.01	0.99	(0.99 - 0.99)
Gender: female (0-1)	-0.12	0.89	(0.86 - 0.92)
Patient lives in own home (0-1)	0.07	1.07	(1.04 - 1.11)
Patient lives with family member (0-1)	0.13	1.14	(1.09 - 1.20)
Patient lives alone (0-1)	0.18	1.20	(1.14 - 1.27)
Vision impairment (0-2)	-0.03 <sup>b</sup>	0.97	(0.94 - 1.00)
Speech/language impairment (0-5)	-0.06	0.94	(0.92 - 0.96)
Stage 1-4 pressure ulcer(s) present (0-1)	-0.28	0.75	(0.70 - 0.81)
Stasis ulcer(s) present (0-1)	-0.43	0.65	(0.59 - 0.72)
Surgical wound(s) present (0-1)	0.17	1.18	(1.12 - 1.24)
Number of surgical wounds present (0-4)	0.08	1.09	(1.06 - 1.12)
Urinary incontinence severity 1 (0-4)	-0.04	0.96	(0.94 - 0.97)
Bowel incontinence frequency (0-5)	-0.05	0.96	(0.94 - 0.97)
Demonstrated behavior: verbal disruption (0-1)	-0.22	0.80	(0.71 - 0.91)
Disability in cognitive functioning (0-4)	-0.04 <sup>a</sup>	0.97	(0.94 - 0.99)
Confusion scale (0-4)	-0.02 <sup>b</sup>	0.98	(0.96 - 1.00)
Disability in dressing upper body (0-3)	-0.05	0.95	(0.93 - 0.97)
Disability in bathing (0-5)	0.77	2.16	(2.12 - 2.20)
Disability in toileting (0-4)	-0.08	0.92	(0.90 - 0.94)
Disability in transferring (0-5)	-0.10	0.91	(0.89 - 0.93)
Disability in ambulation (0-5)	-0.22	0.80	(0.78 - 0.82)
Disability in mgt. of oral medications (0-2)	-0.11	0.90	(0.87 - 0.92)
Disability in transportation (0-2)	-0.08 <sup>b</sup>	0.92	(0.85 - 0.99)
Disability in housekeeping (0-4)	-0.03	0.97	(0.96 - 0.99)
Disability in telephone use (0-5)	-0.04	0.96	(0.95 - 0.98)
ADL assistance provided by caregiver (0-1)	-0.09	0.92	(0.89 - 0.94)
Prior (2 weeks ago) disability in bathing (0-5)	-0.15	0.86	(0.85 - 0.87)
Prior (2 weeks ago) disability in transportation (0-2)	-0.09	0.92	(0.88 - 0.95)
Prior (2 weeks ago) disability in laundry (0-2)	-0.10	0.91	(0.88 - 0.93)
Prior (2 weeks ago) disability in shopping (0-3)	-0.04	0.96	(0.94 - 0.98)
Acute condition: terminal (0-1)	-0.26	0.77	(0.71 - 0.85)
Acute condition: oxygen therapy (0-1)	-0.13	0.88	(0.85 - 0.92)
Acute condition: enteral/parenteral nutrition (0-1)	-0.30	0.74	(0.66 - 0.83)
Chronic condition: urinary incontinence/catheter (0-1)	-0.09	0.91	(0.87 - 0.95)
Chronic condition: dependence in medication admin. (0-1)	-0.07	0.93	(0.90 - 0.97)
Diagnosis: neoplasms (0-1)	-0.10	0.90	(0.86 - 0.95)
Diagnosis: endocrine/nutritional/metabolic (0-1)	-0.03 <sup>b</sup>	0.97	(0.94 - 1.00)
Diagnosis: mental disease (0-1)	-0.05 <sup>b</sup>	0.95	(0.91 - 1.00)
Diagnosis: nervous system disorder (0-1)	-0.15	0.86	(0.83 - 0.90)
Diagnosis: genitourinary system diseases (0-1)	-0.07	0.93	(0.90 - 0.97)
Diagnosis: skin/subcutaneous diseases (0-1)	-0.17	0.84	(0.79 - 0.90)
Diagnosis: other injury (0-1)	-0.14	0.87	(0.83 - 0.92)
Length of stay: more than 31 days (0-1)	0.27	1.31	(1.27 - 1.34)
Constant	-0.91		

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**TABLE 2: Logistic Regression Model for Predicting the Outcome of Improvement in Bathing.  
(Cont'd)**

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Number of Risk Factors: 50

Developmental Sample  $R^2 = 0.192^{\S}$

Validation Sample  $R^2 = 0.193^{\S}$

Developmental Sample C-statistic =  $0.755^{\S}$

Validation Sample C-statistic =  $0.755^{\S}$

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\* SOC = Start of Care, ROC = Resumption of Care after inpatient stay. Risk factors pertain to SOC/ROC unless indicated otherwise.

† The number of values in the measurement scale for each risk factor is in parentheses. For risk factors that take on the values 0 and 1, 1 denotes the presence of the attribute and 0 denotes its absence. For risk factors reflecting health or functional status that are defined using a scale that takes on more than two values, higher values of the scale indicate greater impairment or severity of illness. Selected risk factors take on values that represent simple counts (typically the number of health problems) -- as indicated by the risk factor label. The meaning associated with specific values for each risk factor can be determined by reference to the OASIS data set.

‡ All coefficients/odds ratios are significant at  $P < .10$ , using the likelihood ratio test for the hypothesis that the coefficient is zero (i.e., the odds ratio is 1.00). Coefficients/odds ratios significant for  $.05 < P < .10$  are superscripted by "b." Those that are significant for  $.01 < P < .05$  are superscripted by "a," and the remainder are significant for  $P < .01$ . 90% CIs (confidence intervals) are given and odds ratios are considered significant at  $P < .10$ , because risk models were developed not to assess or evaluate impacts of risk factors on outcomes; rather, they are used primarily for predictive or risk adjustment purposes. Using the 10% significance level meets the need to be more inclusive for prediction/risk adjustment purposes, typically resulting in more stable models whose performance is superior under cross validation.

§ The  $R^2$  values are the squared correlations between predicted and observed values for all patients in the developmental (validation) sample. The developmental sample size for most outcomes is approximately 500,000, with some variation in this number depending on statistical attributes of the outcome measure and risk model. The validation sample is approximately 1,000,000 for all models. These sample sizes pertain to both  $R^2$ s and C-statistics. C is defined as the area under the Receiver Operating Characteristic curve. Intuitively, the C-statistic has the following interpretation: Let  $Y=1$  denote outcome attainment,  $Y=0$  denote non-attainment, and  $\hat{p}$  denote the **predicted** probability that  $Y=1$ . Construct all possible pairs of sample patients where  $Y=1$  for one member of the pair and  $Y=0$  for the other. C is the proportion of such pairs where  $\hat{p}$  for the patient with  $Y=1$  is larger than  $\hat{p}$  for the patient with  $Y=0$ . [Note that  $\hat{p}$  is obtained by substituting a patient's values for all risk factors into the risk model for the outcome under consideration.]

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**TABLE 3: Logistic Regression Model for Predicting the Outcome of Stabilization in Bathing.**

<b>Risk Factor Measured at SOC/ROC*†</b>	<b>Coefficient‡</b>	<b>Odds Ratio‡</b>	<b>(90% CI)‡</b>
Medical regimen change in past 14 days (0-1)	0.13	1.14	(1.08 - 1.20)
Moderate or better recovery prognosis (0-1)	0.31	1.37	(1.25 - 1.50)
Good functional status rehabilitation prognosis (0-1)	0.22	1.24	(1.17 - 1.32)
Obesity at SOC (0-1)	-0.10 <sup>a</sup>	0.91	(0.85 - 0.96)
Age (in years)	-0.02	0.98	(0.98 - 0.99)
Gender: female (0-1)	-0.12	0.88	(0.85 - 0.93)
Infrequency of caregiver assistance (1-7)	-0.04	0.96	(0.95 - 0.97)
Status of most problematic pressure ulcer (0-3)	-0.15	0.86	(0.83 - 0.91)
Number of stasis ulcers present (0-4)	-0.12	0.89	(0.84 - 0.94)
Number of surgical wounds present (0-4)	0.15	1.16	(1.13 - 1.20)
Urinary catheter (0-1)	-0.20	0.82	(0.73 - 0.91)
Bowel ostomy (0-1)	-0.22 <sup>a</sup>	0.80	(0.69 - 0.93)
Bowel incontinence frequency (0-5)	-0.06	0.94	(0.92 - 0.97)
Confusion scale (0-4)	-0.05	0.95	(0.93 - 0.98)
Disability in dressing upper body (0-3)	-0.25	0.78	(0.75 - 0.81)
Disability in bathing (0-5)	1.10	3.00	(2.93 - 3.09)
Disability in toileting (0-4)	-0.16	0.86	(0.83 - 0.89)
Disability in transferring (0-5)	-0.19	0.83	(0.79 - 0.86)
Disability in ambulation (0-5)	-0.25	0.78	(0.75 - 0.80)
Disability in mgt. of oral medications (0-2)	-0.19	0.82	(0.79 - 0.85)
Disability in transportation (0-2)	-0.24	0.79	(0.71 - 0.88)
Disability in laundry (0-2)	-0.19	0.83	(0.79 - 0.87)
Disability in shopping (0-3)	-0.06 <sup>a</sup>	0.95	(0.91 - 0.99)
Disability in telephone use (0-5)	-0.03 <sup>a</sup>	0.97	(0.95 - 0.99)
Prior (2 weeks ago) disability in grooming (0-3)	-0.05 <sup>a</sup>	0.95	(0.91 - 0.98)
Prior (2 weeks ago) disability in transportation (0-2)	-0.17	0.84	(0.79 - 0.90)
Prior (2 weeks ago) disability in housekeeping (0-4)	-0.03 <sup>a</sup>	0.97	(0.95 - 0.99)
Prior (2 weeks ago) disability in shopping (0-3)	-0.06	0.94	(0.90 - 0.97)
Acute condition: terminal (0-1)	-0.40	0.67	(0.60 - 0.76)
Acute condition: contagious/communicable disease (0-1)	-0.24 <sup>a</sup>	0.79	(0.67 - 0.94)
Acute condition: oxygen therapy (0-1)	-0.20	0.82	(0.77 - 0.87)
Chronic condition: eating disability (0-1)	-0.38	0.69	(0.60 - 0.78)
Diagnosis: neoplasms (0-1)	-0.29	0.74	(0.70 - 0.80)
Diagnosis: nervous system disorder (0-1)	-0.10	0.90	(0.85 - 0.96)
Diagnosis: genitourinary system diseases (0-1)	-0.11	0.89	(0.84 - 0.95)
Diagnosis: skin/subcutaneous diseases (0-1)	-0.21	0.81	(0.75 - 0.88)
Diagnosis: other injury (0-1)	-0.14	0.87	(0.80 - 0.95)
Length of stay: more than 62 days (0-1)	-0.34	0.71	(0.66 - 0.77)
Constant	3.13		

Number of Risk Factors: 38

Developmental Sample  $R^2 = 0.114^{\S}$

Validation Sample  $R^2 = 0.116^{\S}$

Developmental Sample C-statistic =  $0.786^{\S}$

Validation Sample C-statistic =  $0.789^{\S}$

\* SOC = Start of Care, ROC = Resumption of Care after inpatient stay. Risk factors pertain to SOC/ROC unless indicated otherwise.

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**TABLE 3: Logistic Regression Model for Predicting the Outcome of Stabilization in Bathing.  
(Cont'd)**

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- † The number of values in the measurement scale for each risk factor is in parentheses. For risk factors that take on the values 0 and 1, 1 denotes the presence of the attribute and 0 denotes its absence. For risk factors reflecting health or functional status that are defined using a scale that takes on more than two values, higher values of the scale indicate greater impairment or severity of illness. Selected risk factors take on values that represent simple counts (typically the number of health problems) -- as indicated by the risk factor label. The meaning associated with specific values for each risk factor can be determined by reference to the OASIS data set.
- ‡ All coefficients/odds ratios are significant at  $P < .10$ , using the likelihood ratio test for the hypothesis that the coefficient is zero (i.e., the odds ratio is 1.00). Coefficients/odds ratios significant for  $.05 < P < .10$  are superscripted by "b." Those that are significant for  $.01 < P < .05$  are superscripted by "a," and the remainder are significant for  $P < .01$ . 90% CIs (confidence intervals) are given and odds ratios are considered significant at  $P < .10$ , because risk models were developed not to assess or evaluate impacts of risk factors on outcomes; rather, they are used primarily for predictive or risk adjustment purposes. Using the 10% significance level meets the need to be more inclusive for prediction/risk adjustment purposes, typically resulting in more stable models whose performance is superior under cross validation.
- § The  $R^2$  values are the squared correlations between predicted and observed values for all patients in the developmental (validation) sample. The developmental sample size for most outcomes is approximately 500,000, with some variation in this number depending on statistical attributes of the outcome measure and risk model. The validation sample is approximately 1,000,000 for all models. These sample sizes pertain to both  $R^2$ 's and C-statistics. C is defined as the area under the Receiver Operating Characteristic curve. Intuitively, the C-statistic has the following interpretation: Let  $Y=1$  denote outcome attainment,  $Y=0$  denote non-attainment, and  $\hat{p}$  denote the **predicted** probability that  $Y=1$ . Construct all possible pairs of sample patients where  $Y=1$  for one member of the pair and  $Y=0$  for the other. C is the proportion of such pairs where  $\hat{p}$  for the patient with  $Y=1$  is larger than  $\hat{p}$  for the patient with  $Y=0$ . [Note that  $\hat{p}$  is obtained by substituting a patient's values for all risk factors into the risk model for the outcome under consideration.]
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**TABLE 4: Logistic Regression Model for Predicting the Outcome of Improvement in Toileting.**

<b>Risk Factor Measured at SOC/ROC*†</b>	<b>Coefficient‡</b>	<b>Odds Ratio‡</b>	<b>(90% CI)‡</b>
Medicare as a payment source (0-1)	0.28	1.32	(1.18 - 1.49)
Inpatient discharge from hospital (0-1)	0.43	1.54	(1.46 - 1.63)
Inpatient discharge from rehab. facility (0-1)	0.42	1.52	(1.42 - 1.64)
Inpatient discharge from nursing home (0-1)	0.29	1.33	(1.23 - 1.44)
Moderate or better recovery prognosis (0-1)	0.23	1.26	(1.15 - 1.38)
Good functional status rehabilitation prognosis (0-1)	0.25	1.28	(1.21 - 1.36)
Gender: female (0-1)	-0.07 <sup>a</sup>	0.93	(0.89 - 0.98)
Patient lives with family member (0-1)	0.18	1.19	(1.10 - 1.29)
Patient lives alone (0-1)	0.35	1.42	(1.29 - 1.56)
Patient has unpaid live-in help (0-1)	0.17	1.19	(1.09 - 1.29)
Vision impairment (0-2)	-0.06 <sup>a</sup>	0.94	(0.91 - 0.98)
Speech/language impairment (0-5)	-0.09	0.92	(0.89 - 0.95)
Stage of most problematic pressure ulcer (0-4)	-0.17	0.84	(0.81 - 0.87)
Status of most problematic stasis ulcer (0-3)	-0.18	0.83	(0.77 - 0.90)
Surgical wound(s) present (0-1)	0.22	1.25	(1.13 - 1.38)
Number of surgical wounds present (0-4)	0.09	1.09	(1.04 - 1.15)
Urinary catheter (0-1)	-0.38	0.68	(0.61 - 0.77)
Urinary incontinence severity 1 (0-4)	-0.06	0.94	(0.92 - 0.97)
Bowel ostomy (0-1)	-0.43	0.65	(0.55 - 0.77)
Bowel incontinence frequency (0-5)	-0.13	0.88	(0.86 - 0.90)
Demonstrated behavior: verbal disruption (0-1)	-0.20 <sup>a</sup>	0.82	(0.71 - 0.96)
Disability in cognitive functioning (0-4)	-0.05 <sup>a</sup>	0.95	(0.92 - 0.99)
Disability in grooming (0-3)	-0.06	0.94	(0.91 - 0.97)
Disability in dressing upper body (0-3)	-0.19	0.83	(0.79 - 0.86)
Disability in toileting (0-4)	0.74	2.10	(2.01 - 2.19)
Disability in transferring (0-5)	-0.23	0.79	(0.76 - 0.82)
Disability in ambulation (0-5)	-0.26	0.77	(0.75 - 0.80)
Disability in eating (0-5)	-0.07	0.93	(0.90 - 0.97)
Disability in light meal preparation (0-2)	-0.12	0.89	(0.84 - 0.93)
Disability in mgt. of oral medications (0-2)	-0.15	0.86	(0.83 - 0.90)
Disability in transportation (0-2)	-0.20	0.82	(0.75 - 0.89)
Disability in telephone use (0-5)	-0.08	0.93	(0.91 - 0.94)
Prior (2 weeks ago) disability in dressing lower body (0-3)	-0.08	0.92	(0.89 - 0.96)
Prior (2 weeks ago) disability in bathing (0-5)	-0.08	0.93	(0.90 - 0.95)
Prior (2 weeks ago) disability in toileting (0-4)	-0.16	0.85	(0.82 - 0.88)
Prior (2 weeks ago) disability in housekeeping (0-4)	-0.07	0.94	(0.91 - 0.96)
Acute condition: terminal (0-1)	-0.32	0.73	(0.64 - 0.82)
Acute condition: enteral/parenteral nutrition (0-1)	-0.26 <sup>a</sup>	0.77	(0.66 - 0.91)
Chronic condition: urinary incontinence/catheter (0-1)	-0.09 <sup>a</sup>	0.91	(0.85 - 0.97)
Diagnosis: neoplasms (0-1)	-0.19	0.82	(0.76 - 0.90)
Diagnosis: blood diseases (0-1)	-0.10 <sup>b</sup>	0.90	(0.83 - 0.99)
Diagnosis: mental disease (0-1)	-0.10 <sup>a</sup>	0.90	(0.84 - 0.97)
Diagnosis: nervous system disorder (0-1)	-0.22	0.80	(0.75 - 0.85)
Diagnosis: genitourinary system diseases (0-1)	-0.17	0.85	(0.79 - 0.90)
Diagnosis: other injury (0-1)	-0.16	0.85	(0.77 - 0.93)
Length of stay: more than 31 days (0-1)	0.33	1.39	(1.33 - 1.45)
Constant	0.98		

**TABLE 4: Logistic Regression Model for Predicting the Outcome of Improvement in Toileting. (Cont'd)**

Number of Risk Factors: 46

Developmental Sample  $R^2 = 0.267^{\S}$

Validation Sample  $R^2 = 0.262^{\S}$

Developmental Sample C-statistic =  $0.800^{\S}$

Validation Sample C-statistic =  $0.797^{\S}$

\* SOC = Start of Care, ROC = Resumption of Care after inpatient stay. Risk factors pertain to SOC/ROC unless indicated otherwise.

† The number of values in the measurement scale for each risk factor is in parentheses. For risk factors that take on the values 0 and 1, 1 denotes the presence of the attribute and 0 denotes its absence. For risk factors reflecting health or functional status that are defined using a scale that takes on more than two values, higher values of the scale indicate greater impairment or severity of illness. Selected risk factors take on values that represent simple counts (typically the number of health problems) -- as indicated by the risk factor label. The meaning associated with specific values for each risk factor can be determined by reference to the OASIS data set.

‡ All coefficients/odds ratios are significant at  $P < .10$ , using the likelihood ratio test for the hypothesis that the coefficient is zero (i.e., the odds ratio is 1.00). Coefficients/odds ratios significant for  $.05 < P < .10$  are superscripted by "b." Those that are significant for  $.01 < P < .05$  are superscripted by "a," and the remainder are significant for  $P < .01$ . 90% CIs (confidence intervals) are given and odds ratios are considered significant at  $P < .10$ , because risk models were developed not to assess or evaluate impacts of risk factors on outcomes; rather, they are used primarily for predictive or risk adjustment purposes. Using the 10% significance level meets the need to be more inclusive for prediction/risk adjustment purposes, typically resulting in more stable models whose performance is superior under cross validation.

§ The  $R^2$  values are the squared correlations between predicted and observed values for all patients in the developmental (validation) sample. The developmental sample size for most outcomes is approximately 500,000, with some variation in this number depending on statistical attributes of the outcome measure and risk model. The validation sample is approximately 1,000,000 for all models. These sample sizes pertain to both  $R^2$ s and C-statistics. C is defined as the area under the Receiver Operating Characteristic curve. Intuitively, the C-statistic has the following interpretation: Let  $Y=1$  denote outcome attainment,  $Y=0$  denote non-attainment, and  $\hat{p}$  denote the **predicted** probability that  $Y=1$ . Construct all possible pairs of sample patients where  $Y=1$  for one member of the pair and  $Y=0$  for the other. C is the proportion of such pairs where  $\hat{p}$  for the patient with  $Y=1$  is larger than  $\hat{p}$  for the patient with  $Y=0$ . [Note that  $\hat{p}$  is obtained by substituting a patient's values for all risk factors into the risk model for the outcome under consideration.]

**TABLE 5: Logistic Regression Model for Predicting the Outcome of Improvement in Transferring.**

This model is comprised of three logistic regression submodels that predict the outcome of Improvement in Transferring for patients in three distinct subpopulations defined by their health status at start or resumption of care (SOC/ROC):

The first submodel predicts this outcome for patients who are at level 3, level 4 or level 5 on the Transferring scale at SOC/ROC.

The second submodel predicts this outcome for patients who are at level 2 on the Transferring scale at SOC/ROC.

The third submodel predicts this outcome for patients who are at level 1 on the Transferring scale at SOC/ROC.

Risk factors, coefficients, odds ratios, and confidence intervals for odds ratios are presented below for each of the three submodels. Thereafter, summary statistics provide information on the total number of unique risk factors (because some risk factors appear in more than one submodel) and the explanatory power of the overall model that results from combining the submodels.

**Submodel 1:** For Improvement in Transferring restricted to patients who are at level 3, level 4 or level 5 on the Transferring scale at SOC/ROC.

<b>Risk Factor Measured at SOC/ROC*†</b>	<b>Coefficient‡</b>	<b>Odds Ratio‡</b>	<b>(90% CI)‡</b>
Inpatient discharge from hospital (0-1)	0.42	1.52	(1.39 - 1.67)
Inpatient discharge from rehab. facility (0-1)	0.43	1.54	(1.30 - 1.82)
Inpatient discharge from nursing home (0-1)	0.49	1.63	(1.37 - 1.94)
Good functional status rehabilitation prognosis (0-1)	0.19	1.21	(1.11 - 1.32)
Obesity at SOC (0-1)	-0.27	0.77	(0.68 - 0.87)
Vision impairment (0-2)	-0.07 <sup>b</sup>	0.93	(0.87 - 1.00)
Status of most problematic pressure ulcer (0-3)	-0.08 <sup>a</sup>	0.93	(0.87 - 0.98)
Urinary incontinence severity 1 (0-4)	-0.14	0.87	(0.84 - 0.90)
Bowel incontinence frequency (0-5)	-0.05	0.95	(0.92 - 0.98)
Disability in dressing lower body (0-3)	-0.22	0.80	(0.72 - 0.89)
Disability in toileting (0-4)	-0.16	0.85	(0.81 - 0.90)
Disability in transferring (0-5)	0.44	1.55	(1.44 - 1.68)
Disability in ambulation (0-5)	-0.22	0.80	(0.74 - 0.87)
Disability in transportation (0-2)	-0.21	0.81	(0.73 - 0.89)
Prior (2 weeks ago) disability in transferring (0-5)	-0.17	0.84	(0.79 - 0.90)
Prior (2 weeks ago) disability in eating (0-5)	-0.09	0.91	(0.87 - 0.97)
Prior (2 weeks ago) disability in ambulation (0-5)	-0.15	0.86	(0.81 - 0.92)
Acute condition: terminal (0-1)	-0.54	0.59	(0.49 - 0.70)
Acute condition: gastrointestinal disorder (0-1)	-0.21	0.81	(0.71 - 0.92)
Acute condition: enteral/parenteral nutrition (0-1)	-0.34	0.71	(0.59 - 0.85)
Diagnosis: neoplasms (0-1)	-0.25 <sup>a</sup>	0.78	(0.65 - 0.94)
Diagnosis: nervous system disorder (0-1)	-0.37	0.69	(0.63 - 0.76)
Diagnosis: skin/subcutaneous diseases (0-1)	-0.40	0.67	(0.58 - 0.77)
Length of stay: more than 31 days (0-1)	0.52	1.69	(1.55 - 1.83)
Constant	2.07		

Number of Risk Factors: 24

**TABLE 5: Logistic Regression Model for Predicting the Outcome of Improvement in Transferring. (Cont'd)**

**Submodel 2:** For Improvement in Transferring restricted to patients who are at level 2 on the Transferring scale at SOC/ROC.

<b>Risk Factor Measured at SOC/ROC*†</b>	<b>Coefficient‡</b>	<b>Odds Ratio‡</b>	<b>(90% CI)‡</b>
Medicare as a payment source (0-1)	0.29	1.34	(1.11 - 1.60)
Inpatient discharge from hospital (0-1)	0.39	1.48	(1.36 - 1.60)
Inpatient discharge from rehab. facility (0-1)	0.47	1.59	(1.41 - 1.80)
Inpatient discharge from nursing home (0-1)	0.40	1.50	(1.32 - 1.71)
Urinary catheter prior to past 2 weeks (0-1)	-0.47	0.63	(0.50 - 0.78)
Good functional status rehabilitation prognosis (0-1)	0.40	1.50	(1.38 - 1.62)
Patient lives alone (0-1)	0.14 <sup>b</sup>	1.15	(1.01 - 1.32)
Speech/language impairment (0-5)	-0.15	0.86	(0.82 - 0.89)
Stage of most problematic pressure ulcer (0-4)	-0.22	0.80	(0.76 - 0.85)
Surgical wound(s) present (0-1)	0.31	1.36	(1.22 - 1.51)
Urinary incontinence severity 1 (0-4)	-0.08	0.92	(0.90 - 0.95)
Demonstrated behavior: verbal disruption (0-1)	-0.39	0.68	(0.55 - 0.83)
Disability in dressing upper body (0-3)	-0.18	0.84	(0.78 - 0.89)
Disability in toileting (0-4)	-0.11	0.90	(0.87 - 0.93)
Disability in ambulation (0-5)	-0.38	0.69	(0.65 - 0.72)
Disability in transportation (0-2)	-0.15 <sup>a</sup>	0.86	(0.77 - 0.96)
Disability in telephone use (0-5)	-0.05	0.95	(0.93 - 0.98)
Prior (2 weeks ago) disability in dressing lower body (0-3)	-0.07 <sup>a</sup>	0.93	(0.88 - 0.99)
Prior (2 weeks ago) disability in eating (0-5)	-0.11	0.90	(0.85 - 0.95)
Prior (2 weeks ago) disability in ambulation (0-5)	-0.13	0.88	(0.83 - 0.93)
Acute condition: terminal (0-1)	-0.46	0.63	(0.53 - 0.75)
Chronic condition: impaired ambulation/mobility (0-1)	-0.45	0.64	(0.57 - 0.72)
Diagnosis: neoplasms (0-1)	-0.36	0.70	(0.61 - 0.81)
Diagnosis: endocrine/nutritional/metabolic (0-1)	-0.16	0.85	(0.78 - 0.92)
Length of stay: more than 31 days (0-1)	0.53	1.69	(1.58 - 1.82)
Constant	2.58		

Number of Risk Factors: 25

**Submodel 3:** For Improvement in Transferring restricted to patients who are at level 1 on the Transferring scale at SOC/ROC.

<b>Risk Factor Measured at SOC/ROC*†</b>	<b>Coefficient‡</b>	<b>Odds Ratio‡</b>	<b>(90% CI)‡</b>
Medicare as a payment source (0-1)	0.19	1.21	(1.14 - 1.29)
Inpatient discharge from hospital (0-1)	0.30	1.35	(1.32 - 1.39)
Inpatient discharge from rehab. facility (0-1)	0.26	1.30	(1.25 - 1.34)
Inpatient discharge from nursing home (0-1)	0.16	1.17	(1.12 - 1.22)
Moderate or better recovery prognosis (0-1)	0.24	1.27	(1.19 - 1.35)
Good functional status rehabilitation prognosis (0-1)	0.24	1.27	(1.22 - 1.32)
Obesity at SOC (0-1)	-0.20	0.82	(0.79 - 0.85)
Drug dependency at SOC (0-1)	-0.13 <sup>a</sup>	0.88	(0.79 - 0.97)
Age (in years)	-0.01	0.99	(0.99 - 0.99)

**TABLE 5: Logistic Regression Model for Predicting the Outcome of Improvement in Transferring. (Cont'd)**

**Submodel 3:** For Improvement in Transferring restricted to patients who are at level 1 on the Transferring scale at SOC/ROC. (Cont'd)

<b>Risk Factor Measured at SOC/ROC*†</b>	<b>Coefficient‡</b>	<b>Odds Ratio‡</b>	<b>(90% CI)‡</b>
Patient lives with family member (0-1)	0.15	1.17	(1.12 - 1.22)
Patient lives alone (0-1)	0.17	1.18	(1.13 - 1.24)
Vision impairment (0-2)	-0.08	0.92	(0.90 - 0.94)
Hearing impairment (0-4)	-0.03	0.97	(0.95 - 0.99)
Speech/language impairment (0-5)	-0.03 <sup>a</sup>	0.97	(0.95 - 0.99)
Stage 1-4 pressure ulcer(s) present (0-1)	-0.24	0.78	(0.73 - 0.84)
Status of most problematic stasis ulcer (0-3)	-0.10	0.91	(0.88 - 0.94)
Number of surgical wounds present (0-4)	0.16	1.18	(1.16 - 1.20)
Dyspnea (0-4)	-0.03	0.97	(0.96 - 0.98)
Urinary incontinence severity 2 (0-4)	-0.04	0.96	(0.95 - 0.97)
Urinary tract infection (0-1)	-0.07	0.93	(0.89 - 0.97)
Bowel incontinence frequency (0-5)	-0.02 <sup>b</sup>	0.98	(0.96 - 1.00)
Depression scale (0-5)	-0.03 <sup>a</sup>	0.97	(0.95 - 0.99)
Disability in grooming (0-3)	-0.05	0.95	(0.94 - 0.97)
Disability in dressing lower body (0-3)	-0.07	0.93	(0.92 - 0.95)
Disability in bathing (0-5)	-0.04	0.96	(0.95 - 0.97)
Disability in toileting (0-4)	-0.07	0.93	(0.92 - 0.95)
Disability in ambulation (0-5)	-0.27	0.76	(0.75 - 0.78)
Disability in eating (0-5)	-0.06	0.94	(0.92 - 0.97)
Disability in mgt. of oral medications (0-2)	-0.04	0.96	(0.94 - 0.99)
Disability in telephone use (0-5)	-0.05	0.95	(0.94 - 0.97)
Prior (2 weeks ago) disability in transferring (0-5)	-0.29	0.75	(0.73 - 0.76)
Prior (2 weeks ago) disability in laundry (0-2)	-0.09	0.92	(0.89 - 0.94)
Prior (2 weeks ago) disability in housekeeping (0-4)	-0.01 <sup>b</sup>	0.99	(0.97 - 1.00)
Prior (2 weeks ago) disability in shopping (0-3)	-0.03	0.97	(0.95 - 0.99)
Acute condition: open wound/lesion (0-1)	-0.05 <sup>a</sup>	0.95	(0.92 - 0.98)
Acute condition: terminal (0-1)	-0.14	0.87	(0.79 - 0.94)
Acute condition: diabetes mellitus (0-1)	-0.09	0.91	(0.87 - 0.95)
Acute condition: IV/Infusion therapy (0-1)	-0.23	0.80	(0.73 - 0.87)
Chronic condition: urinary incontinence/catheter (0-1)	-0.13	0.88	(0.84 - 0.92)
Chronic condition: dependence in medication admin. (0-1)	-0.07	0.93	(0.90 - 0.97)
Diagnosis: blood diseases (0-1)	-0.07	0.93	(0.90 - 0.97)
Diagnosis: nervous system disorder (0-1)	-0.13	0.88	(0.84 - 0.91)
Diagnosis: circulatory system diseases (0-1)	-0.06	0.95	(0.92 - 0.97)
Diagnosis: skin/subcutaneous diseases (0-1)	-0.21	0.81	(0.77 - 0.86)
Diagnosis: musculoskeletal system diseases (0-1)	-0.05	0.95	(0.92 - 0.97)
Diagnosis: fractures (0-1)	-0.11	0.90	(0.87 - 0.93)
Diagnosis: other injury (0-1)	-0.16	0.85	(0.81 - 0.90)
Length of stay: more than 31 days (0-1)	0.15	1.16	(1.13 - 1.19)
Constant	0.96		

Number of Risk Factors: 48

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**TABLE 5: Logistic Regression Model for Predicting the Outcome of Improvement in Transferring. (Cont'd)**

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Number of Unique Risk Factors Across All Model Components: 65

Overall model developmental sample  $R^2 = 0.137^{\S}$

Overall model developmental sample C-statistic = 0.711<sup>§</sup>

Overall model validation sample  $R^2 = 0.137^{\S}$

Overall model validation sample C-statistic = 0.711<sup>§</sup>

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\* SOC = Start of Care, ROC = Resumption of Care after inpatient stay. Risk factors pertain to SOC/ROC unless indicated otherwise.

† The number of values in the measurement scale for each risk factor is in parentheses. For risk factors that take on the values 0 and 1, 1 denotes the presence of the attribute and 0 denotes its absence. For risk factors reflecting health or functional status that are defined using a scale that takes on more than two values, higher values of the scale indicate greater impairment or severity of illness. Selected risk factors take on values that represent simple counts (typically the number of health problems) -- as indicated by the risk factor label. The meaning associated with specific values for each risk factor can be determined by reference to the OASIS data set.

‡ All coefficients/odds ratios are significant at  $P < .10$ , using the likelihood ratio test for the hypothesis that the coefficient is zero (i.e., the odds ratio is 1.00). Coefficients/odds ratios significant for  $.05 < P < .10$  are superscripted by "b." Those that are significant for  $.01 < P < .05$  are superscripted by "a," and the remainder are significant for  $P < .01$ . 90% CIs (confidence intervals) are given and odds ratios are considered significant at  $P < .10$ , because risk models were developed not to assess or evaluate impacts of risk factors on outcomes; rather, they are used primarily for predictive or risk adjustment purposes. Using the 10% significance level meets the need to be more inclusive for prediction/risk adjustment purposes, typically resulting in more stable models whose performance is superior under cross validation.

§ The  $R^2$  values are the squared correlations between predicted and observed values for all patients in the developmental (validation) sample. The developmental sample size for most outcomes is approximately 500,000, with some variation in this number depending on statistical attributes of the outcome measure and risk model. The validation sample is approximately 1,000,000 for all models. These sample sizes pertain to both  $R^2$ 's and C-statistics. C is defined as the area under the Receiver Operating Characteristic curve. Intuitively, the C-statistic has the following interpretation: Let  $Y=1$  denote outcome attainment,  $Y=0$  denote non-attainment, and  $\hat{p}$  denote the **predicted** probability that  $Y=1$ . Construct all possible pairs of sample patients where  $Y=1$  for one member of the pair and  $Y=0$  for the other. C is the proportion of such pairs where  $\hat{p}$  for the patient with  $Y=1$  is larger than  $\hat{p}$  for the patient with  $Y=0$ . [Note that  $\hat{p}$  is obtained by substituting a patient's values for all risk factors into the risk model for the outcome under consideration.]

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**TABLE 6: Logistic Regression Model for Predicting the Outcome of Improvement in Ambulation/Locomotion.**

<b>Risk Factor Measured at SOC/ROC*†</b>	<b>Coefficient‡</b>	<b>Odds Ratio‡</b>	<b>(90% CI)‡</b>
Inpatient discharge from hospital (0-1)	0.25	1.28	(1.24 - 1.33)
Medical regimen change in past 14 days (0-1)	0.16	1.17	(1.12 - 1.22)
Urinary catheter prior to past 2 weeks (0-1)	-0.30	0.74	(0.67 - 0.82)
Moderate or better recovery prognosis (0-1)	0.15	1.17	(1.12 - 1.21)
Good functional status rehabilitation prognosis (0-1)	0.34	1.41	(1.27 - 1.55)
Obesity at SOC (0-1)	-0.15	0.86	(0.82 - 0.90)
Age (in years)	0.00	1.00	(1.00 - 1.00)
Gender: female (0-1)	-0.08	0.92	(0.89 - 0.95)
Patient lives in own home (0-1)	0.06	1.06	(1.04 - 1.07)
Patient lives with family member (0-1)	0.14	1.15	(1.12 - 1.17)
Patient has unpaid live-in help (0-1)	0.12	1.12	(1.03 - 1.23)
Vision impairment (0-2)	-0.06	0.94	(0.84 - 1.05)
Speech/language impairment (0-5)	-0.03 <sup>a</sup>	0.97	(0.94 - 1.00)
Stage of most problematic pressure ulcer (0-4)	-0.21	0.81	(0.80 - 0.82)
Stasis ulcer(s) present (0-1)	-0.27	0.77	(0.74 - 0.79)
Number of surgical wounds present (0-4)	0.18	1.20	(1.16 - 1.24)
Urinary incontinence severity 1 (0-4)	-0.06	0.94	(0.91 - 0.97)
Urinary tract infection (0-1)	-0.12	0.88	(0.85 - 0.92)
Bowel incontinence frequency (0-5)	-0.10	0.90	(0.86 - 0.95)
Disability in bathing (0-5)	-0.08	0.93	(0.91 - 0.95)
Disability in transferring (0-5)	-0.56	0.57	(0.55 - 0.59)
Disability in ambulation (0-5)	1.79	5.96	(5.32 - 6.69)
Disability in transportation (0-2)	-0.32	0.73	(0.72 - 0.74)
Disability in telephone use (0-5)	-0.02 <sup>a</sup>	0.98	(0.91 - 1.05)
Prior (2 weeks ago) disability in ambulation (0-5)	-0.59	0.56	(0.54 - 0.58)
Acute condition: orthopedic (0-1)	-0.17	0.85	(0.81 - 0.88)
Acute condition: open wound/lesion (0-1)	-0.11	0.89	(0.85 - 0.93)
Acute condition: terminal (0-1)	-0.15 <sup>a</sup>	0.86	(0.84 - 0.88)
Acute condition: diabetes mellitus (0-1)	-0.07 <sup>a</sup>	0.93	(0.91 - 0.95)
Acute condition: oxygen therapy (0-1)	-0.05 <sup>b</sup>	0.96	(0.89 - 1.03)
Acute condition: IV/Infusion therapy (0-1)	-0.16 <sup>a</sup>	0.85	(0.81 - 0.90)
Chronic condition: eating disability (0-1)	-0.21	0.81	(0.78 - 0.83)
Diagnosis: blood diseases (0-1)	-0.11	0.89	(0.88 - 0.91)
Diagnosis: nervous system disorder (0-1)	-0.23	0.80	(0.74 - 0.85)
Diagnosis: skin/subcutaneous diseases (0-1)	-0.22	0.81	(0.78 - 0.83)
Diagnosis: musculoskeletal system diseases (0-1)	-0.13	0.88	(0.83 - 0.93)
Length of stay: more than 31 days (0-1)	0.21	1.23	(1.17 - 1.29)
Constant	-2.04		

Number of Risk Factors: 37

Developmental Sample R<sup>2</sup> = 0.180<sup>§</sup>

Validation Sample R<sup>2</sup> = 0.183<sup>§</sup>

Developmental Sample C-statistic = 0.755<sup>§</sup>

Validation Sample C-statistic = 0.758<sup>§</sup>

\* SOC = Start of Care, ROC = Resumption of Care after inpatient stay. Risk factors pertain to SOC/ROC unless indicated otherwise.

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**TABLE 6: Logistic Regression Model for Predicting the Outcome of Improvement in Ambulation/Locomotion. (Cont'd)**

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- † The number of values in the measurement scale for each risk factor is in parentheses. For risk factors that take on the values 0 and 1, 1 denotes the presence of the attribute and 0 denotes its absence. For risk factors reflecting health or functional status that are defined using a scale that takes on more than two values, higher values of the scale indicate greater impairment or severity of illness. Selected risk factors take on values that represent simple counts (typically the number of health problems) -- as indicated by the risk factor label. The meaning associated with specific values for each risk factor can be determined by reference to the OASIS data set.
- ‡ All coefficients/odds ratios are significant at  $P < .10$ , using the likelihood ratio test for the hypothesis that the coefficient is zero (i.e., the odds ratio is 1.00). Coefficients/odds ratios significant for  $.05 < P < .10$  are superscripted by "b." Those that are significant for  $.01 < P < .05$  are superscripted by "a," and the remainder are significant for  $P < .01$ . 90% CIs (confidence intervals) are given and odds ratios are considered significant at  $P < .10$ , because risk models were developed not to assess or evaluate impacts of risk factors on outcomes; rather, they are used primarily for predictive or risk adjustment purposes. Using the 10% significance level meets the need to be more inclusive for prediction/risk adjustment purposes, typically resulting in more stable models whose performance is superior under cross validation.
- § The  $R^2$  values are the squared correlations between predicted and observed values for all patients in the developmental (validation) sample. The developmental sample size for most outcomes is approximately 500,000, with some variation in this number depending on statistical attributes of the outcome measure and risk model. The validation sample is approximately 1,000,000 for all models. These sample sizes pertain to both  $R^2$ 's and C-statistics. C is defined as the area under the Receiver Operating Characteristic curve. Intuitively, the C-statistic has the following interpretation: Let  $Y=1$  denote outcome attainment,  $Y=0$  denote non-attainment, and  $\hat{p}$  denote the **predicted** probability that  $Y=1$ . Construct all possible pairs of sample patients where  $Y=1$  for one member of the pair and  $Y=0$  for the other. C is the proportion of such pairs where  $\hat{p}$  for the patient with  $Y=1$  is larger than  $\hat{p}$  for the patient with  $Y=0$ . [Note that  $\hat{p}$  is obtained by substituting a patient's values for all risk factors into the risk model for the outcome under consideration.]
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**TABLE 7: Logistic Regression Model for Predicting the Outcome of Improvement in Management of Oral Medications.**

<b>Risk Factor Measured at SOC/ROC*†</b>	<b>Coefficient‡</b>	<b>Odds Ratio‡</b>	<b>(90% CI)‡</b>
Medicare as a payment source (0-1)	0.22	1.24	(1.16 - 1.33)
Inpatient discharge from hospital (0-1)	0.26	1.30	(1.26 - 1.34)
Inpatient discharge from rehab. facility (0-1)	0.38	1.46	(1.40 - 1.53)
Inpatient discharge from nursing home (0-1)	0.17	1.19	(1.13 - 1.24)
Impaired decision-making prior to past 2 weeks (0-1)	-0.10	0.91	(0.87 - 0.95)
Moderate or better recovery prognosis (0-1)	0.20	1.22	(1.15 - 1.30)
Good functional status rehabilitation prognosis (0-1)	0.16	1.17	(1.13 - 1.21)
Age (in years)	-0.02	0.98	(0.98 - 0.99)
Gender: female (0-1)	0.15	1.16	(1.13 - 1.20)
Patient lives in own home (0-1)	0.38	1.46	(1.42 - 1.51)
Patient lives with family member (0-1)	0.50	1.64	(1.56 - 1.73)
Patient lives alone (0-1)	0.59	1.80	(1.70 - 1.91)
Patient has unpaid live-in help (0-1)	0.21	1.23	(1.17 - 1.29)
Infrequency of caregiver assistance (1-7)	-0.03	0.97	(0.96 - 0.98)
Vision impairment (0-2)	-0.10	0.90	(0.88 - 0.92)
Speech/language impairment (0-5)	-0.09	0.91	(0.89 - 0.93)
Stage 1-4 pressure ulcer(s) present (0-1)	-0.23	0.80	(0.76 - 0.84)
Surgical wound(s) present (0-1)	0.40	1.50	(1.45 - 1.54)
Presence of urinary incontinence (0-1)	-0.04 <sup>b</sup>	0.96	(0.92 - 1.00)
Urinary incontinence severity 1 (0-4)	-0.04	0.96	(0.95 - 0.98)
Demonstrated behavior: memory deficit (0-1)	-0.17	0.85	(0.81 - 0.89)
Disability in cognitive functioning (0-4)	-0.15	0.86	(0.84 - 0.88)
Confusion scale (0-4)	-0.13	0.88	(0.86 - 0.89)
Disability in dressing upper body (0-3)	-0.02 <sup>b</sup>	0.98	(0.96 - 1.00)
Disability in toileting (0-4)	-0.06	0.94	(0.93 - 0.96)
Disability in transferring (0-5)	-0.04	0.96	(0.94 - 0.98)
Disability in ambulation (0-5)	-0.10	0.91	(0.89 - 0.93)
Disability in light meal preparation (0-2)	-0.10	0.90	(0.88 - 0.92)
Disability in mgt. of oral medications (0-2)	1.56	4.78	(4.57 - 4.99)
Disability in telephone use (0-5)	-0.15	0.86	(0.85 - 0.87)
ADL assistance provided by caregiver (0-1)	-0.06	0.95	(0.91 - 0.98)
Prior (2 weeks ago) disability in transportation (0-2)	-0.10	0.91	(0.87 - 0.94)
Prior (2 weeks ago) disability in laundry (0-2)	-0.06	0.94	(0.91 - 0.96)
Prior (2 weeks ago) disability in shopping (0-3)	-0.03	0.97	(0.95 - 0.99)
Prior (2 weeks ago) disability in mgt. of oral medications (0-2)	-0.18	0.83	(0.80 - 0.87)
Acute condition: neurologic (0-1)	-0.14	0.87	(0.83 - 0.90)
Acute condition: terminal (0-1)	-0.25	0.78	(0.71 - 0.84)
Acute condition: mental/emotional (0-1)	-0.17	0.84	(0.76 - 0.93)
Acute condition: enteral/parenteral nutrition (0-1)	-0.25	0.78	(0.70 - 0.87)
Acute condition: ventilator (0-1)	-0.60 <sup>a</sup>	0.55	(0.34 - 0.88)
Chronic condition: eating disability (0-1)	-0.31	0.74	(0.68 - 0.80)
Chronic condition: dependence in medication admin. (0-1)	-0.44	0.64	(0.61 - 0.67)
Chronic condition: cognitive/mental/behavioral problems (0-1)	-0.14	0.87	(0.83 - 0.92)
Diagnosis: neoplasms (0-1)	-0.08	0.92	(0.88 - 0.97)
Diagnosis: endocrine/nutritional/metabolic (0-1)	-0.07	0.94	(0.91 - 0.96)
Diagnosis: mental disease (0-1)	-0.22	0.81	(0.77 - 0.84)
Diagnosis: nervous system disorder (0-1)	-0.13	0.87	(0.84 - 0.91)
Diagnosis: genitourinary system diseases (0-1)	-0.08	0.93	(0.89 - 0.96)
Diagnosis: congenital anomalies (0-1)	-0.18	0.84	(0.73 - 0.96)

**TABLE 7: Logistic Regression Model for Predicting the Outcome of Improvement in Management of Oral Medications. (Cont'd)**

Risk Factor Measured at SOC/ROC*†	Coefficient‡	Odds Ratio‡	(90% CI)‡
Diagnosis: ill-defined conditions (0-1)	-0.03	0.97	(0.94 - 1.00)
Length of stay: more than 31 days (0-1)	0.25	1.29	(1.26 - 1.32)
Constant	-1.39		

Number of Risk Factors: 51

Developmental Sample  $R^2 = 0.180^{\S}$       Validation Sample  $R^2 = 0.180^{\S}$

Developmental Sample C-statistic =  $0.754^{\S}$       Validation Sample C-statistic =  $0.754^{\S}$

\* SOC = Start of Care, ROC = Resumption of Care after inpatient stay. Risk factors pertain to SOC/ROC unless indicated otherwise.

† The number of values in the measurement scale for each risk factor is in parentheses. For risk factors that take on the values 0 and 1, 1 denotes the presence of the attribute and 0 denotes its absence. For risk factors reflecting health or functional status that are defined using a scale that takes on more than two values, higher values of the scale indicate greater impairment or severity of illness. Selected risk factors take on values that represent simple counts (typically the number of health problems) -- as indicated by the risk factor label. The meaning associated with specific values for each risk factor can be determined by reference to the OASIS data set.

‡ All coefficients/odds ratios are significant at  $P < .10$ , using the likelihood ratio test for the hypothesis that the coefficient is zero (i.e., the odds ratio is 1.00). Coefficients/odds ratios significant for  $.05 < P < .10$  are superscripted by "b." Those that are significant for  $.01 < P < .05$  are superscripted by "a," and the remainder are significant for  $P < .01$ . 90% CIs (confidence intervals) are given and odds ratios are considered significant at  $P < .10$ , because risk models were developed not to assess or evaluate impacts of risk factors on outcomes; rather, they are used primarily for predictive or risk adjustment purposes. Using the 10% significance level meets the need to be more inclusive for prediction/risk adjustment purposes, typically resulting in more stable models whose performance is superior under cross validation.

§ The  $R^2$  values are the squared correlations between predicted and observed values for all patients in the developmental (validation) sample. The developmental sample size for most outcomes is approximately 500,000, with some variation in this number depending on statistical attributes of the outcome measure and risk model. The validation sample is approximately 1,000,000 for all models. These sample sizes pertain to both  $R^2$ s and C-statistics. C is defined as the area under the Receiver Operating Characteristic curve. Intuitively, the C-statistic has the following interpretation: Let  $Y=1$  denote outcome attainment,  $Y=0$  denote non-attainment, and  $\hat{p}$  denote the **predicted** probability that  $Y=1$ . Construct all possible pairs of sample patients where  $Y=1$  for one member of the pair and  $Y=0$  for the other. C is the proportion of such pairs where  $\hat{p}$  for the patient with  $Y=1$  is larger than  $\hat{p}$  for the patient with  $Y=0$ . [Note that  $\hat{p}$  is obtained by substituting a patient's values for all risk factors into the risk model for the outcome under consideration.]

**TABLE 8: Logistic Regression Model for Predicting the Outcome of Improvement in Pain Interfering with Activity.**

This model is comprised of three logistic regression submodels that predict the outcome of Improvement in Pain Interfering with Activity for patients in four distinct subpopulations defined by their health status at start or resumption of care (SOC/ROC):

The first submodel predicts this outcome for patients who are at level 3 on the Pain Interfering with Activity scale at SOC/ROC.

The second submodel predicts this outcome for patients who are at level 2 on the Pain Interfering with Activity scale at SOC/ROC.

The third submodel predicts this outcome for patients who are at level 1 on the Pain Interfering with Activity scale at SOC/ROC.

Risk factors, coefficients, odds ratios, and confidence intervals for odds ratios are presented below for each of the three submodels. Thereafter, summary statistics provide information on the total number of unique risk factors (because some risk factors appear in more than one submodel) and the explanatory power of the overall model that results from combining the submodels.

**Submodel 1:** For Improvement in Pain Interfering with Activity restricted to patients who are at Level 3 on the Pain Interfering with Activity scale at SOC/ROC.

<b>Risk Factor Measured at SOC/ROC*†</b>	<b>Coefficient‡</b>	<b>Odds Ratio‡</b>	<b>(90% CI)‡</b>
Inpatient discharge from rehab. facility (0-1)	0.22	1.25	(1.11 - 1.41)
Moderate or better recovery prognosis (0-1)	0.25	1.28	(1.11 - 1.47)
Good functional status rehabilitation prognosis (0-1)	0.24	1.27	(1.15 - 1.40)
Heavy smoking at SOC (0-1)	-0.34	0.71	(0.65 - 0.79)
Drug dependency at SOC (0-1)	-0.38	0.69	(0.56 - 0.84)
Intractable pain (0-1)	-0.22	0.81	(0.74 - 0.88)
Stage of most problematic pressure ulcer (0-4)	-0.09 <sup>a</sup>	0.91	(0.86 - 0.97)
Status of most problematic stasis ulcer (0-3)	-0.14	0.87	(0.80 - 0.95)
Surgical wound(s) present (0-1)	0.36	1.43	(1.32 - 1.55)
Urinary catheter (0-1)	-0.31	0.73	(0.61 - 0.88)
Anxiety level (0-3)	-0.04 <sup>b</sup>	0.96	(0.92 - 1.00)
Depression scale (0-5)	-0.10	0.91	(0.86 - 0.95)
Prior (2 weeks ago) disability in ambulation (0-5)	-0.05 <sup>a</sup>	0.95	(0.91 - 0.99)
Prior (2 weeks ago) disability in housekeeping (0-4)	-0.06	0.94	(0.92 - 0.96)
Acute condition: terminal (0-1)	-0.27 <sup>a</sup>	0.77	(0.64 - 0.92)
Acute condition: oxygen therapy (0-1)	-0.20	0.82	(0.74 - 0.90)
Acute condition: IV/Infusion therapy (0-1)	-0.65	0.52	(0.44 - 0.62)
Acute condition: enteral/parenteral nutrition (0-1)	-0.35 <sup>a</sup>	0.71	(0.54 - 0.93)
Chronic condition: dependence in personal care (0-1)	-0.09 <sup>b</sup>	0.91	(0.83 - 1.00)
Chronic condition: chronic pain (0-1)	-0.35	0.70	(0.65 - 0.76)
Diagnosis: neoplasms (0-1)	-0.17 <sup>a</sup>	0.84	(0.75 - 0.95)
Diagnosis: musculoskeletal system diseases (0-1)	-0.18	0.84	(0.78 - 0.90)
Diagnosis: ill-defined conditions (0-1)	-0.11 <sup>a</sup>	0.89	(0.83 - 0.96)
Diagnosis: other injury (0-1)	-0.19 <sup>a</sup>	0.82	(0.72 - 0.95)
Length of stay: more than 31 days (0-1)	0.43	1.53	(1.43 - 1.64)
Constant	1.39		

Number of Risk Factors: 25

**TABLE 8: Logistic Regression Model for Predicting the Outcome of Improvement in Pain Interfering with Activity. (Cont'd)**

**Submodel 2:** For Improvement in Pain Interfering with Activity restricted to patients who are at Level 2 on the Pain Interfering with Activity scale at SOC/ROC.

Risk Factor Measured at SOC/ROC*†	Coefficient‡	Odds Ratio‡	(90% CI)‡
Medicare as a payment source (0-1)	0.25	1.29	(1.22 - 1.36)
Inpatient discharge from hospital (0-1)	0.10	1.10	(1.07 - 1.14)
Inpatient discharge from rehab. facility (0-1)	0.11	1.12	(1.08 - 1.16)
Medical regimen change in past 14 days (0-1)	0.16	1.18	(1.13 - 1.22)
Intractable pain prior to past 2 weeks (0-1)	-0.18	0.84	(0.79 - 0.88)
Moderate or better recovery prognosis (0-1)	0.21	1.23	(1.15 - 1.32)
Good functional status rehabilitation prognosis (0-1)	0.22	1.25	(1.20 - 1.30)
Heavy smoking at SOC (0-1)	-0.12	0.88	(0.84 - 0.93)
Obesity at SOC (0-1)	-0.17	0.85	(0.82 - 0.88)
Gender: female (0-1)	-0.12	0.88	(0.86 - 0.91)
Intractable pain (0-1)	-0.24	0.78	(0.75 - 0.82)
Stage of most problematic pressure ulcer (0-4)	-0.03 <sup>b</sup>	0.97	(0.95 - 1.00)
Stasis ulcer(s) present (0-1)	-0.19	0.83	(0.76 - 0.90)
Number of surgical wounds present (0-4)	0.06	1.06	(1.05 - 1.08)
Anxiety level (0-3)	-0.06	0.94	(0.92 - 0.95)
Depression scale (0-5)	-0.09	0.91	(0.89 - 0.93)
Disability in bathing (0-5)	-0.02	0.98	(0.97 - 0.99)
Prior (2 weeks ago) disability in ambulation (0-5)	-0.06	0.94	(0.93 - 0.95)
Acute condition: orthopedic (0-1)	-0.22	0.80	(0.77 - 0.83)
Acute condition: terminal (0-1)	-0.20	0.82	(0.75 - 0.90)
Acute condition: contagious/communicable disease (0-1)	-0.18	0.83	(0.75 - 0.93)
Acute condition: oxygen therapy (0-1)	-0.15	0.86	(0.83 - 0.90)
Chronic condition: chronic pain (0-1)	-0.09 <sup>b</sup>	0.91	(0.84 - 0.99)
Diagnosis: neoplasms (0-1)	-0.12	0.89	(0.85 - 0.93)
Diagnosis: musculoskeletal system diseases (0-1)	-0.31	0.74	(0.71 - 0.76)
Diagnosis: fractures (0-1)	-0.10	0.91	(0.87 - 0.95)
Length of stay: more than 31 days (0-1)	0.33	1.38	(1.35 - 1.42)
Constant	-0.23		

Number of Risk Factors: 27

**Submodel 3:** For Improvement in Pain Interfering with Activity restricted to patients who are at Level 1 on the Pain Interfering with Activity scale at SOC/ROC.

Risk Factor Measured at SOC/ROC*†	Coefficient‡	Odds Ratio‡	(90% CI)‡
Inpatient discharge from hospital (0-1)	0.17	1.19	(1.13 - 1.25)
Inpatient discharge from rehab. facility (0-1)	0.16	1.17	(1.08 - 1.27)
Good functional status rehabilitation prognosis (0-1)	0.19	1.21	(1.13 - 1.28)
Heavy smoking at SOC (0-1)	-0.14 <sup>a</sup>	0.87	(0.79 - 0.95)
Obesity at SOC (0-1)	-0.17	0.84	(0.78 - 0.90)
Gender: female (0-1)	-0.12	0.89	(0.85 - 0.94)
Patient lives alone (0-1)	-0.07 <sup>a</sup>	0.93	(0.88 - 0.98)
Stage 3-4 pressure ulcer(s) present (0-1)	-0.25 <sup>b</sup>	0.78	(0.63 - 0.97)
Status of most problematic stasis ulcer (0-3)	-0.08 <sup>a</sup>	0.92	(0.87 - 0.98)

**TABLE 8: Logistic Regression Model for Predicting the Outcome of Improvement in Pain Interfering with Activity. (Cont'd)**

**Submodel 3:** For Improvement in Pain Interfering with Activity restricted to patients who are at Level 1 on the Pain Interfering with Activity scale at SOC/ROC. (Cont'd)

<b>Risk Factor Measured at SOC/ROC*†</b>	<b>Coefficient‡</b>	<b>Odds Ratio‡</b>	<b>(90% CI)‡</b>
Number of surgical wounds present (0-4)	0.04 <sup>a</sup>	1.04	(1.01 - 1.07)
Dyspnea (0-4)	-0.07	0.93	(0.91 - 0.95)
Anxiety level (0-3)	-0.05 <sup>a</sup>	0.95	(0.92 - 0.98)
Depression scale (0-5)	-0.09	0.91	(0.87 - 0.96)
Disability in ambulation (0-5)	-0.08	0.92	(0.90 - 0.95)
Prior (2 weeks ago) disability in bathing (0-5)	-0.03	0.97	(0.95 - 0.99)
Chronic condition: chronic pain (0-1)	-0.49	0.61	(0.45 - 0.83)
Diagnosis: blood diseases (0-1)	-0.11 <sup>a</sup>	0.90	(0.82 - 0.98)
Diagnosis: musculoskeletal system diseases (0-1)	-0.31	0.73	(0.69 - 0.77)
Diagnosis: fractures (0-1)	-0.21	0.81	(0.74 - 0.88)
Length of stay: more than 31 days (0-1)	0.06 <sup>a</sup>	1.06	(1.01 - 1.12)
Constant	0.28		

Number of Risk Factors: 20

Number of Unique Risk Factors Across All Model Components: 43

Overall model developmental sample  $R^2 = 0.065^{\S}$

Overall model developmental sample C-statistic = 0.643<sup>§</sup>

Overall model validation sample  $R^2 = 0.067^{\S}$

Overall model validation sample C-statistic = 0.644<sup>§</sup>

\* SOC = Start of Care, ROC = Resumption of Care after inpatient stay. Risk factors pertain to SOC/ROC unless indicated otherwise.

† The number of values in the measurement scale for each risk factor is in parentheses. For risk factors that take on the values 0 and 1, 1 denotes the presence of the attribute and 0 denotes its absence. For risk factors reflecting health or functional status that are defined using a scale that takes on more than two values, higher values of the scale indicate greater impairment or severity of illness. Selected risk factors take on values that represent simple counts (typically the number of health problems) -- as indicated by the risk factor label. The meaning associated with specific values for each risk factor can be determined by reference to the OASIS data set.

‡ All coefficients/odds ratios are significant at  $P < .10$ , using the likelihood ratio test for the hypothesis that the coefficient is zero (i.e., the odds ratio is 1.00). Coefficients/odds ratios significant for  $.05 < P < .10$  are superscripted by "b." Those that are significant for  $.01 < P < .05$  are superscripted by "a," and the remainder are significant for  $P < .01$ . 90% CIs (confidence intervals) are given and odds ratios are considered significant at  $P < .10$ , because risk models were developed not to assess or evaluate impacts of risk factors on outcomes; rather, they are used primarily for predictive or risk adjustment purposes. Using the 10% significance level meets the need to be more inclusive for prediction/risk adjustment purposes, typically resulting in more stable models whose performance is superior under cross validation.

§ The  $R^2$  values are the squared correlations between predicted and observed values for all patients in the developmental (validation) sample. The developmental sample size for most outcomes is approximately 500,000, with some variation in this number depending on statistical attributes of the outcome measure and risk model. The validation sample is approximately 1,000,000 for all models. These sample sizes pertain to both  $R^2$ s and C-statistics. C is defined as the area under the Receiver Operating Characteristic curve. Intuitively, the C-statistic has the following interpretation: Let  $Y=1$  denote outcome attainment,  $Y=0$  denote non-attainment, and  $\hat{p}$  denote the predicted probability that  $Y=1$ . Construct all possible pairs of sample patients where  $Y=1$  for one member of the pair and  $Y=0$  for the other. C is the proportion of such pairs where  $\hat{p}$  for the patient with  $Y=1$  is larger than  $\hat{p}$  for the patient with  $Y=0$ . [Note that  $\hat{p}$  is obtained by substituting a patient's values for all risk factors into the risk model for the outcome under consideration.]

**TABLE 9: Logistic Regression Model for Predicting the Outcome of Improvement in Confusion Frequency.**

This model is comprised of four logistic regression submodels that predict the outcome of Improvement in Confusion Frequency for patients in four distinct subpopulations defined by their health status at start or resumption of care (SOC/ROC):

The first submodel predicts this outcome for patients who are at level 4 on the Confusion Frequency scale at SOC/ROC.

The second submodel predicts this outcome for patients who are at level 3 on the Confusion Frequency scale at SOC/ROC.

The third submodel predicts this outcome for patients who are at level 2 on the Confusion Frequency scale at SOC/ROC.

The fourth submodel predicts this outcome for patients who are at level 1 on the Confusion Frequency scale at SOC/ROC.

Risk factors, coefficients, odds ratios, and confidence intervals for odds ratios are presented below for each of the four submodels. Thereafter, summary statistics provide information on the total number of unique risk factors (because some risk factors appear in more than one submodel) and the explanatory power of the overall model that results from combining the submodels.

**Submodel 1:** For Improvement in Confusion Frequency restricted to patients who are at Level 4 on the Confusion Frequency scale at SOC/ROC.

<b>Risk Factor Measured at SOC/ROC*†</b>	<b>Coefficient‡</b>	<b>Odds Ratio‡</b>	<b>(90% CI)‡</b>
Incontinent during day and night (0-1)	-0.10 <sup>b</sup>	0.90	(0.82 - 0.99)
Demonstrated behavior: memory deficit (0-1)	-0.15 <sup>a</sup>	0.86	(0.78 - 0.95)
Demonstrated behavior: impaired decision-making (0-1)	-0.10 <sup>b</sup>	0.91	(0.83 - 0.99)
Demonstrated behavior: disruptive, infant, socially inappr. (0-1)	-0.24 <sup>a</sup>	0.79	(0.67 - 0.92)
Bowel incontinence frequency (0-5)	-0.04 <sup>a</sup>	0.96	(0.93 - 0.99)
Disability in cognitive functioning (0-4)	-0.26	0.77	(0.73 - 0.81)
Total number of chronic conditions reported (0-9)	-0.07	0.94	(0.90 - 0.97)
Gender: female (0-1)	-0.24	0.79	(0.72 - 0.86)
Inpatient discharge from hospital (0-1)	0.37	1.44	(1.33 - 1.57)
Inpatient discharge from rehab. facility (0-1)	0.59	1.80	(1.52 - 2.14)
Inpatient discharge from nursing home (0-1)	0.22 <sup>a</sup>	1.25	(1.08 - 1.45)
Patient lives with family member (0-1)	0.27	1.31	(1.19 - 1.44)
Patient lives alone (0-1)	0.27	1.32	(1.11 - 1.56)
Length of stay: more than 31 days (0-1)	0.41	1.50	(1.39 - 1.63)
Patient lives in own home (0-1)	0.13 <sup>a</sup>	1.14	(1.05 - 1.25)
Memory loss requiring supervision prior to past 2 weeks (0-1)	-0.13 <sup>a</sup>	0.88	(0.80 - 0.97)
Prior (2 weeks ago) disability in light meal preparation (0-2)	-0.19	0.82	(0.75 - 0.91)
Prior (2 weeks ago) disability in telephone use (0-5)	-0.04 <sup>a</sup>	0.96	(0.93 - 0.99)
Behavior problem frequency (0-5)	-0.04	0.96	(0.95 - 0.98)
Speech/language impairment (0-5)	-0.20	0.82	(0.79 - 0.85)
Diagnosis: infectious/parasitic disease (0-1)	-0.49	0.62	(0.47 - 0.81)
Diagnosis: skin/subcutaneous diseases (0-1)	-0.27	0.77	(0.68 - 0.86)
Diagnosis: mental disease (0-1)	-0.15	0.86	(0.79 - 0.94)
Diagnosis: nervous system disorder (0-1)	-0.46	0.63	(0.58 - 0.69)
Constant	1.86		

Number of Risk Factors: 24

**TABLE 9: Logistic Regression Model for Predicting the Outcome of Improvement in Confusion Frequency. (Cont'd)**

**Submodel 2:** For Improvement in Confusion Frequency restricted to patients who are at Level 3 on the Confusion Frequency scale at SOC/ROC.

<b>Risk Factor Measured at SOC/ROC*†</b>	<b>Coefficient‡</b>	<b>Odds Ratio‡</b>	<b>(90% CI)‡</b>
Acute condition: open wound/lesion (0-1)	-0.11	0.89	(0.85 - 0.94)
Acute condition: diabetes mellitus (0-1)	-0.08 <sup>b</sup>	0.92	(0.85 - 1.00)
Age (in years)	-0.01	0.99	(0.99 - 0.99)
Demonstrated behavior: memory deficit (0-1)	-0.17	0.84	(0.80 - 0.88)
Demonstrated behavior: verbal disruption (0-1)	-0.24	0.79	(0.71 - 0.88)
Bowel incontinence frequency (0-5)	-0.03	0.97	(0.95 - 0.99)
Chronic condition: dependence in living skills (0-1)	-0.08 <sup>b</sup>	0.92	(0.86 - 0.99)
Disability in cognitive functioning (0-4)	-0.26	0.77	(0.75 - 0.80)
Gender: female (0-1)	-0.12	0.89	(0.85 - 0.93)
Urinary incontinence severity 1 (0-4)	-0.04	0.96	(0.94 - 0.98)
Inpatient discharge from hospital (0-1)	0.33	1.40	(1.33 - 1.47)
Inpatient discharge from rehab. facility (0-1)	0.47	1.60	(1.48 - 1.74)
Inpatient discharge from nursing home (0-1)	0.28	1.33	(1.22 - 1.44)
Patient lives with family member (0-1)	0.17	1.18	(1.11 - 1.26)
Patient lives alone (0-1)	0.23	1.26	(1.15 - 1.36)
Length of stay: more than 31 days (0-1)	0.40	1.50	(1.43 - 1.56)
Medical regimen change in past 14 days (0-1)	0.12	1.13	(1.06 - 1.20)
Bowel ostomy (0-1)	-0.40	0.67	(0.55 - 0.81)
Patient lives in own home (0-1)	0.06 <sup>b</sup>	1.06	(1.01 - 1.11)
Impaired decision-making prior to past 2 weeks (0-1)	-0.15	0.86	(0.82 - 0.90)
Disruptive/socially inappropriate behavior, past 2 weeks (0-1)	-0.19	0.83	(0.74 - 0.93)
Memory loss requiring supervision prior to past 2 weeks (0-1)	-0.15	0.86	(0.81 - 0.90)
Disability in telephone use (0-5)	-0.08	0.92	(0.90 - 0.93)
Prior (2 weeks ago) disability in mgt. of oral medications (0-2)	-0.21	0.81	(0.78 - 0.84)
Behavior problem frequency (0-5)	-0.01 <sup>b</sup>	0.99	(0.97 - 1.00)
Moderate or better recovery prognosis (0-1)	0.18	1.19	(1.11 - 1.28)
Prior (2 weeks ago) disability in shopping (0-3)	-0.04 <sup>a</sup>	0.96	(0.93 - 0.99)
Good functional status rehabilitation prognosis (0-1)	0.11	1.12	(1.06 - 1.18)
Speech/language impairment (0-5)	-0.05	0.95	(0.92 - 0.98)
Number of surgical wounds present (0-4)	0.05 <sup>b</sup>	1.05	(1.01 - 1.10)
Diagnosis: fractures (0-1)	-0.12	0.89	(0.82 - 0.96)
Diagnosis: mental disease (0-1)	-0.22	0.80	(0.76 - 0.84)
Diagnosis: nervous system disorder (0-1)	-0.26	0.77	(0.73 - 0.82)
Constant	1.72		

Number of Risk Factors: 33

**TABLE 9: Logistic Regression Model for Predicting the Outcome of Improvement in Confusion Frequency. (Cont'd)**

**Submodel 3:** For Improvement in Confusion Frequency restricted to patients who are at Level 2 on the Confusion Frequency scale at SOC/ROC.

<b>Risk Factor Measured at SOC/ROC*†</b>	<b>Coefficient‡</b>	<b>Odds Ratio‡</b>	<b>(90% CI)‡</b>
Inpatient discharge from hospital (0-1)	0.33	1.39	(1.25 - 1.55)
Inpatient discharge from rehab. facility (0-1)	0.50	1.64	(1.37 - 1.97)
Inpatient discharge from nursing home (0-1)	0.30	1.35	(1.12 - 1.62)
Memory loss requiring supervision prior to past 2 weeks (0-1)	-0.20	0.82	(0.73 - 0.93)
Good functional status rehabilitation prognosis (0-1)	0.29	1.34	(1.20 - 1.49)
Age (in years)	-0.01	0.99	(0.99 - 1.00)
Presence of urinary incontinence (0-1)	-0.17	0.84	(0.76 - 0.94)
Demonstrated behavior: impaired decision-making (0-1)	-0.21	0.81	(0.72 - 0.91)
Demonstrated behavior: verbal disruption (0-1)	-0.37 <sup>a</sup>	0.69	(0.52 - 0.92)
Disability in cognitive functioning (0-4)	-0.16	0.85	(0.79 - 0.91)
Disability in eating (0-5)	-0.12	0.88	(0.82 - 0.95)
Disability in shopping (0-3)	-0.10 <sup>b</sup>	0.90	(0.82 - 0.99)
Disability in telephone use (0-5)	-0.07	0.94	(0.90 - 0.97)
Prior (2 weeks ago) disability in housekeeping (0-4)	-0.06 <sup>a</sup>	0.94	(0.90 - 0.98)
Prior (2 weeks ago) disability in mgt. of oral medications (0-2)	-0.20	0.82	(0.75 - 0.89)
Diagnosis: blood diseases (0-1)	-0.19 <sup>b</sup>	0.83	(0.69 - 0.99)
Diagnosis: mental disease (0-1)	-0.30	0.74	(0.65 - 0.85)
Diagnosis: nervous system disorder (0-1)	-0.23	0.80	(0.70 - 0.91)
Length of stay: more than 31 days (0-1)	0.45	1.57	(1.42 - 1.74)
Constant	1.92		

Number of Risk Factors: 19

**Submodel 4:** For Improvement in Confusion Frequency restricted to patients who are at Level 1 on the Confusion Frequency scale at SOC/ROC.

<b>Risk Factor Measured at SOC/ROC*†</b>	<b>Coefficient‡</b>	<b>Odds Ratio‡</b>	<b>(90% CI)‡</b>
Medicare as a payment source (0-1)	0.22	1.25	(1.17 - 1.33)
Inpatient discharge from hospital (0-1)	0.28	1.32	(1.29 - 1.36)
Inpatient discharge from rehab. facility (0-1)	0.47	1.60	(1.54 - 1.66)
Inpatient discharge from nursing home (0-1)	0.21	1.23	(1.18 - 1.29)
Impaired decision-making prior to past 2 weeks (0-1)	-0.22	0.80	(0.78 - 0.84)
Memory loss requiring supervision prior to past 2 weeks (0-1)	-0.15	0.86	(0.82 - 0.91)
Moderate or better recovery prognosis (0-1)	0.10	1.11	(1.05 - 1.17)
Good functional status rehabilitation prognosis (0-1)	0.10	1.10	(1.07 - 1.14)
Heavy smoking at SOC (0-1)	-0.06 <sup>a</sup>	0.94	(0.90 - 0.98)
Age (in years)	-0.01	0.99	(0.99 - 0.99)
Gender: female (0-1)	-0.04 <sup>a</sup>	0.96	(0.94 - 0.99)
Patient lives in own home (0-1)	0.06	1.06	(1.03 - 1.09)
Patient lives with family member (0-1)	0.20	1.22	(1.17 - 1.28)
Patient lives alone (0-1)	0.12	1.13	(1.08 - 1.19)
Vision impairment (0-2)	-0.06	0.95	(0.92 - 0.97)
Hearing impairment (0-4)	-0.04	0.96	(0.95 - 0.98)
Speech/language impairment (0-5)	-0.14	0.87	(0.86 - 0.89)

**TABLE 9: Logistic Regression Model for Predicting the Outcome of Improvement in Confusion Frequency. (Cont'd)**

**Submodel 4:** For Improvement in Confusion Frequency restricted to patients who are at Level 1 on the Confusion Frequency item at SOC/ROC. (Cont'd)

<b>Risk Factor Measured at SOC/ROC*†</b>	<b>Coefficient‡</b>	<b>Odds Ratio‡</b>	<b>(90% CI)‡</b>
Surgical wound(s) present (0-1)	0.18	1.20	(1.14 - 1.27)
Number of surgical wounds present (0-4)	0.03 <sup>a</sup>	1.03	(1.01 - 1.06)
Dyspnea (0-4)	-0.02	0.98	(0.97 - 0.99)
Urinary catheter (0-1)	-0.16	0.85	(0.80 - 0.91)
Presence of urinary incontinence (0-1)	-0.19	0.82	(0.80 - 0.85)
Anxiety level (0-3)	-0.04	0.96	(0.95 - 0.98)
Demonstrated behavior: memory deficit (0-1)	-0.17	0.84	(0.81 - 0.88)
Demonstrated behavior: verbal disruption (0-1)	-0.25	0.78	(0.68 - 0.89)
Demonstrated behavior: disruptive, infant, socially inappr. (0-1)	-0.32 <sup>a</sup>	0.73	(0.58 - 0.91)
Disability in cognitive functioning (0-4)	-0.31	0.73	(0.72 - 0.75)
Disability in mgt. of oral medications (0-2)	-0.10	0.90	(0.88 - 0.92)
Disability in telephone use (0-5)	-0.06	0.94	(0.93 - 0.96)
Prior (2 weeks ago) disability in transportation (0-2)	-0.09	0.91	(0.89 - 0.94)
Acute condition: open wound/lesion (0-1)	-0.06	0.94	(0.91 - 0.98)
Acute condition: terminal (0-1)	-0.12 <sup>a</sup>	0.89	(0.82 - 0.96)
Chronic condition: dependence in medication admin. (0-1)	-0.17	0.84	(0.82 - 0.87)
Diagnosis: endocrine/nutritional/metabolic (0-1)	-0.08	0.92	(0.90 - 0.95)
Diagnosis: mental disease (0-1)	-0.28	0.76	(0.73 - 0.79)
Diagnosis: other injury (0-1)	-0.11	0.89	(0.85 - 0.94)
Length of stay: more than 31 days (0-1)	0.14	1.15	(1.12 - 1.17)
Constant	0.46		

Number of Risk Factors: 37

Number of Unique Risk Factors Across All Model Components: 60

Overall model developmental sample  $R^2 = 0.111^{\S}$

Overall model developmental sample C-statistic = 0.693<sup>§</sup>

Overall model validation sample  $R^2 = 0.110^{\S}$

Overall model validation sample C-statistic = 0.692<sup>§</sup>

\* SOC = Start of Care, ROC = Resumption of Care after inpatient stay. Risk factors pertain to SOC/ROC unless indicated otherwise.

† The number of values in the measurement scale for each risk factor is in parentheses. For risk factors that take on the values 0 and 1, 1 denotes the presence of the attribute and 0 denotes its absence. For risk factors reflecting health or functional status that are defined using a scale that takes on more than two values, higher values of the scale indicate greater impairment or severity of illness. Selected risk factors take on values that represent simple counts (typically the number of health problems) -- as indicated by the risk factor label. The meaning associated with specific values for each risk factor can be determined by reference to the OASIS data set.

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**TABLE 9: Logistic Regression Model for Predicting the Outcome of Improvement in Confusion Frequency. (Cont'd)**

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- ‡ All coefficients/odds ratios are significant at  $P < .10$ , using the likelihood ratio test for the hypothesis that the coefficient is zero (i.e., the odds ratio is 1.00). Coefficients/odds ratios significant for  $.05 < P < .10$  are superscripted by "b." Those that are significant for  $.01 < P < .05$  are superscripted by "a," and the remainder are significant for  $P < .01$ . 90% CIs (confidence intervals) are given and odds ratios are considered significant at  $P < .10$ , because risk models were developed not to assess or evaluate impacts of risk factors on outcomes; rather, they are used primarily for predictive or risk adjustment purposes. Using the 10% significance level meets the need to be more inclusive for prediction/risk adjustment purposes, typically resulting in more stable models whose performance is superior under cross validation.
- § The  $R^2$  values are the squared correlations between predicted and observed values for all patients in the developmental (validation) sample. The developmental sample size for most outcomes is approximately 500,000, with some variation in this number depending on statistical attributes of the outcome measure and risk model. The validation sample is approximately 1,000,000 for all models. These sample sizes pertain to both  $R^2$ s and C-statistics. C is defined as the area under the Receiver Operating Characteristic curve. Intuitively, the C-statistic has the following interpretation: Let  $Y=1$  denote outcome attainment,  $Y=0$  denote non-attainment, and  $\hat{p}$  denote the **predicted** probability that  $Y=1$ . Construct all possible pairs of sample patients where  $Y=1$  for one member of the pair and  $Y=0$  for the other. C is the proportion of such pairs where  $\hat{p}$  for the patient with  $Y=1$  is larger than  $\hat{p}$  for the patient with  $Y=0$ . [Note that  $\hat{p}$  is obtained by substituting a patient's values for all risk factors into the risk model for the outcome under consideration.]
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**TABLE 10: Logistic Regression Model for Predicting the Outcome of Any Emergent Care Provided.**

<b>Risk Factor Measured at SOC/ROC*†</b>	<b>Coefficient‡</b>	<b>Odds Ratio‡</b>	<b>(90% CI)‡</b>
Inpatient discharge from hospital (0-1)	0.11	1.12	(1.08 - 1.15)
Medical regimen change in past 14 days (0-1)	-0.10	0.90	(0.87 - 0.93)
Urinary catheter prior to past 2 weeks (0-1)	0.16	1.17	(1.08 - 1.27)
Maximum severity rating among all diagnoses (0-4)#	0.08	1.08	(1.06 - 1.10)
Number of diagnoses with severity rating > 2 (0-6)#	0.04	1.04	(1.03 - 1.05)
Moderate or better recovery prognosis (0-1)	-0.12	0.88	(0.85 - 0.92)
Good functional status rehabilitation prognosis (0-1)	-0.21	0.81	(0.78 - 0.84)
Heavy smoking at SOC (0-1)	0.11	1.12	(1.07 - 1.17)
Gender: female (0-1)	-0.05	0.95	(0.93 - 0.98)
Patient lives with family member (0-1)	0.11	1.12	(1.07 - 1.17)
Patient lives alone (0-1)	0.19	1.21	(1.15 - 1.27)
Pain interfering with activity (0-3)	0.02 <sup>b</sup>	1.02	(1.00 - 1.03)
Intractable pain (0-1)	0.12	1.13	(1.08 - 1.17)
Stage of most problematic pressure ulcer (0-4)	0.12	1.13	(1.11 - 1.15)
Number of stasis ulcers present (0-4)	0.17	1.18	(1.15 - 1.22)
Surgical wound(s) present (0-1)	-0.43	0.65	(0.60 - 0.70)
Status of surgical wound (0-3)	0.11	1.12	(1.08 - 1.16)
Dyspnea (0-4)	0.12	1.13	(1.12 - 1.15)
Urinary catheter (0-1)	0.30	1.35	(1.27 - 1.43)
Bowel incontinence frequency (0-5)	0.01 <sup>b</sup>	1.01	(1.00 - 1.03)
Anxiety level (0-3)	0.06	1.06	(1.05 - 1.08)
Depression scale (0-5)	0.07	1.07	(1.05 - 1.10)
Disability in grooming (0-3)	0.02 <sup>a</sup>	1.02	(1.00 - 1.05)
Disability in dressing upper body (0-3)	0.04	1.04	(1.02 - 1.07)
Disability in bathing (0-5)	0.03	1.03	(1.01 - 1.04)
Disability in mgt. of oral medications (0-2)	0.05	1.05	(1.03 - 1.08)
Disability in housekeeping (0-4)	0.03	1.03	(1.02 - 1.04)
Prior (2 weeks ago) disability in transportation (0-2)	0.16	1.17	(1.14 - 1.20)
Acute condition: open wound/lesion (0-1)	0.04 <sup>b</sup>	1.04	(1.00 - 1.08)
Acute condition: cardiac/peripheral vascular (0-1)	0.17	1.18	(1.15 - 1.22)
Acute condition: gastrointestinal disorder (0-1)	0.10	1.10	(1.05 - 1.16)
Acute condition: mental/emotional (0-1)	0.42	1.52	(1.39 - 1.67)
Acute condition: oxygen therapy (0-1)	0.16	1.18	(1.13 - 1.22)
Acute condition: IV/Infusion therapy (0-1)	0.35	1.41	(1.32 - 1.51)
Acute condition: enteral/parenteral nutrition (0-1)	0.33	1.39	(1.30 - 1.50)
Chronic condition: dependence in medication admin. (0-1)	0.09	1.09	(1.05 - 1.13)
Diagnosis: infectious/parasitic disease (0-1)	0.19	1.20	(1.13 - 1.28)
Diagnosis: neoplasms (0-1)	0.25	1.28	(1.24 - 1.33)
Diagnosis: endocrine/nutritional/metabolic (0-1)	0.22	1.25	(1.22 - 1.28)
Diagnosis: blood diseases (0-1)	0.17	1.19	(1.14 - 1.24)
Diagnosis: circulatory system diseases (0-1)	0.11	1.12	(1.08 - 1.15)
Diagnosis: respiratory system diseases (0-1)	0.13	1.14	(1.10 - 1.17)
Diagnosis: digestive system diseases (0-1)	0.09	1.10	(1.05 - 1.15)
Diagnosis: genitourinary system diseases (0-1)	0.12	1.13	(1.09 - 1.17)
Diagnosis: other injury (0-1)	0.16	1.17	(1.12 - 1.23)
Length of stay: more than 31 days (0-1)	-0.57	0.57	(0.55 - 0.58)
Intervening inpatient care (0-1)	0.69	2.00	(1.93 - 2.06)
Constant	-2.40		

**TABLE 10: Logistic Regression Model for Predicting the Outcome of Any Emergent Care Provided. (Cont'd)**

Number of Risk Factors: 47

Developmental Sample  $R^2 = 0.100^{\S}$       Validation Sample  $R^2 = 0.099^{\S}$

Developmental Sample C-statistic =  $0.710^{\S}$       Validation Sample C-statistic =  $0.707^{\S}$

\* SOC = Start of Care, ROC = Resumption of Care after inpatient stay. Risk factors pertain to SOC/ROC unless indicated otherwise.

† The number of values in the measurement scale for each risk factor is in parentheses. For risk factors that take on the values 0 and 1, 1 denotes the presence of the attribute and 0 denotes its absence. For risk factors reflecting health or functional status that are defined using a scale that takes on more than two values, higher values of the scale indicate greater impairment or severity of illness. Selected risk factors take on values that represent simple counts (typically the number of health problems) -- as indicated by the risk factor label. The meaning associated with specific values for each risk factor can be determined by reference to the OASIS data set.

‡ All coefficients/odds ratios are significant at  $P < .10$ , using the likelihood ratio test for the hypothesis that the coefficient is zero (i.e., the odds ratio is 1.00). Coefficients/odds ratios significant for  $.05 < P < .10$  are superscripted by "b." Those that are significant for  $.01 < P < .05$  are superscripted by "a," and the remainder are significant for  $P < .01$ . 90% CIs (confidence intervals) are given and odds ratios are considered significant at  $P < .10$ , because risk models were developed not to assess or evaluate impacts of risk factors on outcomes; rather, they are used primarily for predictive or risk adjustment purposes. Using the 10% significance level meets the need to be more inclusive for prediction/risk adjustment purposes, typically resulting in more stable models whose performance is superior under cross validation.

# A primary diagnosis and up to five other diagnoses are recorded for each patient at SOC/ROC. Each of the up to six diagnoses is rated according to the following five-level severity index:

0 - Asymptomatic, no treatment needed at this time.

1 - Symptoms well controlled with current therapy.

2 - Symptoms controlled with difficulty, affecting daily functioning; patient needs ongoing monitoring.

3 - Symptoms poorly controlled, patient needs frequent adjustment in treatment and dose monitoring.

4 - Symptoms poorly controlled, history of rehospitalizations.

§ The  $R^2$  values are the squared correlations between predicted and observed values for all patients in the developmental (validation) sample. The developmental sample size for most outcomes is approximately 500,000, with some variation in this number depending on statistical attributes of the outcome measure and risk model. The validation sample is approximately 1,000,000 for all models. These sample sizes pertain to both  $R^2$ s and C-statistics. C is defined as the area under the Receiver Operating Characteristic curve. Intuitively, the C-statistic has the following interpretation: Let  $Y=1$  denote outcome attainment,  $Y=0$  denote non-attainment, and  $\hat{p}$  denote the **predicted** probability that  $Y=1$ . Construct all possible pairs of sample patients where  $Y=1$  for one member of the pair and  $Y=0$  for the other. C is the proportion of such pairs where  $\hat{p}$  for the patient with  $Y=1$  is larger than  $\hat{p}$  for the patient with  $Y=0$ . [Note that  $\hat{p}$  is obtained by substituting a patient's values for all risk factors into the risk model for the outcome under consideration.]

**TABLE 11: Logistic Regression Model for Predicting the Outcome of Acute Care Hospitalization.**

<b>Risk Factor Measured at SOC/ROC*†</b>	<b>Coefficient‡</b>	<b>Odds Ratio‡</b>	<b>(90% CI)‡</b>
Inpatient discharge from hospital (0-1)	0.25	1.28	(1.25 - 1.31)
Urinary catheter prior to past 2 weeks (0-1)	0.43	1.54	(1.42 - 1.66)
Maximum severity rating among all diagnoses (0-4)#	0.14	1.15	(1.13 - 1.17)
Number of diagnoses with severity rating > 2 (0-6)#	0.06	1.06	(1.05 - 1.07)
Moderate or better recovery prognosis (0-1)	-0.13	0.88	(0.84 - 0.92)
Good functional status rehabilitation prognosis (0-1)	-0.30	0.74	(0.72 - 0.76)
Gender: female (0-1)	-0.07	0.94	(0.91 - 0.96)
Patient lives with family member (0-1)	0.16	1.17	(1.12 - 1.22)
Patient lives alone (0-1)	0.24	1.27	(1.21 - 1.33)
Vision impairment (0-2)	0.03 <sup>a</sup>	1.03	(1.01 - 1.05)
Pain interfering with activity (0-3)	0.04	1.04	(1.02 - 1.05)
Intractable pain (0-1)	0.13	1.14	(1.09 - 1.18)
Stage of most problematic pressure ulcer (0-4)	0.10	1.11	(1.07 - 1.14)
Stage 3-4 pressure ulcer(s) present (0-1)	0.42	1.53	(1.37 - 1.70)
Status of most problematic stasis ulcer (0-3)	0.24	1.27	(1.24 - 1.31)
Surgical wound(s) present (0-1)	-0.55	0.58	(0.54 - 0.62)
Status of surgical wound (0-3)	0.18	1.20	(1.16 - 1.24)
Dyspnea (0-4)	0.17	1.18	(1.17 - 1.19)
Urinary catheter (0-1)	0.38	1.47	(1.38 - 1.56)
Bowel ostomy (0-1)	0.36	1.44	(1.33 - 1.55)
Bowel incontinence frequency (0-5)	0.01 <sup>b</sup>	1.01	(1.00 - 1.03)
Anxiety level (0-3)	0.06	1.06	(1.05 - 1.08)
Depression scale (0-5)	0.09	1.10	(1.08 - 1.12)
Disability in grooming (0-3)	0.02 <sup>a</sup>	1.02	(1.01 - 1.04)
Disability in dressing upper body (0-3)	0.06	1.07	(1.04 - 1.09)
Disability in bathing (0-5)	0.03	1.03	(1.02 - 1.05)
Disability in ambulation (0-5)	0.04	1.04	(1.02 - 1.05)
Disability in housekeeping (0-4)	0.03	1.03	(1.01 - 1.04)
ADL assistance provided by caregiver (0-1)	-0.09	0.91	(0.89 - 0.94)
IADL assistance provided by caregiver (0-1)	-0.08	0.93	(0.90 - 0.96)
Prior (2 weeks ago) disability in transportation (0-2)	0.19	1.21	(1.17 - 1.24)
Prior (2 weeks ago) disability in laundry (0-2)	0.08	1.08	(1.06 - 1.11)
Prior (2 weeks ago) disability in shopping (0-3)	0.03	1.03	(1.02 - 1.05)
Acute condition: cardiac/peripheral vascular (0-1)	0.18	1.19	(1.16 - 1.23)
Acute condition: pulmonary (0-1)	0.08	1.08	(1.05 - 1.12)
Acute condition: mental/emotional (0-1)	0.61	1.84	(1.69 - 2.00)
Acute condition: oxygen therapy (0-1)	0.28	1.32	(1.28 - 1.37)
Acute condition: IV/Infusion therapy (0-1)	0.53	1.71	(1.60 - 1.82)
Acute condition: enteral/parenteral nutrition (0-1)	0.47	1.59	(1.48 - 1.71)
Chronic condition: dependence in medication admin. (0-1)	0.18	1.19	(1.16 - 1.23)
Diagnosis: infectious/parasitic disease (0-1)	0.26	1.29	(1.22 - 1.37)
Diagnosis: neoplasms (0-1)	0.40	1.50	(1.44 - 1.55)
Diagnosis: endocrine/nutritional/metabolic (0-1)	0.31	1.36	(1.33 - 1.39)
Diagnosis: blood diseases (0-1)	0.31	1.36	(1.31 - 1.41)
Diagnosis: circulatory system diseases (0-1)	0.14	1.15	(1.12 - 1.19)
Diagnosis: digestive system diseases (0-1)	0.20	1.22	(1.18 - 1.26)
Diagnosis: genitourinary system diseases (0-1)	0.19	1.21	(1.17 - 1.25)
Diagnosis: skin/subcutaneous diseases (0-1)	0.27	1.31	(1.25 - 1.38)
Diagnosis: ill-defined conditions (0-1)	0.04 <sup>a</sup>	1.04	(1.01 - 1.06)
Diagnosis: other injury (0-1)	0.25	1.29	(1.23 - 1.35)

**TABLE 11: Logistic Regression Model for Predicting the Outcome of Acute Care Hospitalization. (Cont'd)**

<b>Risk Factor Measured at SOC/ROC<sup>*†</sup></b>	<b>Coefficient<sup>‡</sup></b>	<b>Odds Ratio<sup>‡</sup></b>	<b>(90% CI)<sup>‡</sup></b>
Length of stay: more than 31 days (0-1)	-0.77	0.46	(0.45 - 0.47)
Constant	-2.70		
<b>Number of Risk Factors: 51</b>			
Developmental Sample R <sup>2</sup> = 0.152 <sup>§</sup>	Validation Sample R <sup>2</sup> = 0.150 <sup>§</sup>		
Developmental Sample C-statistic = 0.740 <sup>§</sup>	Validation Sample C-statistic = 0.738 <sup>§</sup>		

\* SOC = Start of Care, ROC = Resumption of Care after inpatient stay. Risk factors pertain to SOC/ROC unless indicated otherwise.

† The number of values in the measurement scale for each risk factor is in parentheses. For risk factors that take on the values 0 and 1, 1 denotes the presence of the attribute and 0 denotes its absence. For risk factors reflecting health or functional status that are defined using a scale that takes on more than two values, higher values of the scale indicate greater impairment or severity of illness. Selected risk factors take on values that represent simple counts (typically the number of health problems) -- as indicated by the risk factor label. The meaning associated with specific values for each risk factor can be determined by reference to the OASIS data set.

‡ All coefficients/odds ratios are significant at P<.10, using the likelihood ratio test for the hypothesis that the coefficient is zero (i.e., the odds ratio is 1.00). Coefficients/odds ratios significant for .05<P<.10 are superscripted by "b." Those that are significant for .01<P<.05 are superscripted by "a," and the remainder are significant for P<.01. 90% CIs (confidence intervals) are given and odds ratios are considered significant at P<.10, because risk models were developed not to assess or evaluate impacts of risk factors on outcomes; rather, they are used primarily for predictive or risk adjustment purposes. Using the 10% significance level meets the need to be more inclusive for prediction/risk adjustment purposes, typically resulting in more stable models whose performance is superior under cross validation.

# A primary diagnosis and up to five other diagnoses are recorded for each patient at SOC/ROC. Each of the up to six diagnoses is rated according to the following five-level severity index:

- 0 - Asymptomatic, no treatment needed at this time.
- 1 - Symptoms well controlled with current therapy.
- 2 - Symptoms controlled with difficulty, affecting daily functioning; patient needs ongoing monitoring.
- 3 - Symptoms poorly controlled, patients needs frequent adjustment in treatment and dose monitoring.
- 4 - Symptoms poorly controlled, history of rehospitalizations.

§ The R<sup>2</sup> values are the squared correlations between predicted and observed values for all patients in the developmental (validation) sample. The developmental sample size for most outcomes is approximately 500,000, with some variation in this number depending on statistical attributes of the outcome measure and risk model. The validation sample is approximately 1,000,000 for all models. These sample sizes pertain to both R<sup>2</sup>s and C-statistics. C is defined as the area under the Receiver Operating Characteristic curve. Intuitively, the C-statistic has the following interpretation: Let Y=1 denote outcome attainment, Y=0 denote non-attainment, and  $\hat{p}$  denote the **predicted** probability that Y=1. Construct all possible pairs of sample patients where Y=1 for one member of the pair and Y=0 for the other. C is the proportion of such pairs where  $\hat{p}$  for the patient with Y=1 is larger than  $\hat{p}$  for the patient with Y=0. [Note that  $\hat{p}$  is obtained by substituting a patient's values for all risk factors into the risk model for the outcome under consideration.]