

**Unplanned Rehospitalizations within 30 and 180 days of Hospital Discharge for Survivors
of Critical Illness**

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Supplemental Digital Content

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Supplemental Table 1. Prevalence of Elixhauser Comorbidities Among Patients with Early and Late Rehospitalization, New York Statewide Planning and Research Cooperative System, 2008 – 2010

| Elixhauser Comorbidity ^a | No early rehospitalization (n = 492,653) | Early rehospitalization (n = 79,960) | No late rehospitalization (n = 327,439) | Late rehospitalization (n = 73,250) |
|--|---|---|--|--|
| Congestive Heart Failure | 16.4 | 26.4 | 13.8 | 25.2 |
| Cardiac Arrhythmia | 18.3 | 23.5 | 16.7 | 23.2 |
| Valvular Disease | 6.6 | 8.3 | 6.2 | 8.2 |
| Pulmonary Circulation Disorders | 3.5 | 5.1 | 3.1 | 4.9 |
| Peripheral Vascular Disorders | 5.7 | 7.4 | 5.3 | 7.2 |
| Uncomplicated Hypertension | 45.9 | 42.1 | 46.6 | 43.9 |
| Complicated Hypertension | 10.0 | 17.0 | 8.3 | 16.2 |
| Paralysis | 2.5 | 2.7 | 2.3 | 2.8 |
| Other Neurological Disorders | 7.0 | 8.8 | 6.3 | 9.2 |
| Chronic Pulmonary Disease | 20.5 | 26.0 | 19.0 | 26.3 |
| Diabetes | 20.9 | 24.1 | 20.1 | 24.5 |
| Uncomplicated Diabetes | 3.7 | 6.2 | 3.2 | 6.0 |
| Complicated Diabetes | 9.0 | 9.9 | 8.7 | 10.1 |
| Hypothyroidism | 9.0 | 9.9 | 8.7 | 10.1 |
| Renal Failure | 11.2 | 20.0 | 9.2 | 18.7 |
| Liver Disease | 3.5 | 5.0 | 3.2 | 4.8 |
| Peptic Ulcer Disease | 0.9 | 1.1 | 0.9 | 1.1 |
| Lymphoma | 0.7 | 1.2 | 0.6 | 1.1 |
| Metastatic Cancer | 2.7 | 4.6 | 2.4 | 4.1 |
| Solid Tumor without Metastasis | 3.1 | 5.0 | 2.5 | 4.4 |
| Rheumatoid Arthritis/Collagen Vascular Disease | 2.2 | 2.7 | 2.0 | 2.7 |
| Coagulopathy | 3.8 | 5.3 | 3.5 | 4.7 |
| Obesity | 7.9 | 7.2 | 8.1 | 7.7 |
| Weight Loss | 3.0 | 5.0 | 2.5 | 4.0 |
| Fluid and Electrolyte Disorders | 19.0 | 24.7 | 17.3 | 23.7 |
| Blood Loss Anemia | 1.0 | 1.3 | 1.0 | 1.3 |

| | | | | |
|-----------------|-----|-----|-----|------|
| Iron-Deficiency | 2.2 | 2.7 | 2.0 | 2.8 |
| Anemia | | | | |
| Alcohol Abuse | 6.6 | 6.0 | 6.7 | 7.0 |
| Drug Abuse | 3.8 | 3.7 | 3.8 | 4.2 |
| Psychoses | 1.8 | 2.3 | 1.6 | 2.6 |
| Depression | 9.3 | 9.4 | 9.2 | 10.3 |

^aInformation regarding HIV/AIDS status was not available in the dataset.

Supplemental Table 2. Most Common Admission Diagnoses on Rehospitalization for Patients with Early and Late Rehospitalizations, New York Statewide Planning and Research Cooperative System, 2008 – 2010

| Primary Diagnosis | All (n=79,960) % | Early rehospitalizations | | Primary Diagnosis | % |
|---|------------------------|---------------------------------------|------------------------|---|-------------------|
| | | Non-surgical (n=44,051) | Surgical (n=35,909) | | |
| Septicemia | 7.7 | Congestive heart failure | 8.4 | Complications of surgical procedure or medical care | 15.3 |
| Complications of surgical procedure or medical care | 7.7 | Septicemia | 7.4 | Septicemia | 8.1 |
| Congestive heart failure | 7.6 | Pneumonia | 3.9 | Congestive heart failure | 6.5 |
| Pneumonia | 3.7 | Cardiac dysrhythmias | 3.8 | Complications of device, implant or graft | 4.7 |
| Cardiac dysrhythmias | 3.6 | Respiratory failure or arrest | 3.4 | Cardiac dysrhythmias | 3.5 |
| Complications of device, implant or graft | 3.2 | Chronic obstructive pulmonary disease | 3.0 | Pneumonia | 3.4 |
| Coronary atherosclerosis | 3.0 | Diabetes mellitus with complications | 2.9 | Coronary atherosclerosis | 3.4 |
| Respiratory failure | 2.7 | Acute renal failure | 2.7 | Nonspecific chest pain | 2.3 |
| Acute renal failure | 2.5 | Coronary atherosclerosis | 2.6 | Fluid and electrolyte disorders | 2.2 |
| Diabetes mellitus with complications | 2.3 | Gastrointestinal hemorrhage | 2.5 | Urinary tract infections | 2.2 |
| | | Late rehospitalizations | | | |
| Primary Diagnosis | All (n=73,250) % | Non-Surgical (n=44,787) | Primary Diagnosis | Surgical (n=28,463) | Primary Diagnosis |
| Congestive heart failure | 7.5 | Congestive heart failure | 8.2 | Congestive heart failure | 6.4 |
| Septicemia | 5.6 | Septicemia | 5.3 | Septicemia | 6.0 |
| Coronary atherosclerosis | 3.9 | Pneumonia | 4.0 | Coronary atherosclerosis | 5.6 |
| Pneumonia | 3.8 | Cardiac dysrhythmias | 3.9 | Complications of device, implant or graft | 4.6 |

| | | | | | |
|---|-----|---------------------------------------|-----|---|-----|
| Cardiac dysrhythmias | 3.8 | Chronic obstructive pulmonary disease | 3.8 | Complications of surgical procedure or medical care | 4.3 |
| Diabetes mellitus with complications | 3.0 | Diabetes mellitus with complications | 3.7 | Cardiac dysrhythmias | 3.6 |
| Chronic obstructive pulmonary disease | 3.0 | Respiratory failure or arrest | 3.1 | Pneumonia | 3.4 |
| Complications of device, implant or graft | 3.0 | Coronary atherosclerosis | 2.7 | Nonspecific chest pain | 3.2 |
| Nonspecific chest pain | 2.7 | Nonspecific chest pain | 2.4 | Urinary tract infections | 2.2 |
| Respiratory failure or arrest | 2.3 | Alcohol-related disorders | 2.1 | Acute myocardial infarction | 2.1 |

Supplemental Table 3. Predictors of Early Rehospitalization^a New York Statewide Planning and Research Cooperative System, 2008 – 2010

| | N (400,689) | Hazard Ratio | 95% confidence interval | P value |
|--|----------------|--------------|----------------------------|---------|
| Age < 60 | 194,214 | ref | - | - |
| Age 60-69 | 97,266 | 1.10 | 1.08 – 1.12 | < 0.001 |
| Age 70-79 | 99,579 | 1.14 | 1.12 – 1.17 | < 0.001 |
| Age ≥ 80 | 101,594 | 1.19 | 1.16 – 1.22 | < 0.001 |
| Gender | | | | |
| Female | 233,433 | ref | - | - |
| Male | 259,216 | 1.02 | 1.01 – 1.04 | 0.01 |
| Race | | | | |
| White | 310,037 | ref | - | - |
| Black | 73,694 | 1.10 | 1.07 – 1.12 | <0.001 |
| Hispanic | 16,997 | 1.12 | 1.08 – 1.16 | <0.001 |
| Asian | 13,779 | 1.04 | 1.00 – 1.09 | 0.08 |
| Other | 60,442 | 1.06 | 1.03 – 1.08 | <0.001 |
| Surgical | 225,739 | 0.93 | 0.91 – 0.94 | < 0.001 |
| Median Household by Zip Code | | | | |
| 1 st quartile | 121,585 | ref | - | - |
| 2 nd quartile | 121,771 | 0.98 | 0.96 – 1.00 | 0.02 |
| 3 rd quartile | 123,896 | 0.98 | 0.96 – 1.00 | 0.10 |
| 4 th quartile | 125,401 | 0.99 | 0.96 – 1.01 | 0.16 |
| Mechanical Ventilation | | | | |
| None | 432,012 | ref | - | - |
| Mechanical Ventilation without Tracheostomy | 58,726 | 0.97 | 0.95 – 0.99 | 0.01 |
| Mechanical Ventilation with Tracheostomy | 10,915 | 1.27 | 1.22 – 1.33 | < 0.001 |
| Dialysis during Hospitalization | | | | |
| None | 475,121 | ref | - | - |
| No ESRD | 5,385 | 1.22 | 1.15 – 1.28 | < 0.001 |
| ESRD | 12,147 | 1.33 | 1.28 – 1.38 | < 0.001 |
| Severe Sepsis | 35,755 | 1.14 | 1.11 – 1.17 | < 0.001 |
| Discharge Destination | | | | |
| Home | 259,780 | ref | - | - |
| Home with Health | 108,586 | 1.25 | 1.22 – 1.27 | < 0.001 |

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|---------------------------------|---------|------|-------------|---------|
| Services | | | | |
| SNF | 90,610 | 1.54 | 1.51 – 1.58 | < 0.001 |
| Inpatient | 5,601 | 1.13 | 1.06 – 1.21 | <0.001 |
| Rehabilitation | | | | |
| Facility | | | | |
| Hospice | 5,812 | 0.19 | 0.16 – 0.21 | < 0.001 |
| Other | 23,264 | 1.46 | 1.41 – 1.51 | <0.001 |
| Insurance | | | | |
| Private | 189,877 | ref | - | - |
| Medicare | 222,769 | 1.16 | 1.14 – 1.19 | < 0.001 |
| Medicaid | 43,862 | 1.24 | 1.20 – 1.27 | < 0.001 |
| Self-Pay | 28,818 | 0.87 | 0.83 – 0.90 | < 0.001 |
| Other | 7,327 | 0.79 | 0.73 – 0.86 | < 0.001 |
| Elixhauser | | | | |
| Comorbidities ^b | | | | |
| Congestive Heart Failure | 88,623 | 1.23 | 1.21 – 1.25 | < 0.001 |
| Cardiac Arrhythmia | 94,173 | 1.08 | 1.06 – 1.10 | < 0.001 |
| Valvular Disease | 33,893 | 1.03 | 1.00 – 1.06 | 0.02 |
| Pulmonary Circulation Disorders | 18,612 | 0.99 | 0.96 – 1.02 | 0.54 |
| Peripheral Vascular Disorders | 29,402 | 1.10 | 1.07 – 1.13 | < 0.001 |
| Uncomplicated Hypertension | 222,829 | 0.97 | 0.95 – 0.99 | < 0.001 |
| Complicated Hypertension | 54,693 | 0.96 | 0.93 – 0.99 | 0.01 |
| Paralysis | 12,244 | 0.88 | 0.84 – 0.92 | < 0.001 |
| Other | 36,065 | 1.06 | 1.04 – 1.09 | < 0.001 |
| Neurological Disorders | | | | |
| Chronic Pulmonary Disease | 81,387 | 1.14 | 1.12 – 1.16 | < 0.001 |
| Uncomplicated Diabetes | 105,378 | 1.12 | 1.10 – 1.14 | < 0.001 |
| Complicated Diabetes | 20,321 | 1.22 | 1.18 – 1.26 | < 0.001 |
| Hypothyroidism | 44,983 | 1.01 | 0.99 – 1.04 | 0.32 |
| Renal Failure | 43,654 | 1.30 | 1.26 – 1.34 | < 0.001 |
| Liver Disease | 18,641 | 1.32 | 1.28 – 1.37 | < 0.001 |
| Peptic Ulcer Disease | 4,679 | 1.07 | 1.00 – 1.15 | 0.06 |
| Lymphoma | 3,947 | 1.40 | 1.31 – 1.49 | < 0.001 |

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|---------------------------------|---------|------|-------------|---------|
| Metastatic Cancer | 15,824 | 1.47 | 1.41 – 1.51 | < 0.001 |
| Solid Tumor without Metastasis | 16,947 | 1.28 | 1.24 – 1.33 | < 0.001 |
| Collagen Vascular Disease | 11,055 | 1.16 | 1.11 – 1.21 | < 0.001 |
| Coagulopathy | 20,081 | 1.07 | 1.04 – 1.11 | < 0.001 |
| Obesity | 38,298 | 0.94 | 0.92 – 0.97 | < 0.001 |
| Weight Loss | 3,988 | 1.13 | 1.10 – 1.17 | < 0.001 |
| Fluid and Electrolyte Disorders | 74,058 | 1.05 | 1.03 – 1.07 | < 0.001 |
| Blood Loss | 5,302 | 1.03 | 0.97 – 1.10 | 0.38 |
| Anemia | | | | |
| Iron Deficiency Anemia | 10,904 | 1.06 | 1.02 - 1.11 | 0.01 |
| Alcohol Abuse | 32,141 | 0.97 | 0.94 – 1.00 | 0.04 |
| Drug Abuse | 18,607 | 1.16 | 1.12 – 1.21 | < 0.001 |
| Psychoses | 9,106 | 1.09 | 1.04 – 1.15 | < 0.001 |
| Depression | 46,024 | 1.07 | 1.04 – 1.10 | < 0.001 |
| Length of Index Hospital Stay | | | | |
| < 3 days | 82,693 | ref | - | - |
| 3 to 6 days | 161,932 | 1.30 | 1.26 – 1.33 | < 0.001 |
| 7 to 13 days | 134,110 | 1.61 | 1.57 – 1.66 | < 0.001 |
| ≥ 14 days | 113,918 | 1.91 | 1.85 – 1.97 | < 0.001 |

ESRD, end-stage renal disease; SNF, skilled nursing facility.

^aResults of competing risk regression, accounting for death as a competing risk for rehospitalization. The proportional hazards assumption for the overall model did not appear to be violated using a plot of Schoenfeld-like residuals.

^bAll Elixhauser comorbidities were present on hospital admission.

Supplemental Table 4. Predictors of Late Rehospitalization^a, New York Statewide Planning and Research Cooperative System, 2008 – 2010

| | N (400,689) | Hazard Ratio | 95% confidence interval | P value |
|--|----------------|--------------|----------------------------|---------|
| Age < 60 | 168,726 | ref | - | - |
| Age 60-69 | 79,919 | 1.07 | 1.04 – 1.09 | < 0.001 |
| Age 70-79 | 78,012 | 1.11 | 1.08 – 1.14 | < 0.001 |
| Age ≥ 80 | 74,032 | 1.26 | 1.22 – 1.30 | < 0.001 |
| Gender | | | | |
| Female | 188,284 | ref | - | - |
| Male | 212,403 | 0.97 | 0.96 – 0.99 | < 0.001 |
| Race | | | | |
| White | 251,093 | ref | - | - |
| Black | 59,306 | 1.13 | 1.11 – 1.16 | < 0.001 |
| Hispanic | 13,904 | 1.12 | 1.08 – 1.17 | < 0.001 |
| Asian | 11,496 | 0.92 | 0.87 – 0.96 | < 0.001 |
| Other | 50,076 | 0.99 | 0.97 – 1.01 | 0.41 |
| Surgical | 186,328 | 0.73 | 0.71 – 0.74 | < 0.001 |
| Median Household by Zip Code | | | | |
| 1 st quartile | 98,323 | ref | - | - |
| 2 nd quartile | 99,325 | 0.95 | 0.93 – 0.97 | < 0.001 |
| 3 rd quartile | 100,728 | 0.92 | 0.90 – 0.95 | < 0.001 |
| 4 th quartile | 102,313 | 0.93 | 0.91 – 0.95 | < 0.001 |
| Mechanical Ventilation | | | | |
| None | 349,404 | ref | - | - |
| Mechanical Ventilation without Tracheostomy | 44,369 | 0.93 | 0.91 – 0.96 | 0.001 |
| Mechanical Ventilation with Tracheostomy | 6,916 | 1.36 | 1.29 – 1.44 | < 0.001 |
| Dialysis during Hospitalization | | | | |
| None | 389,160 | ref | - | - |
| No ESRD | 3,600 | 1.18 | 1.11 – 1.26 | < 0.001 |
| ESRD | 7,929 | 1.54 | 1.47 – 1.60 | < 0.001 |
| Severe Sepsis | 24,397 | 1.10 | 1.06 – 1.14 | < 0.001 |
| Discharge Destination | | | | |
| Home | 228,434 | ref | - | - |
| Home with Health | 86,214 | 1.10 | 1.08 – 1.13 | < 0.001 |

| | | | | |
|----------------------------|---------|------|-------------|---------|
| Services | | | | |
| SNF | 61,910 | 1.39 | 1.36 – 1.42 | < 0.001 |
| Inpatient | 4,529 | 1.02 | 0.95 – 1.09 | 0.62 |
| Rehabilitation | | | | |
| Facility | | | | |
| Hospice | 1,269 | 0.33 | 0.28 – 0.40 | < 0.001 |
| Other | 18,333 | 1.13 | 1.09 – 1.17 | < 0.001 |
| Insurance | | | | |
| Private | 163,105 | ref | - | - |
| Medicare | 169,875 | 1.27 | 1.25 – 1.30 | < 0.001 |
| Medicaid | 35,866 | 1.33 | 1.29 – 1.37 | < 0.001 |
| Self-Pay | 25,278 | 0.91 | 0.88 – 0.95 | < 0.001 |
| Other | 6,565 | 0.69 | 0.63 – 0.75 | < 0.001 |
| Elixhauser | | | | |
| Comorbidities ^b | | | | |
| Congestive Heart | 63,759 | 1.33 | 1.30 – 1.35 | < 0.001 |
| Failure | | | | |
| Cardiac | 71,691 | 1.13 | 1.11 – 1.15 | < 0.001 |
| Arrhythmia | | | | |
| Valvular Disease | 26,179 | 1.06 | 1.03 – 1.09 | < 0.001 |
| Pulmonary | 13,813 | 0.96 | 0.93 – 1.00 | 0.03 |
| Circulation | | | | |
| Disorders | | | | |
| Peripheral | 22,644 | 1.16 | 1.13 – 1.20 | < 0.001 |
| Vascular Disorders | | | | |
| Uncomplicated | 184,807 | 0.99 | 0.98 – 1.02 | 0.55 |
| Hypertension | | | | |
| Complicated | 38,982 | 0.99 | 0.96 – 1.03 | 0.54 |
| Hypertension | | | | |
| Paralysis | 9,430 | 0.95 | 0.91 – 1.00 | 0.05 |
| Other | 27,387 | 1.19 | 1.16 – 1.22 | < 0.001 |
| Neurological | | | | |
| Disorders | | | | |
| Chronic | 81,387 | 1.24 | 1.22 – 1.26 | < 0.001 |
| Pulmonary | | | | |
| Disease | | | | |
| Uncomplicated | 83,755 | 1.17 | 1.15 – 1.20 | < 0.001 |
| Diabetes | | | | |
| Complicated | 14,859 | 1.36 | 1.32 – 1.41 | < 0.001 |
| Diabetes | | | | |
| Hypothyroidism | 35,736 | 1.02 | 1.00 – 1.05 | 0.11 |
| Renal Failure | 43,654 | 1.34 | 1.29 – 1.39 | < 0.001 |
| Liver Disease | 13,928 | 1.36 | 1.31 – 1.41 | < 0.001 |
| Peptic Ulcer | 3,737 | 1.10 | 1.03 – 1.18 | 0.01 |
| Disease | | | | |
| Lymphoma | 2,769 | 1.46 | 1.35 – 1.57 | < 0.001 |

| | | | | |
|---------------------------------------|---------|------|-------------|---------|
| Metastatic Cancer | 10,150 | 1.77 | 1.70 – 1.85 | < 0.001 |
| Solid Tumor without Metastasis | 11,288 | 1.40 | 1.35 – 1.46 | < 0.001 |
| Collagen Vascular Disease | 8,627 | 1.22 | 1.16 – 1.28 | < 0.001 |
| Coagulopathy | 14,910 | 1.02 | 0.99 – 1.05 | 0.42 |
| Obesity | 32,125 | 0.96 | 0.93 – 0.99 | 0.01 |
| Weight Loss | 10,909 | 1.10 | 1.05 – 1.13 | < 0.001 |
| Fluid and Electrolyte Disorders | 74,058 | 1.03 | 1.01 – 1.05 | < 0.001 |
| Blood Loss Anemia | 4,101 | 1.09 | 1.02 – 1.16 | 0.01 |
| Iron Deficiency Anemia | 8,457 | 1.09 | 1.04 – 1.14 | < 0.001 |
| Alcohol Abuse | 26,917 | 1.08 | 1.05 – 1.12 | < 0.001 |
| Drug Abuse | 15,537 | 1.20 | 1.16 – 1.25 | < 0.001 |
| Psychoses | 7,035 | 1.24 | 1.18 – 1.30 | < 0.001 |
| Depression | 37,496 | 1.12 | 1.09 – 1.14 | < 0.001 |
| Length of Index Hospital Stay | | | | |
| < 3 days | 74,823 | ref | - | - |
| 3 to 6 days | 139,061 | 1.20 | 1.17 – 1.24 | < 0.001 |
| 7 to 13 days | 105,558 | 1.34 | 1.31 – 1.38 | < 0.001 |
| ≥ 14 days | 81,247 | 1.58 | 1.53 – 1.63 | < 0.001 |

ESRD, end-stage renal disease; SNF, skilled nursing facility.

^aResults of competing risk regression, accounting for death as a competing risk for rehospitalization. The proportional hazards assumption for the overall model did not appear to be violated using a plot of Schoenfeld-like residuals.

^bAll Elixhauser comorbidities were present on hospital admission.

Supplemental Table 5. Results of Sensitivity Analysis, Excluding Patients Residing in Downstate Counties in New York State, New York Statewide Planning and Research Cooperative System, 2008 – 2010

| | Early (n=181,618) | Late (n= 149,080) |
|--|----------------------|----------------------|
| Cumulative incidence of rehospitalization | 14.8% | 17.9% |
| Percentage of rehospitalized patients requiring ICU care | 29.5% | 28.5% |
| In-hospital mortality | 7.0% | 4.5% |