Clinical and Economic Outcome of Mechanically Ventilated Patients in New York State During 1993*

Analysis of 10,473 Cases Under DRG 475

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Study objectives: To examine and describe the relationship between age and disposition in patients undergoing mechanical ventilation.

Design: Retrospective analysis of a statewide database.

Setting: All acute-care hospitals in New York State.

Patients: All patients (n=10,473) aged ≥18 years discharged from hospital during 1993 with a final diagnosis related group (DRG) coding of 475.

Interventions: None.

Measurements and results: The final disposition, according to six codes (other acute-care facility, residential health-care facility, other health-care facility, home, home health-care services, and death) were examined for the whole population. Cost per case was assumed to equal the average statewide Medicaid rate. An inverse relationship between survival rate and age was observed and this resulted in an age-related increased cost per survivor. Also, survivors in older age groups have an increasing rate of hospital discharge to residential health-care facilities.

Conclusion: Patients who undergo mechanical ventilation are expensive to care for. The older they are, the less satisfactory is the outcome both from clinical and economic perspectives.

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Key words: critical care; economics; intensive care; mechanical ventilation; outcome

Abbreviations: DRG=diagnosis related group; RHCF=residential health-care facility; SPARCS=Statewide Planning and Research Cooperative System

The impact of mechanical ventilation on both ICU and hospital resources is significant.1-3 Outcome studies of this patient group are usually based on relatively small samples, and the findings vary considerably.4-7 Given the current economic climate, in which resources for sophisticated technologies are becoming progressively exiguous, knowledge of the financial aspects of mechanical ventilation is becoming increasingly important in the determination of resource allocation among the critically ill.

In previous related studies, using a statewide database, this group reported on >40,000 mechanically ventilated patients8 and on >6,000 tracheostomy

For ventilator dependency.9 In the former, mechanical ventilation was identified using ventilator procedure codes to identify ventilator-assisted patients. The latter used diagnosis related group (DRG) 483 (tracheostomy except for face, mouth, and neck diagnoses)—a high-cost DRG. Both studies supported the notion that outcome from mechanical ventilation is age dependent.

The current study attempts to look at a DRG primarily applied to respiratory failure that does not result in tracheostomy—DRG 475. Patients having different disease processes unified by a primary respiratory diagnosis and the need for mechanical ventilation are included. This DRG includes three procedure codes and is applied to patients undergoing mechanical ventilation for a variable period of time. This DRG was applied to 10,473 hospital discharges in New York State during the study year 1993 at a statewide average Medicaid reimbursement of $21,578 US per discharge.10

The purpose of this investigation is threefold: first, to
reaffirm whether previous observations concerning age and mechanical ventilation apply to a population selected under DRG 475; second, to present information regarding rates of hospital survival, discharge to home, and need for skilled nursing care to physicians who treat these patients on a daily basis; and finally, to examine the economic impact of DRG 475 in terms of reimbursement and hospital outcome.

**Materials and Methods**

We obtained discharge records from the Statewide Planning and Research Cooperative System (SPARCS) database maintained by the New York State Department of Health for all adult patients (≥18 years) in DRG 475 discharged from New York State hospitals between January 1, 1993, and December 31, 1993. DRG 475 is defined as "respiratory system diagnosis with ventilatory support." Table 1 summarizes the definitions for hospital disposition. A description of the SPARCS data and the methods for using this data set have been described elsewhere. The database information is validated using many checks for consistency as described in the Inpatient Output Data Dictionary. Completeness and accuracy of SPARCS data are ensured by periodic reviews of a facility's submissions by comparing SPARCS with other New York State Department of Health databases. When the review of the facility's data indicates the possibility of a significant problem, the facility is contacted and a copy of the findings is provided to the facility for their review and confirmation. The maintenance and quality of the data are critical to the use of SPARCS data for reimbursement purposes as well as to the growing use of data for health research.

Actual hospital reimbursement (excludes physician payments) for this DRG is shown in Table 2. Medicare and Medicaid reimbursement rates are very similar in New York State; hence, the aggregate, average statewide Medicaid rate was used for all cost determinations. Notwithstanding, private insurance carriers, including managed-care organizations, use varying methods to reimburse hospitals. Those who use the DRG system generally pay at or above the Medicaid rate.

We also determined the cost per survivor. This ratio is calculated with the use of the following equation:

\[
\text{Cost per survivor} = \frac{\text{number of patients} \times \text{average New York State Medicaid Rate}}{\text{Frequency of Survival}}
\]

The cost per survivor ratio depicts the amount of resources spent to procure a given level of desired outcome (ie, hospital survival). Since the numerator approximates the sum of all resources expended for all patients (survivors and nonsurvivors) and the denominator reflects the clinical outcome (ie, survival), higher survival will lead to a lower overall ratio.

**Results**

Table 3 shows the age distribution of patients in each age group and the cost per hospital survivor. Of note, the smallest subset is still >300 patients and >50% of patients are ≥70 years. Although length of stay is higher in the latter decades of life, this does not impact the reimbursement based cost estimate employed in these calculations. Cost per hospital survivor generally increases with advancing age.

The distribution of patients by gender is shown in Figure 1. Although the overall number of male and female patients is similar, the distribution across groups is not. There is a significant predominance of male subjects in the younger population, while the inverse is true for the older age groups. This may reflect the predominance of certain risk factors for mechanical ventilation in young men and the higher life expectancy of women.

The inverse relationship between survival rate and age is shown in Figure 2. Figure 3 shows the percentage of the total population, in each age group, discharged from hospital to home with or without home care (code 05, 06), while Figure 4 shows the same data plotted as percentage of survivors. The percentage of patients discharged from the hospital to residential health-care facilities (RHCFs) is shown in Figures 5 and 6. Although the overall population of patients in each age group transferred to a RHCF is relatively small, the percentage of survivors who go to RHCFs increases with age. Figure 7 shows percentage of the total population discharged from the hospital to other categories, including other

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**Table 1—Definition of the Patient's Destination Under SPARCS**

<table>
<thead>
<tr>
<th>Code</th>
<th>Disposition</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>Other acute-care hospital</td>
<td>Patient discharged to article 28 facility</td>
</tr>
<tr>
<td>02</td>
<td>RHCF</td>
<td>Patient discharged to licensed nursing care facility</td>
</tr>
<tr>
<td>04</td>
<td>Other health-care facilities</td>
<td>Patient discharged to other health-care facility not described by codes 1, 2, or 9</td>
</tr>
<tr>
<td>05</td>
<td>Home</td>
<td>Patient discharged to a personal residence</td>
</tr>
<tr>
<td>06</td>
<td>Home health services</td>
<td>Patient discharged to a personal residence under the care of an organized home health service</td>
</tr>
<tr>
<td>07</td>
<td>Left against medical advice</td>
<td>Patient discharged him/herself from the hospital against the advice of the physician</td>
</tr>
<tr>
<td>08</td>
<td>Died</td>
<td>Patient died</td>
</tr>
<tr>
<td>09</td>
<td>Psychiatric chronic-care facility</td>
<td>Patient discharged to a short-term chronic hospital or long-term specialty hospital providing treatment for psychiatric illness</td>
</tr>
</tbody>
</table>

*Source: SPARCS data element description, discharge data abstract component, April 1992, pages 82-83.*

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Table 2—Hospital Reimbursement for DRG 475 in New York State*

<table>
<thead>
<tr>
<th>Case Payment Group</th>
<th>Case Mix Neutral Rate</th>
<th>Average Payment DRG 475 (SIW=4.7440)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nonteaching upstate 0-99 beds</td>
<td>$3,002</td>
<td>$14,244</td>
</tr>
<tr>
<td>Nonteaching upstate &gt;100 beds</td>
<td>$3,038</td>
<td>$14,410</td>
</tr>
<tr>
<td>Teaching upstate</td>
<td>$3,221</td>
<td>$15,282</td>
</tr>
<tr>
<td>Nonteaching downstate</td>
<td>$3,581</td>
<td>$16,988</td>
</tr>
<tr>
<td>Teaching downstate</td>
<td>$5,218</td>
<td>$24,756</td>
</tr>
<tr>
<td>Teaching affiliate</td>
<td>$6,114</td>
<td>$24,263</td>
</tr>
<tr>
<td>Major public</td>
<td>$6,787</td>
<td>$32,200</td>
</tr>
<tr>
<td>Statewide-Medicaid rate</td>
<td>$4,548</td>
<td>$21,578</td>
</tr>
</tbody>
</table>

*Source: Bureau of Health Economics, New York State Department of Health. SIW=service intensity weight.

acute-care facilities, other facilities, and nonfollow-up groups. Of note, the younger group had a much larger population of patients leaving against medical advice. Further analysis of this group reveals that with the exception of two counties in the downstate area (Orange, Dutchess), all patients discharged against medical advice are from New York City counties (Kings, Queens, New York, Bronx) or counties that include a major metropolitan area (Buffalo, Syracuse). The correlation of this phenomenon with certain clinical characteristics of these patients is open to speculation. We were unable to discern any particular pattern in relation to the diagnostic categories. Figure 8 shows the percentage of survivors discharged from hospitals to other categories as described above.

The population in Psychiatric Chronic Care Facilities in the DRG 475 group is too small to evaluate; therefore, we surveyed the data on the “other” categories, and analyzed them on both percentage of survivors and percentage of total population in each age group.

Table 3—Demographic and Economic Data—DRG 475—New York State 1993*

<table>
<thead>
<tr>
<th>Age Group, yr</th>
<th>No. of Patients</th>
<th>Percent of Total (Cumulative)</th>
<th>Days in Hospital (±SD) (a)</th>
<th>Cost/Survivor Based on Reimbursement(b)</th>
</tr>
</thead>
<tbody>
<tr>
<td>18±29</td>
<td>315</td>
<td>3 (3)</td>
<td>10±15</td>
<td>$25,966</td>
</tr>
<tr>
<td>30±39</td>
<td>513</td>
<td>5 (8)</td>
<td>11±16</td>
<td>$29,022</td>
</tr>
<tr>
<td>40±49</td>
<td>746</td>
<td>7 (15)</td>
<td>14±14</td>
<td>$31,732</td>
</tr>
<tr>
<td>50±59</td>
<td>1,149</td>
<td>11 (26)</td>
<td>17±25</td>
<td>$32,692</td>
</tr>
<tr>
<td>60±69</td>
<td>2,194</td>
<td>21 (47)</td>
<td>18±20</td>
<td>$34,249</td>
</tr>
<tr>
<td>70±74</td>
<td>1,455</td>
<td>14 (61)</td>
<td>18±20</td>
<td>$36,571</td>
</tr>
<tr>
<td>75±79</td>
<td>1,407</td>
<td>13 (74)</td>
<td>20±23</td>
<td>$41,942</td>
</tr>
<tr>
<td>80±84</td>
<td>1,240</td>
<td>12 (86)</td>
<td>20±25</td>
<td>$44,035</td>
</tr>
<tr>
<td>85±89</td>
<td>876</td>
<td>8 (94)</td>
<td>19±20</td>
<td>$56,782</td>
</tr>
<tr>
<td>90+</td>
<td>578</td>
<td>6 (100)</td>
<td>19±19</td>
<td>$71,926</td>
</tr>
<tr>
<td>Overall</td>
<td>10,473</td>
<td>100</td>
<td>18</td>
<td>$37,854</td>
</tr>
</tbody>
</table>

*Source: (a) SPARCS Database 1993; (b) Bureau of Health Economics, New York State Department of Health.

DRG 475 includes three procedural codes: 96.70 (continuous ventilation-unspecified duration), 96.71 (mechanical ventilation <96 h), and 96.72 (mechanical ventilation >96 h). The distribution of the data (Figure 9) shows that the older patients are more frequently ventilated for >96 h, when compared with the younger patients.

**Discussion**

Our group has reported previously that age impacts the outcome of patients requiring mechanical ventilation. To our knowledge, this report, exploring DRG 475, represents the largest focused study on a respiratory failure DRG and confirms that survival rate is negatively affected by age. Nevertheless, survivors still have a reasonable chance of returning home at all ages. For example, in the youngest age group (18 to 29 years), approximately 85% survive hospitalization and 80% of those survivors are discharged directly to home. By comparison, patients >80 years of age, if compiled, have a hospital discharge rate of only <40%, but approximately 60% of those survivors are discharged directly to home. Not surprisingly, the rate of discharge to an RHCF rises exponentially with advancing age. This peaks at about 40% in the oldest (90+ years) age group.

In an earlier publication, we reported on a 1/10 sample of nonventilator-assisted patients in order to assess the mortality rates with respect to the ventilator coded groups that were being studied. These rates began at <1% in the youngest (18 to 29 years) age group and rose exponentially to 16% in the oldest (90+ years). In that comparison, mortality was much higher (>32-fold) at age 18 to 29 years and remained proportionately elevated but declined to more than threefold in the >90-year-old group. A similar pattern, but less dramatic, can be seen here-
in—ergo, outcomes are better in DRG 475 than we previously observed using ventilator procedure codes. In large part, the difference can be explained by the exclusion of tracheostomized patients in the current investigation. Notwithstanding, the relatively high mortality rates seen in DRG 475 emphasizes the clinical importance of respiratory failure. Also, our present data simply confirm that ventilator mortality follows similar trends with age as does the general hospital population.8

From an economic standpoint, DRG 475 reimbursement is not terribly different from many medi-
um-cost DRGs and compares with DRG 458 (non-extensive burns with skin graft) or DRG 107 (coronary bypass without cardiac catheterization). However, the higher mortality rates do elevate the cost per survivor figures. DRG 483 (tracheostomized patients), by comparison, has a statewide average reimbursement rate of >$100,000 and cost per survivor figures that are five to seven times higher than DRG 475.9 Based on the average Medicaid reimbursement rate, hospitals in New York State were paid >$210,000,000 US for this DRG during 1993. Extrapolating this nationally, we estimate that nearly $3,000,000,000 is reimbursed to hospitals for DRG 475. If one factors in physician reimbursement and the cost of posthospital care, this number would almost certainly rise to the 4 to 5 billion dollar range. Thus, DRG 475 has an important impact on healthcare economics and this group of patients will almost

Figure 3. Patients discharged home with and without home care. Data presented as percentage of the total population (codes 05 and 06).

Figure 4. Patients discharged home with and without home care. Data presented as percentage of survivors (codes 05 and 06).
certainly be scrutinized carefully as health-care resource allocations are evaluated in the future.

RHCF is practically synonymous with nursing home care and this disposition might be considered as a diminished quality of life. The life expectancy, quality-adjusted life years,\textsuperscript{13} and long-term care costs in this patient group need to be analyzed to understand the full impact that treating these patients has on society.

This study does not attempt to analyze the underlying severity of individual cases, nor does it purport to accurately predict outcome in individual cases.

Figure 5. Patients discharged to an RHCF. Data presented as percentage of the total population (code 02).

Figure 6. Patients discharged to an RHCF. Data presented as percentage of survivors (code 02).
Those type of analyses, if performed appropriately, require a more robust clinical database than SPARCS. Clinical information retrieved from administrative databases is subject to a number of limitations. These include the following: (1) the inability to clearly determine if a certain condition was present at admission (comorbidity), developed during the hospitalization, or as a consequence of therapy (complication); (2) the lack of quality of life and functional status data; and (3) a tendency to code more complex diagnoses than warranted for reimbursement purposes cannot be ruled out. Both insurance claims and administrative databases have proved to be inaccurate sources of clinical information.

The outcome of the population studied is not dissimilar to that seen in a generalized hospital population or in other similar studies of ventilated
patients. The relative impact of age and chronic disease were not separately analyzed. It is important to note, however, that aging is associated with an increasing prevalence of chronic diseases. Data from the US Department of Health and Human Services show that at least 20% of those aged ≥65 years are limited in activities of daily living, such as bathing, dressing, and eating. Further, those aged ≥85 years constitute a substantial share of all people who are not independent in physical functioning. The older age groups have an increased incidence of degenerative diseases, led by arthritis and heart disease. Also, the major causes of death for those >65 years are heart disease, cancer, stroke, COPD, pneumonia, and influenza.17

Despite the limitations of the database, it is the authors’ belief that the demographic and financial information presented is useful in the daily care of mechanically ventilated patients. Bedside judgments involve the integration of information from different sources, ranging from randomized trials data to anecdotal experiences. The data presented in this study represent outcome information about a relatively large population. These data can be applied relatively easily to clinical scenarios and aid clinicians in developing a prognosis (eg, what are the chances of an 85-year-old receiving mechanical ventilation, who does not require a tracheotomy, going home or to a nursing home?). This information added to clinical data and the experience of the observer can enhance the ability of physicians to prognosticate. Also, in an era of “cost-consciousness,” it is important to develop a better understanding of the economic impact of the treatments they/we provide, such as mechanical ventilation. Additionally, it would seem judicious for clinicians to familiarize themselves with the type of data that policy makers and third-party payers commonly use for benchmarking, in outcomes research and in making health-care utilization guidelines.

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