Outcomes of Intensive Care for Patients With Human Immunodeficiency Virus Infection

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Background: Intensive care for patients with human immunodeficiency virus is common, costly, and associated with high morbidity. Accurate and up-to-date outcome and prognostic data are needed to effectively counsel patients and to make difficult decisions regarding admission to the intensive care unit.

Methods: We reviewed the medical charts of 394 adults infected with human immunodeficiency virus who received intensive care at San Francisco General Hospital, San Francisco, Calif, from 1992 to 1995, and we performed a multivariate analysis to learn which factors were predictive of poor outcomes.

Results: Respiratory failure (47%), sepsis (12%), and neurologic disease (11%) were the most common indications for admission to the intensive care unit. Overall, 63% of the patients survived hospitalization; survival rates were 27%, 18%, 13%, and 11% at 1, 2, 3, and 4 years, respectively. Independent predictors of hospital mortality were low serum albumin level, Acute Physiology Score, mechanical ventilation, and a diagnosis of Pneumocystis carinii pneumonia during admission to the intensive care unit. Low CD4+ cell count, low serum albumin level, and mechanical ventilation predicted poor long-term survival. Of the 121 patients who had a CD4+ cell count less than 50 cells/µL (0.05 × 10^9/L) and a serum albumin level less than 25 g/L and required mechanical ventilation, 7% survived for 2.5 years or more after hospital discharge.

Conclusions: In this series, which is the largest to date of patients admitted to the intensive care unit with human immunodeficiency virus infection, we found that long-term survival rates were low. However, even among patients who had multiple risk factors for mortality, a substantial minority survived, with a few patients achieving long-term survival.

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During the past 2 decades, a clinical, legal, and ethical consensus emerged regarding decision making about life-sustaining treatments. Simply stated, life-sustaining treatment, including the use of the intensive care unit (ICU), should be offered to patients when such care is clinically indicated and not futile. Since futility is rare, in most cases clinicians will offer intensive care to patients for whom there are medical indications for such care and provide patients or their proxy decision makers the information they need to make informed choices.

Despite the availability of more effective therapies for the human immunodeficiency virus (HIV), infection is associated with high morbidity and is probably ultimately fatal. Therefore, both clinicians and patients frequently confront decisions about the use of the ICU and require up-to-date and accurate data to inform these difficult decisions.

Unfortunately, there are few published data on the spectrum of illnesses leading to admission to the ICU in patients with HIV. Since the start of the epidemic, most published studies regarding intensive care have focused primarily, if not exclusively, on the outcome of patients with respiratory failure and Pneumocystis carinii pneumonia (PCP). Given the changes in populations at risk, spectrum of illness, and therapies for HIV disease, there is reason to believe that the indications for admission to the ICU have changed during the years and that the prognosis of patients with acquired immunodeficiency syndrome (AIDS) requiring intensive care has changed as well. Few recent studies have addressed this issue, and the numbers of patients in these studies were modest. We collected data on all patients infected with HIV admitted for intensive care at San Francisco General Hospital, San Francisco, Calif, during the 4-year period from January 1, 1992, to December 31, 1995, to address these issues.

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PATIENTS AND METHODS

We conducted a retrospective review of the medical charts of all patients aged 18 years or older with HIV infection, with or without AIDS, admitted to any ICU at San Francisco General Hospital during the 4-year period from January 1, 1992, to December 31, 1995. San Francisco General Hospital is a county teaching hospital with 375 beds serving a largely indigent patient population. There are 3 ICUs with a total of 30 ICU beds available for the medical, surgical, and subspecialty services. Patients are admitted to the ICU from the emergency department, outpatient clinics, or inpatient wards. The decision to admit patients to the ICU is made by the house staff and their attending physicians in these areas. There are no set policies or guidelines regarding which patients should be admitted to the ICU.

Patients were identified through hospital billing data. A logbook of patients admitted to the ICU is also kept, and a 6-month period of these logbooks was cross-checked with the list obtained, and there was 98% agreement. Therefore, we determined that the billing list was an accurate representation of those patients actually admitted to an ICU.

For all patients, epidemiologic data were collected, including the age, sex, race, and risk factors for HIV. Historical data included opportunistic infections or malignancies and the use of antiretroviral agents or PCP prophylaxis. The indication for ICU admission was recorded. In several cases, there were 2 reasons for ICU admission (eg, sepsis and respiratory failure), but the medical chart reviewers chose a single primary diagnostic category determined to be responsible for each admission; up to 2 additional diagnostic categories were recorded as well, if it was determined that they contributed to the need for intensive care. Data from the stay in the ICU also included the service to which the patient was admitted, length of hospitalization, hospital day of the ICU admission, length of the ICU stay, and disposition (died in the ICU, survived to leave the ICU but died in the hospital, or survived to leave the hospital). Physiologic data collected included all the elements of Acute Physiology and Chronic Health Evaluation II score, CD4+ cell count within the 6 months prior to or during the hospitalization, serum albumin level, lactate dehydrogenase level, and percentage of ideal body weight near the time of ICU admission. Data on the hospital course included the use of mechanical ventilation, the development of pneumothorax and its treatment, and the presence of PCP (even if not an indication for admission) and its treatment. It was also noted whether a first diagnosis of HIV was made during this hospitalization and whether the patient met the 1993 Centers for Disease Control and Prevention criteria for AIDS by the end of the hospitalization.

Data on follow-up included subsequent hospitalizations at the same hospital and the date of death. If the date of death was not available from the medical record, it was obtained from the death registry of the city and county of San Francisco, and, if still not found, the National Death Registry was searched using the patient’s name and date of birth. In cases when the dates of death were still not found despite these steps, these patients were presumed to be alive as of June 1, 1997 (the most recent update of the National Death Registry at the time of inquiry). In cases when there was more than 1 ICU admission per patient, data were collected for subsequent ICU admissions only if they occurred in the course of a separate hospitalization. The number of ICU admissions occurring during separate hospitalizations during the 4-year period was recorded.

Survival curves with 95% confidence intervals were computed using the Kaplan-Meier method. Logistic regression analysis was used to identify variables that were predictive of death during the hospitalization; Cox proportional hazards model was used to identify predictors of long-term mortality. In both cases, variables that predicted mortality in a univariate analysis with P<.10 were entered into a stepwise multivariate analysis. Statistical analysis was performed using SAS statistical software (SAS Institute Inc, Cary, NC).

For the same period (January 1, 1992, to December 31, 1995), we recorded the number of hospital admissions of patients with HIV and/or AIDS.

Approval for the study was obtained from the Committee on Human Research at the University of California, San Francisco.

To avoid repetitive publication, we contacted the authors of a previous study that was conducted in part at San Francisco General Hospital to learn if any of the patients we studied were in their study; this overlap was true for only 1 patient, whose data were retained in our analysis.

RESULTS

During the 4-year study period, a total of 399 patients met our study criteria; of these, 394 patient medical charts were reviewed, and 5 were unavailable for review. These 394 patients accounted for 443 ICU admissions (each during a separate hospitalization) during the 4-year period. During the same period, adult patients with known HIV infection accounted for 6508 admissions to all services in the hospital; thus, of those, 7% of all admissions of adult patients with HIV included an ICU stay. Twelve percent of patients were alive at the end of the follow-up period.

PATIENTS

Table 1 shows the characteristics of the 394 patients. Overall, 91% were men, and the median age at the time of the ICU admission was 38 years. Of the 394 patients, 52% were white, 27% were black, and 16% were Hispanic. The vast majority of patients had a risk factor of male homosexual activity (41%), injection drug use (29%), or both (19%).

Prior to their ICU admission, 60% had had one or more opportunistic infections, 67% had taken PCP prophylaxis at some time in the past, and 52% had taken antiretroviral therapy. The mean CD4+ cell count (available in 97% of admissions) was 108 cells/µL (0.11 × 10⁹/L), with a median of 52 cells/µL (0.05 × 10⁹/L) (range, 0-960 cells/µL [0.0-0.96 × 10⁹/L]).

Table 2 shows that 362 patients had a single admission to an ICU, while the remaining 32 patients accounted for
81 admissions. Of the admissions, 77% were to the medical service. Of the ICU admissions, 60% occurred on the first hospital day; the mean was on the third day, with a range of 1 to 30 days. The length of hospital stay varied from 1 to 199 days, with a median of 11 days. The median ICU stay was 3 days, with a range of 1 to 49 days.

The Acute Physiology Score (APS) ranged from 0 to 30 (of a possible 60), with a mean of 11; the Acute Physiology and Chronic Health Evaluation II scores ranged from 0 to 37 (of a possible 71), with a mean of 16. The mean lactate dehydrogenase level (available for 57% of admissions) was 563 U/L, and the mean serum albumin level (available for 83% of admissions) was 25 g/L. The hospitalization included mechanical ventilation in 55% of the cases; 21% of all patients had PCP during their hospitalization, and 9% had pneumothorax during their hospital course. Ninety-one percent of the patients were found to have AIDS by the end of their hospitalization, and 9% had pneumothorax during their hospitalization. Ninety-one percent of the patients were found to have AIDS by the end of their hospital course. Ninety-one percent of the patients were found to have AIDS by the end of their hospitalization, and 9% had pneumothorax during their hospital course.

INDICATIONS FOR INTENSIVE CARE AND OUTCOMES

Of the 443 admissions, 284 (64%) had 1 indication leading to intensive care, 126 (28%) had 2, and 33 (7%) had 3. Table 3 shows the distribution of admissions into each of 10 diagnostic categories as a primary indication for intensive care; although nearly half of the patients were admitted for respiratory failure, with 38% of this group for respiratory failure secondary to PCP, more than half were admitted for a wide range of other indications.

As shown in Table 2, of all ICU admissions, nearly a fourth of the patients died in the ICU and 63% survived to leave the hospital. The overall survival curve of the entire cohort is shown in Figure 1. Of patients surviving the hospitalization, 87% were alive at 1 month, 60% at 6 months, 44% at 1 year, 29% at 2 years, 21% at 3 years, and 18% at 4 years. Of those surviving their hospitalization, the mean number of subsequent hospitalizations at the same hospital was 1.4 (range, 0-10), and the mean number of total days spent in the hospital during these subsequent hospitalizations was 9.6 (range, 0-134).

Patients with sepsis and respiratory failure had the highest hospital mortality rates in our cohort (Table 3), whereas patients in the ICU for other indications had better outcomes. Compared with patients with respiratory
failure as the primary indication for intensive care, the hospital mortality rate was not statistically significantly different for patients with sepsis ($P = .47$), neurologic disease ($P = .14$), gastrointestinal bleeding ($P = .08$), metabolic disturbances ($P = .13$), or miscellaneous indications for ICU admission ($P = .45$). There was decreased risk of dying in the hospital among those who were admitted to the ICU for cardiac disease (odds ratio, 0.07), postoperative care (odds ratio, 0.29), trauma (odds ratio, 0.10), or drug overdose (odds ratio, 0.13).

### PREDICTORS OF HOSPITAL AND LONG-TERM MORTALITY

In the multivariate analysis, we found that the following features were associated with higher hospital mortality (Table 4): the use of mechanical ventilation, PCP during admission, higher APS, and lower serum albumin level. There was a trend toward an increased hospital mortality with the development of pneumothorax while intubated ($P = .09$) and for decreased hospital mortality if injection drug use was the sole risk factor for HIV ($P = .07$), although neither of these reached statistical significance.

As shown in Table 5, certain features, if present, predicted an increased risk for long-term mortality in the multivariate analysis. These factors were the need for mechanical ventilation, lower serum albumin level, and lower CD4+ cell count.

We found no constellation of clinical or epidemiologic factors that suggested survival after intensive care would be unprecedented. Of the 121 patients who had a CD4+ cell count less than 50 cells/µL ($0.05 \times 10^9$/L) and a serum albumin level less than 25 g/L and mechanical ventilation for any reason, 47 (39%) survived hospitalization. Of those who survived hospitalization, the median survival was 4.9 months, the mean survival was 8.9 months, and the survival rates at 1 and 2 years were 36% and 17%, respectively. Of note, 8 of the hospital survivors in this group who were alive at the end of the follow-up had survived for at least 2.5 years after discharge, including 1 patient who was alive more than 5 years after discharge.

The following variables examined affected neither the hospital mortality nor the long-term mortality: sex; race; history of malignancy; history of opportunistic infections (including PCP); prior use of PCP prophylaxis or antiretroviral agents; the presence of chronic renal, liver, or respiratory disease (by Acute Physiology and Chronic Health Evaluation II criteria); a history of ICU admissions; or the year of hospital discharge. Clinical data and characteristics related to the hospital course that did not affect survival included the number of days in the ICU, length of hospitalization, length of hospitalization prior to ICU admission, initial lactate dehydrogenase level, whether the patient had undergone elective or emergent surgery, or whether this was the first diagnosis of HIV or AIDS.

### PATIENTS WITH RESPIRATORY FAILURE AND PCP

Pneumocystis carinii pneumonia was documented in 87 admissions. In 78 admissions (18% of the total ICU cohort), the primary indication for ICU admission was respiratory failure secondary to PCP. Of these patients, 48 (68%) required mechanical ventilation. The survival curve for all patients with a primary diagnosis of PCP is shown in Figure 2. Of 78 patients with a primary diagnosis of PCP, 46 (59%) died in the hospital; 39 (81%) of the 48 patients with PCP who required mechanical ventilation died in the hospital. Among the 9 survivors of PCP who received mechanical ventilation, the mean survival was 11 months and the median survival was 10.2 months; 4 patients in this group died in the first 6 months, the others died at 10.2 months and 1.5 years, and 3 others were alive at 2.5, 3, and 4 years after discharge. Thus, although the overall prognosis for this group of patients was poor, 3 (6%) of the 48 survived for 2.5 years or more after hospital discharge.

### COMMENT

Past studies showed that the range of indications for intensive care in patients infected with HIV has broad-
ended over time. In the beginning of the epidemic, most admissions were for respiratory failure, especially that associated with PCP.8,21-23 More recently, a wider variety of indications precipitated intensive care, although respiratory failure remains the single most common indication. Since 1995, hospital or ICU mortality rates for patients with HIV or AIDS have been 28% to 51%.14-17 During the first decade of the epidemic, about two thirds of admissions to the ICU among patients with AIDS were for respiratory failure, and roughly half of all admissions were specifically due to respiratory failure from PCP.8,21-23 Recently, in our study and others,14-17 respiratory failure from PCP or from other causes has made up a smaller, but still significant, proportion of admissions to ICUs among patients with AIDS.

In the United States, reports showed that about two thirds of patients with AIDS admitted to an ICU with respiratory failure died in the hospital; for patients with PCP requiring intensive care, but not necessarily intubation, hospital mortality rates were 55% to 64%.14,15 In our study, respiratory failure carried a hospital mortality rate of 46%; it was higher (59%) when the underlying cause of respiratory failure was PCP than it was for other causes of respiratory failure (38%). However, 2 recent studies16,17 conducted in France reported a remarkably low mortality rate of 25% to 34% for respiratory failure and a mortality rate of only 22% to 25% when PCP was the cause of the respiratory failure. The reasons for the different outcomes in our study compared with those in the studies in France are not clear, but in one study,16 ICU mortality, not hos-

### Table 4. Multivariate Analysis of Predictors Associated With Hospital Mortality in 394 Patients With Human Immunodeficiency Virus With 443 Admissions to the Intensive Care Unit (ICU)

<table>
<thead>
<tr>
<th>Predictor</th>
<th>Survivors (n = 281)</th>
<th>Nonsurvivors (n = 162)</th>
<th>Odds Ratio (95% Confidence Interval)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mechanical ventilation*</td>
<td>121</td>
<td>124</td>
<td>4.3 (2.5-7.5)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Pneumocystis carinii pneumonia at ICU admission</td>
<td>160</td>
<td>36</td>
<td>2.4 (1.3-4.5)</td>
<td>.009</td>
</tr>
<tr>
<td>Albumin level, g/L, mean†</td>
<td>26.6</td>
<td>22.5</td>
<td>0.39 (0.26-0.59) per 10 g/L increase</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Acute Physiology Score, mean‡</td>
<td>9.8</td>
<td>13.9</td>
<td>1.08 (1.03-1.13) per point increase</td>
<td>.002</td>
</tr>
</tbody>
</table>

*Data available for 441 admissions.
†Data available for 370 admissions.
‡Data available for 435 admissions.
§Data available for 418 admissions.

### Table 5. Multivariate Analysis of Predictors Associated With Long-term Mortality in 281 Hospital Survivors With Human Immunodeficiency Virus Admitted to the Intensive Care Unit*  

<table>
<thead>
<tr>
<th>Predictor</th>
<th>Median Length of Survival After Hospitalization, mo</th>
<th>Risk Ratio (95% Confidence Interval)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>All hospital survivors</td>
<td>9.9</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Albumin level, g/L†</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;25 (n = 196)</td>
<td>8.6</td>
<td>0.79 (0.66-0.94) per 10 g/L increase</td>
<td>.008</td>
</tr>
<tr>
<td>≥25 (n = 174)</td>
<td>9.8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CD4+ cell count, cells/μL‡</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;50 (n = 209)</td>
<td>4.2</td>
<td>0.97 (0.96-0.98) per 10 cells/μL increase</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>≥50 (n = 220)</td>
<td>16.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mechanical ventilation§</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes (n = 245)</td>
<td>9</td>
<td>1.37 (1.08-1.74)</td>
<td>.01</td>
</tr>
<tr>
<td>No (n = 196)</td>
<td>11.5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*NA indicates not applicable.
†Data available for 370 admissions.
‡Data available for 429 admissions. The CD4+ cell count is expressed as 0.05 × 10^9/L in Systeme International units with a risk ratio of 0.97 (0.96-0.98) per 0.01 × 10^9/L increase.
§Data available for 441 admissions.

![Figure 2. Overall survival curves for 78 patients with primary diagnosis of Pneumocystis carinii pneumonia (PCP) (solid line) and for those 48 patients with PCP requiring mechanical ventilation (dashed line).](image-url)
hospital mortality, was the relevant end point, so we cannot directly compare our survival rates with their survival rates. In the same study, the mean serum albumin level, a factor we found to be predictive of both short-term and long-term mortality, was higher than it was in our patients (27 g/L vs 25 g/L). In contrast, the CD4+ cell counts in their patient cohort were lower, and the Simplified APS I corresponding to the Acute Physiology and Chronic Health Evaluation II scores of our patients were higher. Our study supports the point that among the vast array of indications for intensive care in patients infected with HIV, respiratory failure remains the most important in that it is the most frequent and among the most fatal.

In our study, among broad indications for intensive care, admissions for sepsis carried the highest mortality rate (52%). Typically, even more than a decade ago, 9% to 14% of ICU admissions of patients with AIDS or HIV were for sepsis,8,22-25 and recent mortality rates were about 50%,14-17. Another indication for intensive care in patients infected with HIV, and one that has become increasingly important, is neurologic disease. In a study24 specifically examining the mortality rates of patients with HIV and neurologic dysfunction requiring intensive care, 32% of patients initially admitted to the ICU were alive at 3 months, compared with 37% of our patients admitted with neurologic dysfunction. The predictors of death in this interval were only those related to the level of neurologic dysfunction at the time of ICU admission. We did not study the quality of life of the ICU survivors in our study, but clearly this factor is an important issue in assessing the overall benefit from any type of medical intervention, especially in patients recovering from neurologic disease. Interestingly, one study8 found that among HIV-infected survivors of the ICU who were alive at the end of the follow-up, the functional status was not significantly different compared with what it was before the ICU admission.

We found that the APS, need for mechanical ventilation, low serum albumin level, and diagnosis of PCP (even if it was not the primary indication for intensive care) were all independent predictors of hospital mortality. In other studies,14-17 predictors of hospital or ICU mortality included a Simplified APS I greater than 10,16 higher APS,16 serum albumin level less than 30 g/L,16 diagnosis of AIDS greater than 1 year prior to ICU admission,16 indication for intensive care,15 and lower percentage of ideal body weight.15 The presence of a lower CD4+ cell count has been found to be a predictor of hospital mortality in some studies,15,17 but not in others.14,16 We did not find that CD4+ cell count or percentage of ideal body weight predicted hospital mortality. Our findings were most similar to another recent study16 that used multivariate analysis to examine independent predictors of outcomes of patients with AIDS receiving intensive care. Although we did not examine the time between diagnosis of AIDS and admission to the ICU as a potential predictor, we found no difference in hospital survival in patients in whom the first diagnosis of HIV infection was made during the ICU stay vs those with known diagnoses of HIV.

Long-term survival among patients with HIV and/or AIDS following an ICU stay is of interest to patients, clinicians, and policy makers alike. Early in the epidemic, one study,7 which included patients admitted to an ICU for a variety of indications, revealed that at 1 year 11% of the hospital survivors were still alive. Two studies conducted in France,16,17 looked at survival for as long as 1 or 2 years. At 1 year, 22% to 28% of patients initially admitted to the ICU were alive. In our study, patients’ 1-year survival rate was similar to that in previous report,16 but our 2-year survival rate was slightly higher. Both French studies were conducted from 1990 to 1992, with follow-up thereafter. To our knowledge, the data in our study describe the largest reported cohort of patients infected with HIV receiving intensive care, include survival up to 4 years, offering an expanded and updated perspective.

In contrast to hospital mortality, we found predictors of long-term mortality to be a lower CD4+ cell count, lower serum albumin level, and intubation during the ICU stay. In other studies,16,17 predictors of long-term survival included higher functional status prior to admission; in one of the studies,17 weight loss, CD4+ cell count, duration of AIDS, indication for ICU admission, and Simplified APS I were also associated with long-term outcome.

Hospital mortality in patients requiring mechanical ventilation for PCP has changed during the years; at our institution, the mortality rate was 87% during 1981-1986,8 a time subsequently called era I with respect to PCP mortality, while in era II (1986-1988) the mortality rate was 60%,9 and in era III (1989-1991), the mortality rate rose to 76%.16 We propose that era III at San Francisco General Hospital has extended into the period covered in this study (1992-1995) because the mortality rate was 81%. It has been postulated,15 and we agree, that the higher mortality rate recently reported for patients with PCP who received mechanical ventilation at San Francisco General Hospital and other institutions may reflect a poorer prognosis among those patients who require mechanical ventilation, despite the use of antibiotics and corticosteroids. Early studies11,12,23 of patients surviving mechanical ventilation during an episode of PCP showed a mean survival after discharge from the ICU of 7 to 10 months. Although one recent study13 reported marked improvement in long-term survival rates following PCP and acute respiratory failure, our outcomes in this subset of patients clearly were not as encouraging.

Given our predictors of hospital and long-term mortality, we analyzed our data to determine if there was a group of patients who had such poor long-term survival that the appropriateness of intensive care might be questioned. Of 121 patients with a CD4+ cell count less than 50 cells/µL (0.05 × 10⁹/L) and a serum albumin level less than 25 g/L who received mechanical ventilation, 47 (39%) survived the hospitalization; of the survivors, the mean and median survival times were 8.9 and 4.9 months, respectively. One third of these survivors were alive 1 year later and 8 (7% of the initial cohort) survived 2.5 years or more. These findings support the notion that, even among patients with multiple risk factors for a poor outcome, a substantial minority survive even prior to the widespread use of highly active antiretroviral therapy.
The primary limitation of applying the results of this study to current practice is that we describe herein outcomes just prior to the widespread use of highly active antiretroviral therapy. Although the follow-up continued to June 1, 1997, and so included a period when these agents were used commonly, only 12% of the 394 patients were alive at this time. Thus, our study probably does not reflect, to a great extent, the effect that highly active antiretroviral therapy has on the survival of patients infected with HIV. Nevertheless, about one third of our patients had not received PCP prophylaxis, and nearly half had not received antiretroviral therapy. Therefore, although the availability of highly active antiretroviral therapy will undoubtedly influence subsequent studies of the use and outcomes of ICU stay, we can expect the need for intensive care to continue, as there will be patients who fail to receive these therapies as a result of personal choice or lack of access to health care. Moreover, data\textsuperscript{6,7,25,28} suggest that even patients who are able to adhere to a complex antiretroviral regimen may ultimately develop progressive HIV disease; this development will sometimes result in clinical deterioration necessitating intensive care. Another limitation of our study is that it was conducted at a single institution. Given the difference in the use of ICUs for patients with HIV,\textsuperscript{27} conclusions from our academic county hospital may be not applicable to other settings. In addition, as a case series, this study does not address the true value of intensive care for all critically ill patients with HIV because it is possible that a significant selection bias existed, that is, patients who were thought not likely to benefit may not have been admitted to the ICU and patients who refused intensive care but may have benefited from it also were excluded.

Our study demonstrates that even those patients with multiple factors that predict poor hospital or long-term outcome have a chance of survival and that even long-term survival is possible. Given the advances in antiretroviral treatment and their widespread use since 1996-1997, we have even more reason to be optimistic about HIV treatment and their widespread use since 1996-1997. We have even more reason to be optimistic about HIV treatment and their widespread use since 1996-1997.

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REFERENCES