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Administrative Data Versus Corrected Administrative Data

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ABSTRACT

The purpose of this research was to provide insight into the use of existing administrative data and to identify changes that could be made to improve broad-based use of administrative data. Data were collected on patients hospitalized with pneumonia at a 715 bed hospital in North Carolina in 1996-1997. Patients were selected from administrative databases via diagnosis and charge codes. Outcome variables were length of stay and total hospital charges. Explanatory variables were age, sex, race, insurance type, season of year, admission source (emergency department or other), comorbidity score, care path designation, physician specialty and teaching appointment.
These data were collected from administrative data and then from a limited chart review to correct the administrative data. We found no significant differences in economic outcomes between the administrative data and the corrected administrative data. Administrative data appear to be a reliable and cost-effective data source for quality assessment.

Health care professionals use administrative data, such as patient demographic information and diagnosis and charge codes, in many ways (1). Administrators use administrative data to obtain reimbursement from insurance companies and to evaluate providers such as physicians and hospitals (2-4). Meanwhile, health care professionals use this data in determining ways to improve quality of care (5-12).

The advantages and disadvantages of using administrative data for the purposes above have been the topic of much discussion, starting back in the early 1980s (13-15). The advantages of using administrative data center around 3 issues. One, administrative data are easy to obtain (16) and much cheaper than collecting primary data by chart review or clinical trials (17). Two, administrative data offer information on large, diverse populations across time (18). And, three, administrative data are not susceptible to the selective recall, nonresponse, or Hawthorne effects of randomized trials (19).

The disadvantages of using administrative data primarily concern the possible bias in collecting administrative data. Administrative data are collected at the institution's expense for reimbursement, not quality assessment purposes. Hence, administrative data may contain at least 4 sources of bias. One, administrative data could contain inaccurate coding (2), in part because these data are usually collected by nonclinicians from discharge summaries. Two, most administrative data cannot distinguish between comorbidities and complications or between chronic and acute illnesses. Three, most administrative data exclude diagnostic criteria and other clinical information such as blood pressure and laboratory results (3, 19).

Many studies have found biases in administrative data as compared with clinical data (4). Administrative data may fail to identify outliers (20) or patients with given illnesses (18), under report chronic diagnoses (19) and comorbidities (21), or underestimate severity (22). These errors, depending on whether they are systematic or random, can result in inaccurate findings (20). Hence, Iezzoni (10) concluded that administrative data should only be used to identify areas for further study.

In contrast, other studies have found that administrative data are statistically as accurate as clinical data. For example, Iezzoni et al (16, 17) found that administrative data predicted in-hospital mortality among acute myocardial infarction patients as accurately as clinical data (23). Whereas, Romano (20) and Pine et al (24) found the same mortality predictions with administrative data as with clinical data. Some health care professionals have tried correcting administrative data with data obtained from limited chart reviews. For example, Hannan et al (21) found no differences between administrative data and corrected administrative data on in-hospital mortality and quality of care. Nor did Hannan et al (3) in a study correcting administrative data with a few key clinical variables obtained from clinical data. Fisher et al (15) concluded that corrected administrative data are sufficient as long as they are stratified on confounding clinical conditions such as demographics, severity, and comorbidity.

In summary, there is no clear consensus on the quality of administrative data, or the advantage of corrected administrative data. To provide insight into the use of existing administrative data and to identify changes that could be made to improve broad-based use of administrative data, we compared the economic outcomes of patients with community-acquired pneumonia using administrative data and corrected administrative data (1). We included controls for demographics and comorbidity. We hypothesized that errors in the administrative data would have, cumulatively, little effect on the results. We expected to find no significant difference in predicted economic outcomes between administrative data and corrected administrative data.

MATERIALS AND METHODS

The study was conducted retrospectively, with patients hospitalized for community-acquired pneumonia between January 1996 and March 1997 at Pitt County Memorial Hospital (PCMH), a 715 bed, primary and tertiary care center for eastern North Carolina (see Estrada et al [25] for a discussion of our methods). The target population was patients with community-acquired pneumonia who required hospitalization but were not critically ill at admission. We approximated the control of a randomized study by controlling for several patient characteristics and by specifying what types of patients should be included and excluded from the study. Below we describe the hospital in greater detail, as well as the patient and provider data collected.

PCMH

PCMH uses multiple applications for financial management, including laboratory data and patient care documentation, among others. Of particular importance is the ability to integrate such information to guide tracking outcomes and assist decision making. This case study is such example. Given the extent that administrative data is being used at PCMH, we thought it imperative to assess the quality of this data and determine if and how errors in administrative data might affect conclusions drawn from outcomes-based research.

If we found errors in the administrative data that biased the conclusions of our outcomes research, we were mandated by PCMH, through its Clinical Information and Support Office (CISO), to design ways to improve the measurement, tracking, and monitoring of clinical and administrative data. If we did not find errors that biased the conclusions of our outcomes research, we were mandated by PCMH, through CISO, to conduct more outcomes research studies using administrative data that would inform clinical policies.

Patient Selection

We identified patients with a discharge diagnosis of bacterial pneumonia by diagnosis codes. We included codes for pneumococcal pneumonia, other bacterial pneumonia, and pneumonia due to other organisms. Appendix A contains the numeric diagnosis codes used for inclusion and exclusion purposes (26).

We excluded patients (see Appendix A) who were not likely to have community-acquired pneumonia, were severely ill, or who had underlying conditions that might affect the epidemiology of pneumonia because these conditions influence treatment options, survival, and resource use. Specifically, we excluded patients who were (a) younger than 18 years, (b) diagnosed with a hip replacement, craniotomy, coronary artery bypass surgery, myocardial infarction, ruptured thoracic aneurysm, multiple fractures, or subarachnoid hemorrhage, (c) transferred from a nursing home or another acute care hospital, (d) initially admitted to an intensive care unit, (e) hospitalized within 7 days before admission for pneumonia (2), or who had (f) acquired pneumonia in the hospital.

Further, we excluded patients with any of the following conditions: pneumonia associated with a pulmonary malignancy, pneumonia associated with the human immunodeficiency virus or the acquired immunodeficiency syndrome, aspiration pneumonia, and pneumonia associated with tuberculosis.

Table 1

Descriptive Statistics

	Administrative Data (n = 380)	Corrected Administrative Data (n = 369)
Patient characteristics		
Age	60.9 ± 19.5	60.1 ± 19.5
Female (yes/no)	50.5%	50.4%
White (yes/no)	55.8%	55.3%
Insurance type		
Medicare	52.1%	52.6%
Medicaid	15.0%	14.6%
Commercial	16.1%	15.7%
Self pay	16.8%	17.1%
Season		
Summer	11.8%	11.9%
Fall	23.4%	24.1%
Winter	46.8%	46.9%
Spring	17.9%	17.1%
Emergency room admission (yes/no)	74.2%	74.5%
Comorbidity index	1.24 ± 1.28	1.22 ± 1.28
Provider characteristics		
Path	21.3%	35.7%
Physician specialty		
Family medicine	26.1%	26.3%
Internal medicine	38.4%	39.0%
Other	35.5%	34.7%
Academic physician (yes/no)	47.4%	48.5%
Economic outcomes		
Length of stay (d)	6.3 ± 5.3	6.35 ± 5.25
Total charges ($)	6956 ± 5394	6940 ± 5341

Data Collection

Data included patient characteristics, provider characteristics, and economic outcomes (see Table 1). The patient and provider characteristics served as covariates. Patient characteristics included age, sex, race, insurance type, season of the year, source of admission (emergency department or other), and comorbidities (5). Provider characteristics included care path designation, physician specialty, and teaching appointment. The economic outcomes were length of stay and hospitalization charge.

Comorbidities were measured in 2 ways. With the corrected administrative data, we computed a Charlson comorbidity index (27). The index sums weights for each chronic comorbid condition suffered by the patient (see Appendix B) as identified in current and prior hospital admissions (28). It has been shown to predict the risk of death within 1 year of medical hospitalization (29). With the administrative data, we followed Deyo et al's model (30) for computing the Charlson comorbidity index using diagnosis codes. Severity of illness is not included in this analysis because there was no complement in the hospital's administrative database for comparison (3).

Table 2

Care Path Designations

Administrative Data	Corrected Administrative Data		
	Yes	No	Total
Yes	74	7	81
No	23	265	299
Total	97	272	380

We collected the data in Table 1 from administrative databases and then corrected it with a limited chart review. Trained abstractors performed chart reviews. All chart review data were inspected for inconsistent or unusual values; if found, the chart was examined again. In addition, 10% of the reviewed charts were randomly selected for a second or third review by the study investigators. This design resulted in 2 datasets: administrative data and corrected administrative data.

Statistical Analysis

We used linear regression to estimate the influence of patient and provider characteristics on economic outcomes. We ran the analysis first on the administrative data and then on the corrected administrative data. We used a *t* test to compare the coefficients across samples (31). We performed all hypotheses tests at alpha = 0.05.

We used standard multivariate techniques to explore assumption violations and interactions. We found no violations. Total charges and length of stay were logged due to skewed distributions. All ordinal and nominal variables were transformed into dummy variables. The reference categories were: spring for the season variables, internal medicine for physician specialty, and commercial insurance for financial class. Outliers were identified using the Medicare definition for pneumonia of patients with a length of stay greater than 40 days and removed from the data sets.

RESULTS

There were 6155 patients during the study period with diagnosis codes for community-acquired pneumonia. After applying exclusion criteria, the administrative data contained 380 patients, and the corrected administrative data had 369 patients.

The samples differed by a total of 11 cases, and several cases had different values for the same variable in the 2 samples. These differences were due to incorrect coding in the administrative data on inclusion and exclusion criteria and on differences in variable values. The administrative data failed to list some patients as having been transferred from another hospital or nursing home. Some patients were coded as having primary pneumonia when actually their pneumonia was secondary compared with more serious illnesses such as stroke or congestive heart failure. In a few cases, the secondary codes omitted serious illnesses such as cancer. Other patients were coded as having primary pneumonia when actually they had no pneumonia.

The most common error was inaccurate care path designations in the administrative data. As shown in Table 2, in the corrected administrative data there were 16 additional care path patients and 27 fewer noncare path patients than in the administrative data. We investigated the cause of the errors. A nurse informing a unit secretary to key in or "flag" a patient initiated the care path variable in the administrative data. Often patients were never flagged or were flagged and then removed from the care path.

Statistical Tests

For the most part, the administrative and corrected administrative data had similar descriptive statistics (see Table 1) and regression coefficients (see Table 3).

The models explained similar percentages (13-15%) of the variation in the economic outcomes for both samples. As shown in Table 3, age, insurance, and comorbidities consistently explained length of stay and total charges. Looking across the administrative and corrective administrative samples, for every 1O-year increase in age, patients incurred 6-7% higher bills and stayed 8-9% longer in the hospital. Medicaid patients incurred 32-33% higher bills and stayed 38% longer in the hospital. In addition, for every I-unit increase in comorbidity, patients incurred 14-15% higher bills and stayed 10-11% longer in the hospital.

In less consistent patterns, patients admitted through the emergency room incurred 18-21% higher bills than patients with regular admissions. And, patients treated by academic affiliated physicians left the hospital 23-26% quicker than patients treated by nonacademic physicians.

DISCUSSION

In this study, we compared the economic outcomes of hospitalized patients with community-acquired pneumonia using administrative data and corrected administrative data. As expected, we found similar economic outcomes with a sample of administrative data as with a sample of corrected administrative data. Our findings mirror those of previous reports support ing the quality of administrative data. Inaccurate diagnosis and charge codes occurred infrequently.
The main problem found with the administrative data was classification errors with whether or not patients were on a care path. This information was usually entered by a clerical person. These errors could be corrected by entering this information at the time care is delivered. Standardized coding guided by specific algorithms is another way to improve entry.

Table 3

Ordinary Least Squares Regression Coefficients, Standard Errors, and Difference Tests (Coefficient/Standard Error)

	Administrative Data (n = 380)		Corrected Administrative Data (n = 369)	
	Logged	Logged	Logged	Logged
Age	.006*/.003	.008**/.003	.007**/.002	.009**/.002
Female	.008/.07	.09/.08	.02/.07	.11/.07
White	−.06/.07	−.04/.08	−.08/.07	−.08/.07
Insurance type[a]				
Medicaid	.33*/.13	.38**/.14	.32*/.13	.38**/.13
Medicare	.05/.12	.09/.13	.01/.12	.04/.12
Self	−.08/.12	−.04/.13	−.04/.12	−.001/.12
Season of[b]				
Summer	−.06/.13	−.02/.14	−.05/.13	−.06/.13
Fall	−.07/.11	−.11/.12	−.10/.11	−.15/.11
Winter	−.17/.10	−.13/.10	−.11/.10	−.08/.10
Emergency Department admit	.21*/.08	.10/.09	.18*/.08	.07/.08
Comorbidity	.14***/.03	.10**/.03	.15***/.03	.11***/.03
Path	−.07/.09	.02/.09	−.09/.08	−.009/.08
Physician[c]				
Family	−.13/.09	−.15/.10	−.06/.09	−.08/.09
Other	.07/.08	−.03/.09	.12/.08	.03/.08
Academic physician	.01/.08	−.26**/.08	.02/.08	−.23**/.08
Constant	8.06***	1.04***	7.93***	.99***
Adjusted R^2	.13***	.13***	.14***	.15***

[a] Commercial.
[b] Spring.
[c] Internal medicine.
* = $P < .05$.
** = $P < .01$.
*** = $P < .001$.

Having found that using administrative data resulted in no bias in study findings, we recommended that the hospital initiate additional outcomes studies using administrative data, such as studies on how length of stay influences the functional status of cardiac and rehabilitation patients, how pain management influences clinical outcomes, and how case management of diabetes patients influences the use of and need for insulin. We have also applied the knowledge gained during this process in other areas: analyses of outcomes in patients undergoing cardiovascular surgery, understanding of data integrity, and most importantly, the specific steps necessary to link seemingly different data sources. Because regulatory agencies require more performance indicators, understanding the current capacity, potential, and limitations of current information systems is of importance.

Conducting outcomes research studies using administrative data would reduce human and financial resources for hospitals because full-scale chart reviews would not be necessary to collect the necessary data.

Hospitals and other providers could improve the value of administrative databases in conducting outcomes research, and possibly eliminate the need for limited chart reviews, by collecting severity and comorbidity indices and increasing the number of diagnostic codes coded.

Administrative data should likely not be used to study patient populations with many preexisting conditions because other studies suggest that these populations may not be accurately coded in administrative data, due, in part, to variation in the number of diagnostic codes maintained in financial databases from state to state (20). California allows up to 25 diagnoses and comorbidities, New York allows 5, and North Carolina, where this study was done, allows 15. The varying number of diagnoses and procedure codes can produce different findings. For example, in a national study Fisher (12) found that corrected administrative data contained little error, as did Romano et al (20) in a multi site study, and Pine et al (24) in Ohio. Whereas, Hannan et al (21) found administrative data to be biased in New York, as did Iezzoni et al (23) in a national and a California study (32).

Previous research also identifies other potential limitations of using administrative data in outcomes research. Errors in administrative data may vary across patient severity (3) or diagnosis (15, 18, 24). Iezzoni et al (32) found a bias against coding comorbidities in patients who died. Similarly, Jollis et al (19) found that Medicare populations, representing 50% of our sample, had lower error rates because more illnesses were coded to obtain higher reimbursement. Administrative data were found to underestimate myocardial infarction, congestive heart failure, and ischemic heart disease but accurately report major comorbidities such as diabetes (18, 19). Contrastingly, Fisher et al (15) found that administrative data accurately represent hip fractures, acute myocardial infarction, cancer, and most surgeries but not other conditions.

Finally, other studies assessing the quality of administrative data may draw different conclusions from ours based on their dependent variables, sampling techniques, and sample sizes. The amount of error in administrative data may vary across dependent variables such as coding accuracy (2, 15, 18, 19), clinical outcomes (20, 22, 32), or economic outcomes. We used economic outcomes exclusively. We were not able to compare clinical outcomes, such as mortality and morbidity measures, due to a lack of variation in the data on these items. Results from studies with samples drawn using clinical information may differ from studies with samples drawn from administrative data, which may omit some cases (18, 20). Previous research indicates that biases in conclusions drawn from studies using administrative data may be more prominent with small samples where there is less opportunity for errors in administrative data to cancel each other out (24).

In conclusion, there are varying degrees of errors in administrative data that may be tolerable, depending on the topic and purpose of the analysis. We found errors in administrative data, some which appeared random and others nonrandom. These errors caused no statistical consequences. We conclude that administrative data are a reliable and cost-effective data source for quality assessment. Our study provides insight into the use of existing administrative data and identifies changes that could be made to improve broad-based use of administrative data. We emphasize the need for monitoring data input processes and paying close attention to the accuracy of data collection and data analyses. We recommend that health care providers, particularly hospitals, continue the journey toward developing a central database. Such a database would include multiple fields for multiple uses at the point of care, as well as for financial and outcomes research purposes. A central database requires institutional commitment based on a strategic plan with buy-in from the top down, not the bottom up. Our institution is taking steps in this direction and is conducting limited chart review studies on additional patient populations.

References

1. Gornick M, Lubitz J, Riley G. US initiatives and approaches for outcomes and effectiveness research. *Health Policy. 1991;17:209-* 225.

2. Hsia DC, Krushat WM, Fagan AB, et al. Accuracy of diagnostic coding for Medicare patients under the prospective-payment system. *N Engl J Med. 1988;318:352-355.*

3. Hannan EL, Racz MJ, Jollis JG, et al. Using Medicare claims data to assess provider quality for CABG surgery: does it work well enough? *Health Serv Res. 1997;31:659-678.*

4. Iezzoni LI, Ash AS, Shwartz M, et al. Judging hospitals by severity-adjusted mortality rates: the influence ofthe severity-adjustment method. *Am J Public Health. 1996;86:1379-1387.*

5. Lave JR, Fine MJ, Sankey SS, et al. Hospitalized pneumonia. Outcomes, treatment patterns, and costs in urban and rural areas. *J Gen Intern Med. 1996;11:415-421.*

6. Gleason PP, Kapoor WN, Stone RA, et al. Medical outcomes and anti-microbial costs with the use of the American Thoracic Society guidelines for outpatients with community-acquired pneumonia. *JAMA. 1997;278:32-39.*

7. Fine MJ, Hough LJ, Medsger AR, et al. The hospital admission decision for patients with community-acquired pneumonia. Results from the Pneumonia Patient Outcomes Research Team Cohort Study. *Arch Intern Med.* 1997a;157:36-44.

8. Fine MJ, Medsger AR, Stone RA, et al. The hospital discharge decision for patients with community-acquired pneumonia. Results from the Pneumonia Patient Outcomes Research Team Cohort Study. *Arch Intern Med.* 1997b;157:47-56.

9. Fine MJ, Singer DE, Phelps AL, et al. Differences in length of hospital stay in patients with community-acquired pneumonia: a prospective four-hospital study. *Med Care. 1993;31:371-380.*

10. Iezzoni LI. Assessing quality using administrative data. *Ann Intern Med. 1997;127:666-674.*

11. Whittle J, Steinberg EP, Anderson GF, et al. Use of Medicare claims data to evaluate the outcomes of elderly patients undergoing lung resection for lung cancer. *Chest. 1991;100:729-734.*

12. Fisher ES. Helping patients choose treatments: an important role for administrative health care databases. *Chest. 1991;100:* 595-596.

13. Demlo LK, Campbell PM. Improving hospital discharge data: lessons from the National Hospital Discharge Survey. *Med Care.* 1981;19:1030-1040.

14. Lloyd SS, Rissing JP. Physician and coding errors in patient records. *JAMA. 1985;254:1330-1336.*

15. Fisher ES, Whaley FS, Krushat WM, et al. The accuracy of Medicare's hospital claims data: progress has been made, but problems remain. *Am J Public Health. 1992;82:243-248.*

16. Iezzoni LI, Ash AS, Shwartz M, et a1. Differences in procedure use, in-hospital mortality, and illness severity by gender for acute myocardial infarction patients: are answers affected by data source and severity measure? *Med Care. 1997;35:158-171.*

17. Iezzoni LI, Ash AS, Shwartz M, et a1. Predicting who dies depends on how severity is measured: implications for evaluating patient outcomes. *Ann Intern Med. 1995;123:763-770.*

18. Lohr KN. Use of insurance claims data in measuring quality of care. *Int J Technol Assess Health Care. 1990;6:263.*

19. Jollis JG, Ancukiewicz M, DeLong ER, et al. Discordance of databases designed for claims payment versus clinical information systems. *Ann Intern Med. 1993;119:844-850.*

20. Romano PS, Roos LL, Luft HS, et al. A comparison of administrative versus clinical data: coronary artery bypass surgery as an example. *J Clin Epidemiol. 1994;47:249-260.*

21. Hannan EL, Kilburn H Jr, Lindsey ML, et a1. Clinical versus administrative data bases for CABG surgery. *Med Care. 1992;30:* 892-907.

22. Shwartz M, Iezzoni LI, Moskowitz MA, et a1. The importance of comorbidities in explaining differences inpatient costs. *Med Care. 1996;34:767-782.*

23. Iezzoni LI, Ash AS, Shwartz M, et al. Predicting in-hospital deaths from coronary artery bypass graft surgery: do different severity measures give different predictions. *Med Care. 1998;36:* 28-39.

24. Pine M, Norusis M, Jones B. Predictions of hospital mortality rates: a comparison of data sources. *Ann Intern Med. 1997;126:* 347-354.

25. Estrada CA, Uterborn IN, Price J, et al. Judging the effectiveness of clinical pathways for pneumonia: the role of risk adjustment. *EffClin Pract. 2000;4:221-228.*

26. Albaum MN, Hill LC, Murphy M, et a1. Interobserver reliability of the chest radiograph in community-acquired pneumonia. *Chest. 1996;110:343-350.*

27. Charlson ME, Pompei P, Ales KL, et a1. A new method of classifying prognostic comorbidity in longitudinal studies: development and validation. *J Chronic Dis. 1987;40:373-383.*

28. Roos LL, Stranc L, James RC, et al. Complications, comorbidities, and mortality: improving classification and prediction. *Health Serv Res. 1997;32(2):229-238.*

29. Coleman DA. Pneumonia: where nursing care really counts (continuing education credit). *RN. 1986;49:22-29.*

30. Deyo RA, Cherkin DC, Ciol MA. Adapting a clinical comorbidity index for use with ICD-9-CM administrative databases. *J Clin Epidemiol. 1992;45:613-619.*

31. Steel RGD, Torrie JH. *Principles and Procedures of Statistics: A Biometrical Approach.* 2nd ed. New York: McGraw-Hill; 1980.

32. Iezzoni LI, Foley SM, Daley J, et al. Comorbidities, complications, and coding bias. *JAMA. 1992;267:2197-2203.*

Appendix A

Inclusion and Exclusion DRG and ICD9 Codes[a]

Criteria	Description
Inclusion	
DRGs	
89	Simple pneumonia and pleurisy with complications
90	Simple pneumonia and pleurisy without complications
ICD9s	
481	Pneumococcal pneumonia
482.0, 482.1, 482.2, 482.30, 482.31, 482.32, 482.39, 482.4, 482.81, 482.82, 482.83, 482.89, 482.9	Other bacterial pneumonia
483.0, 483.1, 483.8, 485, 486	Pneumonia due to other organisms
Exclusion	
ICD9s	
162.00–162.09, 162.20–162.59, 162.80–163.19, 163.80–163.99, 197.00–197.39	Pulmonary malignancy
42.00–42.99, 43.30–43.39, 44.90–44.99, 79.50–79.59, 795.71, 795.8, V01.7, V08	Human immunodeficiency virus or acquired immunodeficiency syndrome
10.10–10.19, 12.00–12.99, 11.00–11.99	Tuberculosis
507.0	Aspiration or pneumonitis
480.##	Viral pneumonia
480.0	Adenovirus
480.1	Respiratory syncytial virus
480.2	Parainfluenza virus
480.8	Pneumonia due to other virus
480.9	Viral pneumonia, unspecified
487.0	Influenza pneumonia

[a] DRG indicates Diagnosis-Related Groups; ICD, International Classification of Diseases.

Appendix B

Charlson Comorbidity Index[a]

Weight	Condition	Observations
1	Cerebrovascular disease	History of CVA or transient ischemic attack
	Congestive heart failure	—
	Connective tissue disease	Polymyositis, lupus, rheumatoid, other
	Dementia	Chronic cognitive deficit
	Diabetes	And no end organ damage
	Liver disease, mild	Chronic hepatitis, cirrhosis
	Myocardial infarct, current	—
	Peptic ulcer disease	Current or history of bleeding from it
	Peripheral vascular disease	Intermediate claudification, bypass, gangrene, arterial unsafe, aneurysm >6 cm
2	Pulmonary disease, chronic	Dyspnea, asthma, oxygen use, hypercapnia, $po_2 < 50$, pneumonia, PE, COPD, pH
	Diabetes	With eyes, kidney, nerve compromise
	Hemiplegia	Regardless of cause
	Lymphoma	Hodgkin, multiple myeloma
	Leukemia	Any
	Renal disease, moderate/severe	Dialysis, transplant, uremia, creatinine > 3
	Tumor, any	<5 y, no metastasis
3	Liver disease, moderate/severe	Cirrhosis with varices, or bleed
6	Metastatic solid tumor	Breast, lung, colon, other
	Acquired immune deficiency syndrome	Or acquired immune deficiency syndrome–related complex

[a] CVA indicates cerebrovascular accident; po_2, pressure of oxygen; PE, pulmonary embolism; COPD, chronic obstructive pulmonary disease.