CareScience
Mortality Risk Model

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I. Significance

Mortality is arguably the most commonly employed outcome measure in quality of care studies. Easily measured by simply counting deaths from discharges, inpatient mortality presents a seemingly unambiguous yardstick for judging quality. As an outcome measure, its clinical significance and relevance are unequivocal. It is the archetypical "sentinel event," signaling ultimate failure in care. For hospital staff and leadership, it forms the basis of Mortality and Morbidity Reviews, and for the public and media, it is a focus of quality assessment. In addition to its clinical relevance, mortality is easily explained and understood, a valuable attribute in performance improvement discussions and public reporting.

II. Challenges

Despite the aforementioned advantages, mortality presents challenges as an outcome measure. The approach of counting deaths from discharges can inadvertently mask "true" mortality rates, which may be disguised by discharge policies. More specifically, inpatient mortality rates may be reduced by transferring the most severely afflicted patients to other acute care facilities, skilled nursing homes, or hospice facilities. Mortality rates are also prone to wide variation across diseases, rendering them irrelevant for certain populations for quality analysis. In populations where death is very rare (e.g. kidney and ureter calculus) or largely expected (e.g. admitted with DNR), mortality becomes a less meaningful quality measure.

III. CareScience Mortality Risk Model

3.1 Defining the Mortality Population

Mortality rates can be defined for a range of periods (e.g. inpatient stay, N days post hospital admission, etc), however, the CareScience Mortality Risk Model restricts its purview to inpatient mortality to isolate in-hospital care effects.

3.2 Risk Model Specification

The purpose of the CareScience Mortality Risk Model is to generate the expected or "standard" mortality rate ("risk" rate) under typical care, given the patient's health status and relevant characteristics. Patient-level mortality risk is assessed via a stratified multiple regression model with the following functional form:

$$y_{ijk} = x_{ijk}\beta_k + \varepsilon_{ijk}, \forall ijk$$

where y_{ijk} is the mortality risk rate at patient level i, provider j, and principal diagnosis k. x_{ijk} is a vector of patient characteristics and socioeconomic factors. β_k is the marginal effect of the independent variables on the mortality outcome measure, and ε_{ijk} is the random error component of the model. The strata (k) are roughly based on 3-digit level ICD-9-CM diagnosis codes. Rare and insignificant diagnoses are rolled up into broad diagnosis groups, which are defined in the ICD-9-CM book. A total of 142 disease strata are analyzed.

3.3 Independent Variables

The following patient characteristics and socioeconomic factors comprise the set of regressors (i.e. classes of independent variables) used in the CareScience Mortality Risk Model.

1. **Age** *(quadratic form)*
2. **Birth weight** (*quadratic form, for neonatal model only*)
3. **Sex** *(female, male, unknown)*
4. **Race** *(white, black, asian-pacific islander, unknown)*
5. **Income** *(median household income within a zip code reported by US Census Bureau)*
6. **Distance traveled** *(the centroid-to-centroid distance between the zip code of the household and the zip code of the hospital or provider, represented as a relative term)*
7. **Principal diagnosis** *(terminal or three digit ICD-9-CM code, where statistically significant)*
8. **CACR**[1] **comorbidity scores** *(count of comorbidities within each of five severity categories on the CACR Likert scale)*
9. **Defining diagnosis** *(three digit ICD9-CM code for neonatal model only)*
10. **Cancer status** *(benign, malignant, carcinoma in situ, history of cancer, derived from secondary diagnoses)*
11. **Chronic disease and disease history** *(terminal digit ICD9-CM diagnosis codes, such as diabetes, renal failure, hypertension, chronic GI, chronic CP, obesity, and history of substance abuse)*
12. **Valid procedure** *(terminal ICD9-CM procedure codes, where clinically relevant and statistically significant)*
13. **Admission source** *(Physician Referral, Clinic Referral, HMO Referral, Transfer from a Hospital, Skilled Nursing Facility or Another Health Care Facility, Emergency Room, Court/Law Enforcement, Newborn - Normal Delivery, Premature Delivery, Sick Baby, or Extramural Birth, Unknown/Other)*
14. **Admission type** *(Emergency, Urgent, Elective, Newborn, Delivery, Unknown/Other)*
15. **Payor class** *(Self-pay, Medicaid, Medicare, BC/BS, Commercial, HMO, Workman's Compensation, CHAMPUS/FEHP/Other Federal Government, Unknown/Other)*
16. **Facility type** *(Acute, long-term, Psych.)*

Risk factors used in the CareScience risk assessment model are tailored to specific patient subpopulations and outcomes. Use of the following risk factors may vary depending on the specific subpopulation and outcome evaluated:

- diagnosis detail
- significant comorbidities
- defining procedures
- birth weight (used instead of age for neonates)

[1] Comorbidity Adjusted Complication Risk – Brailer DJ, Kroch E, Pauly MV, Huang J. Comorbidity-Adjusted Complication Risk: A New Outcome Quality Measure, Medical Care 1996; 34:490-505.

3.3.1 CACR Comorbidity Scores

CACR comorbidity scores are derived from principal and secondary diagnosis codes. Secondary diagnoses are first categorized according to a five point Likert scale of increasing severity (A-E) where E is most severe.[2] Comorbidities are calculated for each severity level as

$$N_{is} = \sum_{p_{ij} \in S} (1 - p_{ij}), \; S = A, B, ..., E$$

where N_{is} is the expected number of comorbidities of severity s for a patient with principal diagnosis i, p_{ij} is the CACI probability of complication for the *j*th secondary diagnosis given principal diagnosis *i*, and S is one of the severity levels, A-E.

Common chronic diseases enter the model as dummy variables separate from comorbidities. Both comorbidities and chronic diseases are constrained to be non-negative coefficients in the model calibration.

3.3.2 Valid Procedures

Strictly speaking, a procedure is not a patient characteristic but rather a provider care choice. For example, two physicians may opt to pursue two different yet equally effective courses of treatment for the same patient. Although procedures represent the discretion of the care provider, they can signal important information about the patient's overall health status. Certain procedures can serve as effective proxies for lab reports and treatment history that are not available in the current database, as well as for other unobservable critical factors. To be included in the model, procedures must be designated as "valid" for the patient's particular disease stratum. Additionally, the timing of certain procedures relative to the patient's hospital admission must be considered. Valid procedures are grouped into one of two categories based on timing criteria.

Each disease stratum has a unique set of valid procedures. If a procedure falls into Category 1, timing of the procedure is not considered, and the analytic program simply searches for the procedure's corresponding coefficient. (Procedures failing to be statistically significant are not included in the model and have no impact on the risk score.[3])

If a procedure is mapped to Category 2, inclusion of the procedure in the model depends on the procedure's timing during the inpatient stay. If the procedure occurs within a critical time period from the patient's hospital admission, the procedure is included in the model. If not, the procedure is excluded. The critical time windows for Category 2 procedures are assigned by internal panels of clinicians.

For several disease strata, the risk model does not incorporate valid procedures. These groups include DRGs 103, 480, 481, 495, 512, and 513.

[2] Severity ratings are assigned by an internal panel of clinicians.
[3] See Sections 4.4 and 4.5 on Model Selection.

3.3.3 Missing Independent Variables

As with most large databases, some records may lack one or more independent variables. Dismissing these records completely from the analysis may eliminate important patient information and in turn shrink the base sample size. This is particularly true for public data sets where missing data elements are more common. Recognizing that independent variables have varying impacts on risk scores, the risk model is designed to tolerate missing values to some extent.

Zero Tolerance

Principal Diagnosis, Age, and Birthweight (for neonates) are mandatory elements in the risk assessment model. Patient records missing any of these required elements are excluded from the model.

Conditioned Tolerance

For most categorical variables, such as Admission Source, there is an 'Unknown' category designated for unrecognizable or missing values. Among the categories, 'Unknown' statistically has the greatest probability of having the highest counts, since missing data are due to random errors. In risk modeling, the largest and most common category is often used as the reference group. Assigning the 'Unknown' category as the reference group is thus justifiable, however, a high proportion of 'Unknown' values risks diluting the real characteristics of the reference group.

Due to tight quality control, 'Unknown' values are very rare in private client data. In public data, however, the missing portion ranges from a couple of percent to around ten percent. It is therefore necessary to check the distribution of the data before calibration. In general, the 'Unknown' values should not represent more than one third of the entire sample in order to be used as the reference group.

Value Proxy

Income and Relative Distance are derived from zip code information. In the case of Income, the patient's residence zip code is used. For Relative Distance, both the patient's residence zip code and the hospital zip code are employed. If the patient's zip code is missing, the average Distance and Income of all patients in that hospital will be applied. In cases where both patient and hospital zip codes are unavailable, the Relative Distance is set to 1, and the national average income is applied.

3.4 Population Exemptions

Due to hospital discharge policies that can mask "true" mortality rates and measurement considerations, select patients are excluded from the CareScience Mortality Risk Model and do not receive mortality risk scores.

3.4.1 Discharged to Acute Care Facility

At the patient level, mortality is captured by the discharge disposition field in the administrative patient record. Patients expiring in hospital can be identified by discharge disposition codes of '20.'

Patients who are transferred to an acute care facility receive discharge disposition codes of '02.' These patients have an indeterminate mortality value and are consequently excluded from mortality analyses. The mortality risk for these patients is accordingly set to 'null.'

3.4.2 Insufficient Mortality for Measurement

Hospital-level mortality rates hover around 2 to 3 percent, however, wide variation exists across the model's 142 disease strata. Some of the strata have very low mortality rates, indicating that mortality may not be an appropriate performance measure for all disease strata. For example, among *intervertebral disc disorder* patients (ICD-9 722), mortality rates are less than 0.1%. Death is so rare that mortality is difficult to model for these types of disease strata. As a result, these disease groups are omitted from mortality analyses rather than forced into a poor model.

3.5 Out of Range Predictions

The CareScience mortality model is based on linear regression, and consequently the predicted mortality risks may fall out of the range between zero and one at the patient level. Out-of-range risks are acceptable unless they exceed the "reasonable range" of -0.5 <= and <= 1.5 at which point they are considered invalid. If negative risks occur in aggregate reporting, they are rounded to zero.[4]

IV. Data Source and Model Calibration

CareScience employs three main data sources: MedPAR, All-Payor State data, and private client data. All three datasets are calibrated separately.

4.1 MedPAR Data

MedPAR consists of approximately 12 million inpatient visits that are covered by Medicare each year. These fiscal year data are generally consistent and updated annually with roughly a one-year lag time. (e.g. Fiscal year 2004 data were available at the end of 2005.) MedPAR covers all U.S. states and territories and is publicly available. Unsurprisingly, many research projects and publications are based on MedPAR. MedPAR covers around one-third of all hospital inpatients, almost all of which are 65 and older. Consequently, some specialties such as Pediatrics and Obstetrics are practically absent.

[4] Theoretically, it is possible to have mortality risks greater than 1 in aggregate reporting. In reality, however, these events never happen, since mortality is a relatively rare occurrence. (Aggregate mortality risks of ~0.80 are already considered unusually high.)

4.2 All-Payor State Data

All-Payor State data include all inpatients regardless of payor type or other restrictions, thus providing an advantage over MedPAR. Additionally, All-Payor State data contain a larger volume: roughly 20 million records from around 2700 hospitals. Despite these advantages, the data set has limitations. The most noticeable of these is that the data are less geographically representative. All-Payor State data come from fewer than 20 states located mostly on the coasts. In addition to this handicap, the data set lacks a continuum of data for each of the states, since changing regulatory laws often affect the availability of states' data from year to year. This lack of continuous data can severely limit the feasibility of longitudinal studies. Additionally, because State data is released by individual states with their own data specifications, the data are often inconsistent across states. As a result, All-Payor State data require significant internal resources to validate and improve its quality. The two-year lag time in release prevents All-Payor State data from being chosen as the model's calibration database, because the standards of hospital care are in constant flux (reflected in part by new codes appearing every year to reflect changes in diagnosis, procedure, DRG, etc). Despite the aforementioned limitations, All-Payor State data remains a good choice for hospital ranking because of its volume and completeness of disease segments. It also serves as a reference data set for CareScience's private data.

4.3 Private Client Data

In addition to the public data sets, CareScience collects private data from clients. Client data are submitted in compliance with CareScience's Master Data Specifications (MDS), ensuring its consistency and quality. The data are updated frequently with three to six months lag and offer much richer content that allows exploration of new model specifications. Annually, the combined Premier-CareScience data base consists of about 8 million records from over 600 hospitals dispersed across the United States. Because the client base is continually changing, the number of hospitals and records may fluctuate each year. The quality and richness of the client data make it an ideal calibration database despite its smaller size than the two public data sets.

4.4 Model Selection for Private Client Data

To avoid overfitting, CareScience's model calibration employs Stepwise Selection for private client data with critical significance set at 0.10. Variables are added to the model one at a time with the computational program selecting the variable whose F statistic is the largest and also meets the specified critical significance. After a variable is added, the stepwise method inspects all variables in the model and deletes any whose F statistic fails to meet the specified significance threshold. Once the check is made and the necessary deletions accomplished, another variable is added to the model. This process effectively reduces the possibility of multicollinearity caused by highly correlated independent variables. The stepwise process ends when the F statistics for every variable outside the model fail to meet the significance threshold while the F statistics for every variable within the model satisfy the significance criterion.

Due to the selection criteria, the number of selected independent variables ranges from several to dozens, depending on the disease. The R-Square of the model may be smaller than that of a full model without restriction but are far more robust than an overfitted full model. For out-of-sample predictions, robust parameter estimates generate more reliable risk scores.

Chronic conditions and comorbidities are restricted to positive-only parameter estimates due to their clinical attributes.

4.5 Model Selection for Public Data

Public data sets are always calibrated on themselves. Because their parameter estimates are not used for out-of-sample predictions, a full model is preferred as it provides a higher R-Square.

V. Performance Assessment

Provider performance can be assessed for virtually any patient grouping (e.g. hospital-level, physician-level, principal diagnosis, DRG, procedure, etc.) through aggregation and comparison of the model's raw and risk complication rates. Positive deviations, as calculated below, indicate worse than expected (average) performance while negative deviations indicate better than expected (average) performance.

$$\text{Mortality Deviation}_i = \frac{1}{n}\left(\sum_{i=1}^{n}\text{Raw Rate}_i - \sum_{i=1}^{n}\text{Risk Rate}_i\right),\ i = 1,2,...,n$$

where n is the number of patients in the ith patient group.

Statistical significance tests can be used to determine whether complication deviations indicate reliable areas for opportunity. CareScience performance reports flag deviations significant at 75% and 95% confidence levels.

Figure 5: Computing Mortality Risk Rates and Deviations Example

Principal Diagnosis: Septicemia (038)
Sample Patient Characteristics

	Dependent Variable	**Independent Variables**							
Patient	*Raw Mortality Survived=0 Expired=1*	*Age*	*Age^2*	*Gender Male=0 Female=1*	*Income*	*Comorbidities Severity D*	*Comorbidities Severity E*	*Procedure 96.72 Cont. Mech. Ventilation >96hrs*	…
1	0	42	1764	1	$40,000	2	1	0	…
2	0	55	3025	1	$55,000	1	2	0	…
3	0	63	3969	0	$39,000	4	3	1	…
4	1	66	4356	0	$25,000	3	3	1	…

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Principal Diagnosis: Septicemia (038)

Independent Variable	Coefficient (Parameter Estimate)
Age	-0.0022
Age^2	0.000043
Gender	0.0123
Income	-0.00000046
Comorbidities Severity D	0.0694
Comorbidities Severity E	0.1896
Cont. Mech. Ventilation >96 Hrs	0.0939
…	…

Patient-Level Risk:

Mortality Risk = $b_0 + b_1(age) + b_2(age^2) + b_3(gender) + b_4(income) + \ldots$

$= 0.0186 - 0.0022(age) + 0.000043(age^2) + 0.0123(gender) - 0.00000046(income) + \ldots$

$= 0.0186 - 0.0022(42) + 0.000043(1764) + 0.0123(1) - 0.00000046(40{,}000) + \ldots = 0.1882$

- **Patient 1 has an 18.8% chance of expiring during her inpatient stay.**

Provider-Level Risk:

Patient	Raw Mortality *(0 = Survived, 1 = Expired)*	Mortality Risk Rate (%)
1	0	19
2	0	12
3	0	24
4	1	20
5	0	17
6	1	39
SUM	**2**	**131**

Raw Rate = 2/6 = 33%

Risk Rate = 131%/6 = 22%

- **Mortality Deviation = 33% - 22% = 11% (excess mortality)**

VI. Comparison to a Logit Model

Mortality is a binary outcome; the patient either lives or expires. In the CareScience Mortality Model, however, risk scores may fall outside of the 0 to 1 range due to the inherently unbounded nature of linear regression models. One approach to correcting this discrepancy is to use a logit model.

6.1 Logit Model Functional Form

Logit models are often the preferred choice for modeling binary outcomes such as mortality, since their output values are restricted to a range between 0 and 1. Mathematically, the model is expressed as

$$\text{Log}\,[P_i / (1- P_i)] = \alpha + \beta_1 x_{i1} + \beta_2 x_{i2} + \ldots + \beta_k x_{ik}$$

where k is the number of explanatory variables with i=1,…, n individuals and P_i is the probability that Y_i=1. The expression on the left-hand side is usually referred to as the logit or log-odds.[5] Similar to an ordinary linear regression, the x's may either be continuous or dummy variables. The logit equation can be solved for P_i to obtain

$$P_i = \text{EXP}\,(\alpha + \beta_1 x_{i1} + \beta_2 x_{i2} + \ldots + \beta_k x_{ik}) / (1 + \text{EXP}\,(\alpha + \beta_1 x_{i1} + \beta_2 x_{i2} + \ldots + \beta_k x_{ik}))$$

This equation can be further simplified by dividing both the numerator and denominator by the numerator itself:

$$P_i = 1/ (1 + \text{EXP}\,(-\alpha - \beta_1 x_{i1} - \beta_2 x_{i2} - \ldots - \beta_k x_{ik}))$$

The resulting equation has the desirable property that regardless what values are substituted for the β's and x's, P_i will always be a number between 0 and 1.

The linear regression model used by CareScience provides a good approximation to the logistic curve in localized regions of the mortality model.

6.2 Logit Model Considerations

At the aggregate level, the logit model generates similar results to linear model. At the patient level, however, the logit model offers better face validity. Although the logit model presents certain, considerations exist as well.

6.2.1 Sampling

In-hospital death is rare among many patient populations. At the hospital level, the survival to death split is around 98% to 2%. This split can be more extreme among many disease groups. For a given sample size, the standard errors of the coefficients depend heavily on the split on the dependent variable. As a general rule, the model is better with a 50%-50% split than with a 95% -5% split. The logit model, however, has a unique sampling property that allows disproportionate stratified random sampling on the dependent variable without biasing the coefficient estimates. Under such sampling schemes, the intercept changes, and the data set needs to be specifically tailored to each disease stratum.

6.2.2 Convergence

Convergence failure is a common issue with the logit model. Most independent variables are categorical and enter the model equation as dummy variables. Often some of the dummy variables exhibit the following property: at one level of the dummy variable every case has a 1

[5] Transforming the dependent variable to an odds ratio, $P_i / (1- P_i)$, removes the equation's upper bound of 1. The lower bound of 0 is removed by taking the logarithm of the odds.

on the dependent variable or every case has a 0. This property causes complete separation or quasi-complete separation preventing convergence. Removing problematic dummy variables can achieve convergence. Alternatively, uncommon categories can be collapsed. In each case, the data set must be specifically tailored to each disease stratum, which is a labor-intensive process.

VII. Calibration Data

Description of Facilities in 2008 Calibration Dataset	
Facilities	**N=617**
Regions	
Midwest	169 (27.44%)
Northeast	70 (11.36%)
South	274 (44.48%)
West	103 (16.72%)
Teaching Status	
Teaching	286 (46.8%)
Non-Teaching	325 (53.2%)
Bed-size	
<100 beds	134 (21.9%)
100-200 beds	133(21.8%)
201-300 beds	119 (19.5%)
301-400 beds	90 (14.7%)
401-500 beds	39 (6.4%)
500-600 beds	25 (4.1%)
>600 beds	71 (11.6%)
Average bed-size	293 Beds
Discharges	
Average # of discharge	22,414
Total Discharges	14,454,473

			Mortality			Morbidity			Complications		
Diag	**DESCRIPTION**	**% Cases**	**Rate**	**Factors**	**FIT**	**Rate**	**Factors**	**FIT**	**Rate**	**Factors**	**FIT**
008	Infct, intestinal d/t oth organisms	0.48%	1.7%	24	0.094	9.9%	39	0.492	30.5%	37	0.388
038	Septicemia	1.42%	18.2%	58	0.223	31.5%	69	0.670	64.7%	76	0.459
042	HIV disease	0.16%	7.0%	22	0.184	25.3%	35	0.356	47.9%	34	0.305
151	Neoplasm, Malignant, stomach	0.06%	9.4%	29	0.195	22.0%	35	0.324	58.4%	33	0.301
153	Neoplasm, Malignant, colon	0.29%	4.6%	47	0.152	21.5%	45	0.389	50.7%	51	0.345
154	Neoplasm, Malignant, rectum/anus	0.12%	3.5%	34	0.122	13.4%	38	0.426	48.5%	49	0.314
157	Neoplasm, Malignant, pancreas	0.10%	11.1%	30	0.189	14.3%	28	0.373	49.4%	35	0.320
162	Neop, mlig, trachea/bronchus/lung	0.43%	12.3%	40	0.208	24.7%	40	0.267	49.3%	45	0.319
174	Neoplasm, Malignant, female breast	0.21%	2.1%	29	0.237	2.7%	28	0.367	15.9%	37	0.277
182	Neoplasm, Malignant, body, uterus	0.11%	1.2%	23	0.129	6.4%	25	0.458	33.8%	27	0.298
183	Neop, mlig, ovary/uterine adnexa	0.08%	5.2%	22	0.211	11.8%	29	0.423	47.5%	37	0.330
185	Neoplasm, Malignant, prostate	0.25%	1.1%	24	0.220	5.5%	22	0.217	23.3%	33	0.280
188	Neoplasm, Malignant, bladder	0.10%	3.3%	27	0.143	12.1%	35	0.500	41.0%	34	0.415
189	Neop, Mlig, kdny/oth urinary organ	0.13%	2.2%	32	0.140	10.2%	28	0.473	41.1%	37	0.342
191	Neoplasm, Malignant, brain	0.09%	4.6%	24	0.170	7.0%	28	0.407	34.8%	30	0.371
197	Neoplasm, metastatic, rsprt/dgstv	0.35%	13.0%	42	0.148	15.4%	35	0.362	44.6%	48	0.384
198	Neoplasm, Metastatic, other sites	0.29%	7.3%	36	0.123	9.5%	36	0.369	39.6%	56	0.384
202	Neop, mlig,lymphoid/histiocytic	0.09%	10.7%	28	0.194	16.9%	33	0.420	49.5%	36	0.368
250	Diabetes mellitus	1.29%	0.9%	31	0.078	10.4%	61	0.611	37.6%	68	0.431
276	Dsord, fluid/elctrlyt/acid-base bal	1.17%	2.0%	34	0.075	8.4%	50	0.535	36.5%	52	0.357
280	Anemias, iron deficiency	0.19%	0.5%	14	0.040	4.6%	25	0.305	35.6%	33	0.222
282	Anemias, hereditary hemolytic	0.20%	0.4%	13	0.056	6.4%	22	0.412	30.2%	27	0.247
285	Anemia, other & unspecified	0.20%	1.3%	23	0.041	5.8%	32	0.332	37.8%	36	0.248
288	Diseases of white blood cells	0.13%	2.3%	22	0.091	7.9%	35	0.345	46.9%	38	0.326
295	Disorders, schizophrenic	0.71%	0.0%	14	0.003	1.0%	27	0.283	14.3%	48	0.220
296	Psychoses, affective	1.82%	0.0%	18	0.002	1.0%	38	0.299	13.9%	59	0.250
304	Dependence, drug	0.18%	0.0%	11	0.023	0.6%	21	0.229	9.9%	39	0.236
331	Degeneration, other cerebral	0.21%	2.0%	28	0.129	6.1%	31	0.409	35.7%	44	0.325
345	Epilepsy	0.18%	1.1%	18	0.096	9.7%	17	0.552	31.0%	46	0.437
348	Brain conditions, other	0.14%	7.7%	30	0.392	16.4%	35	0.586	50.4%	50	0.457
398	Disease, other rheumatic heart	0.10%	4.7%	18	0.125	16.3%	22	0.321	49.7%	34	0.265
401	Hypertension, essential	0.24%	0.3%	17	0.062	4.2%	34	0.488	39.3%	30	0.199
410	Acute myocardial infarction	1.86%	5.9%	47	0.231	29.4%	68	0.600	54.7%	76	0.433
411	Disease, other acute ischemic heart	0.10%	0.4%	12	0.036	7.5%	39	0.440	26.2%	31	0.358
413	Angina pectoris	0.05%	0.1%	10	0.011	2.3%	11	0.214	21.0%	23	0.247
414	Disease, oth chronic ischemic heart	3.26%	0.6%	36	0.076	9.6%	48	0.369	34.9%	64	0.386
415	Disease, acute pulmonary heart	0.42%	3.6%	27	0.204	16.0%	35	0.505	45.6%	46	0.350
424	Diseases, endocardium, other	0.21%	3.4%	24	0.179	28.0%	44	0.324	62.8%	48	0.345
425	Cardiomyopathy	0.08%	2.5%	32	0.233	6.0%	33	0.315	30.6%	31	0.297

			Mortality			Morbidity			Complications		
Diag	DESCRIPTION	% Cases	Rate	Factors	FIT	Rate	Factors	FIT	Rate	Factors	FIT
426	Disorder, conduction	0.16%	1.5%	35	0.125	11.9%	32	0.585	33.2%	49	0.413
427	Dysrhythmias, cardiac	1.92%	2.1%	38	0.436	8.9%	49	0.629	30.9%	61	0.401
428	Failure, heart	2.57%	3.4%	49	0.111	14.4%	49	0.444	54.3%	59	0.335
430	Hemorrhage, subarachnoid	0.08%	23.1%	29	0.361	31.1%	29	0.506	57.9%	34	0.444
431	Hemorrhage, intracerebral	0.20%	28.0%	31	0.340	27.4%	37	0.467	56.0%	42	0.358
432	Hemorrhage, intracranial	0.09%	16.0%	24	0.350	20.0%	31	0.487	49.5%	41	0.416
433	Oclsn/stenosis, precerebral artery	0.51%	1.2%	16	0.146	5.2%	41	0.337	25.5%	53	0.308
434	Occlusion, cerebral arteries	1.04%	5.7%	34	0.163	12.6%	44	0.482	43.6%	50	0.376
435	Ischemia, transient cerebral	0.48%	0.2%	15	0.010	2.7%	33	0.281	25.4%	40	0.280
436	Disease, acute cerbvas, ill-defined	0.01%	5.8%	12	0.162	5.7%	10	0.413	32.8%	13	0.359
440	Atherosclerosis	0.47%	1.8%	34	0.124	10.6%	46	0.550	36.5%	58	0.359
441	Aneurysm and dissection, aortic	0.22%	8.8%	42	0.281	23.2%	48	0.498	52.2%	73	0.405
444	Embolism and thrombosis, arterial	0.10%	4.0%	31	0.167	15.4%	39	0.536	44.5%	49	0.376
453	Embolism/thrombosis, venous, other	0.38%	1.0%	24	0.054	8.0%	39	0.449	31.5%	47	0.385
458	Hypotension	0.27%	1.9%	23	0.145	7.5%	30	0.378	44.9%	40	0.246
466	Bronchitis and bronchiolitis, acute	0.40%	0.1%	15	0.035	7.7%	22	0.054	23.4%	28	0.174
480	Pneumonia, viral	0.05%	0.8%	14	0.105	6.7%	22	0.446	27.6%	25	0.336
481	Pneumonia d/t pneumococcal virus	0.06%	2.8%	19	0.141	16.2%	30	0.553	51.4%	29	0.317
482	Pneumonia, other bacterial	0.23%	6.6%	35	0.114	22.9%	47	0.409	61.2%	48	0.314
486	Pneumonia, organism NOS	2.16%	3.5%	34	0.096	10.9%	46	0.441	46.9%	57	0.299
491	Bronchitis, chronic	1.13%	1.9%	35	0.074	16.0%	44	0.436	45.8%	51	0.289
493	Asthma	0.95%	0.3%	24	0.104	9.7%	35	0.126	27.3%	44	0.199
496	Obstruction, chronic airway NEC	0.04%	7.4%	19	0.320	15.6%	19	0.461	47.1%	31	0.309
507	Pneumonitis due to solids/liquids	0.45%	13.2%	27	0.119	27.1%	48	0.384	59.3%	50	0.317
511	Pleurisy	0.16%	3.8%	22	0.113	21.7%	30	0.404	56.6%	33	0.283
512	Pneumothorax	0.11%	2.5%	20	0.151	9.4%	27	0.436	32.3%	30	0.342
515	Fibrosis postinflammatory pulmonary	0.07%	7.0%	21	0.132	21.9%	26	0.442	47.6%	34	0.335
518	Diseases, lung, other	1.03%	18.0%	42	0.200	41.0%	48	0.410	69.7%	66	0.356
531	Ulcer, gastric	0.23%	2.2%	23	0.159	12.2%	41	0.455	52.2%	48	0.308
532	Ulcer, duodenal	0.16%	3.6%	26	0.160	14.4%	35	0.479	52.9%	46	0.326
535	Gastritis and duodenitis	0.31%	0.6%	20	0.045	8.7%	30	0.213	42.5%	41	0.242
540	Appendicitis, acute	0.68%	0.2%	20	0.062	3.0%	25	0.503	16.0%	29	0.355
557	Insufficiency, vascular, intestine	0.16%	9.7%	33	0.218	22.3%	42	0.441	59.5%	40	0.306
560	Obstruction, intestinal w/o hernia	0.79%	2.7%	40	0.110	9.9%	49	0.447	40.6%	66	0.324
567	Peritonitis	0.06%	4.1%	26	0.140	12.8%	34	0.469	48.4%	31	0.343
569	Disorders, intestine, other	0.28%	3.5%	54	0.178	14.6%	56	0.448	50.8%	61	0.326
571	Disease and cirrhosis, liver, chrn	0.26%	8.1%	26	0.176	18.3%	41	0.371	57.6%	40	0.283
572	Abscess and disease sequelae, liver	0.14%	8.5%	26	0.192	17.0%	28	0.433	54.5%	36	0.303
574	Cholelithiasis	0.87%	0.6%	37	0.077	8.2%	40	0.517	32.5%	56	0.379

			Mortality			Morbidity			Complications		
Diag	**DESCRIPTION**	**% Cases**	**Rate**	**Factors**	**FIT**	**Rate**	**Factors**	**FIT**	**Rate**	**Factors**	**FIT**
577	Diseases, pancreas	0.71%	1.1%	28	0.138	8.0%	41	0.480	38.8%	50	0.322
578	Hemorrhage, gastrointestinal	0.43%	3.8%	23	0.155	12.5%	44	0.472	52.9%	43	0.301
584	Renal failure, acute	0.91%	5.6%	44	0.107	19.8%	56	0.411	53.3%	56	0.319
585	Renal failure, chronic	0.04%	7.6%	26	0.378	15.1%	21	0.472	53.2%	26	0.322
590	Infections, kidney	0.31%	0.3%	14	0.024	6.0%	31	0.353	25.5%	32	0.346
592	Calculus, kidney and ureter	0.40%	0.1%	15	0.048	2.6%	35	0.199	15.2%	31	0.256
599	Disorder, urethra/urinary tract oth	0.92%	1.3%	27	0.027	10.1%	49	0.380	32.7%	50	0.288
682	Cellulitis and abscess, other	1.31%	0.4%	28	0.039	3.6%	41	0.418	23.6%	63	0.336
707	Ulcer, chronic, skin	0.17%	2.2%	33	0.063	10.6%	63	0.422	45.8%	65	0.362
715	Osteoarthrosis and allied disorders	2.25%	0.1%	15	0.045	2.5%	37	0.250	32.0%	66	0.172
721	Spondylosis and allied disorders	0.32%	0.2%	17	0.059	3.2%	37	0.392	22.3%	51	0.375
722	Disorders, intervertebral disc	1.06%	0.1%	20	0.078	1.9%	43	0.329	18.5%	55	0.360
724	Disorders, back, other & unspc	0.44%	0.2%	22	0.070	3.3%	35	0.399	30.1%	47	0.339
730	Infections involving bone	0.14%	0.8%	21	0.061	8.4%	57	0.462	38.4%	70	0.381
733	Disorders, bone and cartilage	0.44%	0.9%	34	0.067	5.7%	43	0.413	33.7%	66	0.333
780	Symptoms, general	1.62%	0.5%	31	0.031	4.1%	45	0.331	28.8%	60	0.249
784	Symptoms involving head and neck	0.15%	0.4%	11	0.032	4.5%	28	0.434	32.4%	36	0.290
785	Symptoms inv cardiovascular system	0.07%	3.3%	22	0.390	8.0%	32	0.621	39.7%	45	0.357
786	Symptoms inv respiratory syst/chest	2.26%	0.1%	21	0.018	2.0%	41	0.248	19.3%	49	0.248
787	Symptoms involving digestive system	0.23%	0.7%	19	0.026	6.1%	29	0.396	43.3%	40	0.246
789	Symptoms inv abdomen, pelvis, other	0.50%	0.5%	21	0.038	5.8%	32	0.136	35.5%	38	0.244
805	Fx, vrt column w/o spinal crd inj	0.27%	1.3%	30	0.105	7.3%	42	0.513	36.8%	57	0.366
807	Fracture Rib/Sternum/Larynx/Trachea	0.10%	1.8%	23	0.113	9.2%	27	0.489	36.8%	41	0.370
808	Fracture, pelvis	0.15%	1.4%	24	0.094	7.6%	33	0.503	36.3%	43	0.371
851	Laceration and contusion, cerebral	0.06%	8.8%	40	0.374	14.4%	35	0.445	41.5%	35	0.479
852	Hemorrhage, intracranial post-inj	0.19%	11.1%	42	0.371	15.3%	38	0.468	44.9%	46	0.444
965	Poisoning analgesics/antirheumatics	0.17%	1.7%	17	0.221	18.7%	26	0.634	48.9%	33	0.377
969	Poisoning by psychotropic agents	0.20%	0.7%	8	0.139	17.2%	18	0.644	45.9%	28	0.378
996	Complication peculiar to procedures	1.55%	1.8%	53	0.109	12.0%	78	0.488	45.9%	106	0.328
997	Complication affecting body NEC	0.33%	1.6%	39	0.134	16.2%	59	0.478	49.1%	64	0.307
998	Complications of procedures NEC	0.72%	1.0%	24	0.106	7.8%	51	0.492	36.2%	70	0.360
DRG103		0.01%	21.6%	13	0.199	59.8%	14	0.420	91.3%	11	0.227
DRG480		0.01%	5.3%	9	0.079	30.9%	18	0.364	72.2%	19	0.283
DRG481		0.02%	6.5%	12	0.320	13.8%	14	0.554	62.2%	20	0.375
DRG495		0.00%	4.2%	6	0.135	39.9%	5	0.201	82.5%	7	0.225
DRG512		0.00%	2.1%	4	0.134	17.0%	11	0.647	69.2%	9	0.339
DRG513		0.00%	2.2%	1 .		13.0%	8	0.724	63.6%	5	0.358
Femur_	Femur_Fracture	0.97%	2.5%	38	0.108	13.7%	48	0.469	56.7%	60	0.281
Hernia	Hernia	0.48%	1.1%	28	0.118	8.9%	38	0.500	34.4%	52	0.352

			Mortality			Morbidity			Complications		
Diag	**DESCRIPTION**	**% Cases**	**Rate**	**Factors**	**FIT**	**Rate**	**Factors**	**FIT**	**Rate**	**Factors**	**FIT**
Hyperte	Hypertensive	0.51%	2.5%	39	0.094	23.9%	49	0.570	51.4%	53	0.398
Immatur	Immature_Neonates	1.27%	3.0%	16	0.356	**na**	**na**	**na**	**na**	**na**	**na**
Leukemi	Leukemia	0.10%	16.9%	20	0.203	20.8%	27	0.446	54.4%	34	0.378
Normal_	Normal_Neonates	9.66%	0.1%	23	0.009	**na**	**na**	**na**	**na**	**na**	**na**
Skull_Fr	Skull_Fracture	0.12%	9.5%	40	0.240	12.4%	35	0.404	35.9%	37	0.497
V55	Attention to artificial openings	0.11%	0.7%	24	0.071	8.6%	34	0.483	41.4%	40	0.335
V57	Care, rehabilitation procedures	1.54%	0.6%	32	0.015	10.9%	46	0.410	51.3%	49	0.289
V58	Aftercare	0.45%	1.4%	38	0.122	4.2%	37	0.457	23.3%	47	0.407
BDG1	Infectious and Parasitic Diseases	0.65%	1.7%	36	0.130	8.0%	51	0.485	30.9%	55	0.402
BDG2	Neoplasma	1.79%	2.3%	61	0.151	6.7%	78	0.400	29.4%	102	0.337
BDG3	Endocrine, Nutritional, Metabolic, and	0.72%	0.8%	32	0.073	5.8%	51	0.437	27.5%	65	0.343
BDG4	Diseases of Blood and Blood-Forming	0.25%	2.8%	33	0.128	10.4%	49	0.456	39.3%	44	0.388
BDG5	Mental Disorders	1.82%	0.2%	41	0.024	2.8%	51	0.325	23.3%	56	0.374
BDG6	Diseases of Nervous System and Sense	0.89%	1.0%	44	0.090	5.0%	57	0.477	29.3%	78	0.358
BDG7	Diseases of the Circulatory System	0.85%	2.8%	52	0.128	14.5%	64	0.480	44.1%	90	0.382
BDG8	Diseases of the Respiratory System	0.66%	1.6%	40	0.101	10.7%	54	0.480	33.3%	63	0.423
BDG9	Diseases fo the Digestive System	2.90%	0.9%	52	0.095	8.6%	60	0.315	35.2%	75	0.320
BDG10	Diseases of the Genitourinary System	2.02%	0.2%	39	0.045	2.8%	59	0.430	23.8%	82	0.259
BDG11	Complications of Pregnancy and	12.30%	0.0%	33	0.020	2.3%	51	0.034	53.6%	58	0.432
BDG12	Diseases of Skin and Subcutaneous Tiss	0.21%	0.4%	25	0.070	3.4%	36	0.479	20.9%	49	0.342
BDG13	Musculoskeletal and Connective Tissue	0.95%	0.5%	26	0.061	4.8%	50	0.457	28.5%	78	0.367
BDG14	Congenital Anomalies	0.28%	0.9%	33	0.092	6.0%	56	0.334	28.6%	85	0.345
BDG16	Symptoms, Signs, and Ill-Defined	0.42%	2.0%	35	0.111	8.1%	50	0.457	40.8%	60	0.359
BDG17	Injury and Poisoning	2.64%	1.5%	69	0.137	7.3%	79	0.487	30.2%	104	0.397
BDG18	Factors Influencing Health Status	0.25%	2.9%	27	0.480	4.6%	42	0.534	24.3%	64	0.393