Update of Severity-Adjustment Models for Hospital Efficiency Data

A White Paper Analysis

For

The Leapfrog Group

By

The Center for Health Systems Research and Analysis
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Introduction

Purpose: Historically, the Leapfrog Hospital Survey required hospitals to report on the efficiency of care as measured by average lengths of stay for CABG, PCI, pneumonia, and AMI patients. Starting with the 2013 Survey, these four categories will be replaced with the three patient categories employed on the CMS Hospital Compare mortality and re-admission measures, i.e., Heart Attack, Heart Failure and Pneumonia. Leapfrog has engaged the Center for Health Systems Research and Analysis (CHSRA) of the University of Wisconsin – Madison to develop the severity-adjustment model for these new patient cohorts using recent and credible hospital discharge data.

Objectives: The major project objectives include:

1. Obtain a representative (all-payer, 2007 or later, with diagnosis and procedure codes) dataset of hospital discharges for use in modeling length of stay as a function of selected risk factors (e.g., patient characteristics, diagnosis codes, procedure codes).
2. Propose candidate risk factors based on prior Leapfrog analyses, risk factors employed on the CMS Hospital Compare mortality and re-admission measures, and an updated literature review.
3. Using the hospital discharge dataset, fit linear regression models for each of three new categories of hospital stay (Heart Attack, Heart Failure and Pneumonia) suitable on statistical and clinical grounds for application to non-patient-specific discharge data from participating hospitals in risk-adjusting lengths of stay.
4. Prepare a white paper summary of the modeling process and results suitable for hospital review (and possible publication).

Data Source: We used data from recent rounds of the National Hospital Discharge Survey (NHDS). The NHDS is an annual three-stage national sample of hospital discharges. The first two stages select a sample of short-stay, general or children's hospitals with six or more staffed beds. The third stage randomly selects discharges within each of the selected hospitals. The most recent published round of the NHDS in 2010 contains information abstracted from 151,000 discharges arising from 203 hospitals.

NHDS discharge records contain information on age, sex, race, marital status, discharge year and month, discharge status (home, transfer, death, etc.), length of stay in days, region (northeast, midwest, south, west), hospital size (beds), hospital ownership type, ICD-9 diagnoses (up to seven codes) and procedures (up to four codes), payment sources, DRG, admission type (emergency, urgent, elective, newborn) and admission source (physician referral, transfer, etc.). These data items are typically available from hospital discharge records and are sufficient to construct risk factors.

NHDS data is de-identified and can be downloaded directly from the NCHS website at http://www.cdc.gov/nchs/about/major/hdasd/nhds.htm. Since the survey is repeated annually, model coefficients can be updated annually, if necessary. Appendix A provides a file layout for the NHDS data.

Methodology: The analysis followed these steps to address the project objectives:

Step 1: CHSRA reviewed prior Leapfrog risk factor development work, documentation for the CMS Hospital Compare mortality and re-admission measures and current literature to form a list of candidate risk factors available from the NHDS. This list was reviewed for face validity and reasonableness.

Step 2: CHSRA constructed SAS code to identify hospital stay categories and candidate risk factors for each NHDS record.

Step 3: CHSRA applied multivariate linear regression to data from the 2007, 2008, 2009 and 2010 NHDS rounds to model variation in length of stay (days) as a function of candidate risk factors. Four years of data were used, rather than three, because the sample size of the NHDS was reduced in 2008 and an additional year generated discharge counts similar to prior model analyses. Risk factors were screened for statistical significance and the coefficients were reviewed for clinical reasonableness (sign and magnitude). We also compared risk factor coefficients across years for consistency.

Step 4: We provided a draft white paper for review by Leapfrog.

Step 5: After receiving comments from Leapfrog, we made suggested modifications to the analysis and provided this final version of the white paper.

Results

Specifications for the three patient categories (Heart Attack, Heart Failure and pneumonia) were taken from the corresponding CMS Hospital Compare mortality and re-admission measure patient categories. Candidate risk factors were taken from prior Leapfrog measures for the AMI and pneumonia cohorts, augmented by risk factors used in the CMS mortality and re-admission measures. Appendix B provides a summary of the diagnosis and procedure codes employed to define each category and the risk factors. Table 1 summarizes the candidate risk factors.

Table 1 – Candidate Risk Factors

		CMS Hospital Compare Measures						2012 Survey	
		Heart Attack		Heart Failure		Pneumonia		AMI	Pneu-
RF	Risk Factor Description	Mort	Readm	Mort	Readm	Mort	Readm		monia
	Leapfrog 2012 Survey AMI and Pneumonia Risk Factors								
rf01	Age GE 55							x	x
rf06	Cancer							x	
rf08	Chronic renal disease							x	
rf09	chronic liver disease							x	
rf16	PCI							x	
rf17	CABG							x	
rf31	Cirrhosis or chronic hepatitis								x
rf32	Stroke or transient ischemic attack								x
rf33	Congestive heart failure								x
rf34	Kidney disease								x
rf36	COPD								x
rf43	Pleural effusion								x
rf44	Septicemia								x
rf45	Respiratory failure								x
	Risk Factors from CMS Mortality/Re-Admission Measures								
	Demographic								
rf050	Age >= 65	x	x	x	x	x	x		
rf051	Age-65 (years above 65, continuous)	x	x	x	x	x	x		
rf052	Male	x	x	x	x	x	x		
	Cardiovascular								
rf060	History of PTCA	x		x		x			
rf061	History of PTCA		x						
rf062	History of CABG	x	x	x	x	x	x		
rf063	Congestive heart failure	x	x	x	x	x	x		
rf064	Acute coronary syndrome		x		x		x		
rf065	Acute myocardial infarction	x		x		x			

		CMS Hospital Compare Measures						2012 Survey	
		Heart Attack		Heart Failure		Pneumonia		AMI	Pneu-
RF	Risk Factor Description	Mort	Readm	Mort	Readm	Mort	Readm		monia
rf066	Other acute/subacute forms of ischemic heart disease	x		x		x			
rf067	Chronic atherosclerosis	x		x		x			
rf068	Angina pectoris/old myocardial infarction		x		x		x		
rf069	Coronary atherosclerosis/other chronic ischemic heart disease		x		x		x		
rf070	Cardio-respiratory failure and shock	x	x	x	x	x			
rf071	Valvular and rheumatic heart disease	x	x	x	x		x		
rf072	Arrhythmias		x		x		x		
rf073	Other and unspecified heart disease		x						
rf074	Vascular or circulatory disease		x		x		x		
rf075	Anterior myocardial infarction	x	x						
rf076	Other location of myocardial infarction	x	x						
	Comorbidities								
rf080	Hypertension	x		x		x			
rf081	Stroke	x	x	x	x	x	x		
rf082	Cerebrovascular disease	x				x			
rf083	Renal failure	x	x	x	x	x	x		
rf084	COPD	x	x	x	x	x	x		
rf085	Pneumonia	x	x	x	x	x	x		
rf086	Diabetes and DM complications	x		x					
rf087	Protein-calorie malnutrition	x	x	x	x	x	x		
rf088	Dementia and senility	x	x	x	x	x	x		
rf089	Hemiplegia, paraplegia, paralysis, functional disability	x	x	x	x	x	x		
rf090	Vascular or circulatory disease	x		x		x			
rf091	Metastatic cancer and acute leukemia	x		x		x			
rf092	Trauma	x		x		x			
rf093	Major psychiatric disorders	x	x	x	x	x			
rf094	Chronic liver disease	x		x		x			
rf095	Severe hematological disorders		x		x	x			
rf096	Iron deficiency and other/unspecified anemias and blood disease		x		x	x	x		
rf097	Depression		x	x					
rf098	Parkinson's and Huntington's disease			x					

		CMS Hospital Compare Measures						2012 Survey	
		Heart Attack		Heart Failure		Pneumonia		AMI	Pneu-
RF	Risk Factor Description	Mort	Readm	Mort	Readm	Mort	Readm		monia
rf099	Seizure disorders and convulsions			x					
rf100	Fibrosis of lung and other chronic lung disorders			x	x		x		
rf101	Asthma		x		x		x		
rf102	Vertebral fractures			x	x				
rf103	Metastatic cancer and acute leukemia		x		x		x		
rf104	Lung, upper digestive tract, and other severe cancers						x		
rf105	Lymphatic, head and neck, brain, and other major cancers; breast, prostate, colorectal and other cancers and tumors						x		
rf106	Cancer		x		x				
rf107	Diabetes and DM complications		x		x		x		
rf108	Disorders of fluid/electrolyte/acid-base		x		x		x		
rf109	End-stage renal disease or dialysis		x		x		x		
rf110	Other urinary tract disorders		x		x		x		
rf111	Decubitus ulcer or chronic skin ulcer		x		x		x		
rf112	History of infection		x				x		
rf113	Other gastrointestinal disorders		x		x				
rf114	Drug/alcohol abuse/dependence/psychosis		x		x				
rf115	Other psychiatric disorders		x		x				
rf116	Peptic ulcer, hemorrhage, other specified gastrointestinal disorders				x				
rf117	Nephritis		x						
rf118	Liver and biliary disease		x						
rf119	Septicemia/shock				x				
rf120	Pleural effusion/pneumothorax				x				
rf121	Other lung disorders				x				
rf122	Urinary tract infection				x				
rf123	Other injuries				x				

For initial modeling, we used any risk factor used by Leapfrog for the 2012 Survey AMI or pneumonia measures or used in the CMS mortality/re-admission measures, or suggested by the literature review. We refer to these as the candidate risk factors in later discussions.

Appendix C provides a summary of the literature review articles.

Data Exploration: The NHDS data provides several thousand discharges for each of the three patient categories. Table 2 summarizes the discharge counts by patient category.

Table 2 – 2007-2010 NHDS Discharge Counts

Category	Count
Heart Attack	14,540
Heart Failure	23,856
Pneumonia	20,060

Length of stay includes the day of admission and excludes the day of discharge, unless the patient is discharged on the day of admission, in which case the length of stay is defined as one day.

As with prior Leapfrog models, a log transformation of the length of stay was adopted for final risk modeling. This requires hospitals to report the geometric mean of lengths of stay, rather than (or in addition to) the arithmetic mean. (The arithmetic mean of a group of n values is the sum of the values divided by n. The geometric mean is the n^{th} root of the product of the values.) The geometric mean is a readily available function in most computational environments, e.g., the GEOMEAN function in Excel. Taking the log of the reported geometric mean yields the arithmetic mean of the log of lengths of stay, which is consistent with the response variable in the proposed linear regression severity adjustment model.

Following the specifications for the CMS mortality and re-admission measure cohorts, discharges qualify for a patient category on the basis of the primary diagnosis code alone. While this was the case for the AMI cohort in prior survey years, the PCI, CABG and pneumonia cohorts previously used both primary and secondary diagnoses/procedure codes.

Table 3 displays discharge counts and average log-length-of-stay values by patient cohort and NHDS year.

Table 3 – Counts and Averages by Patient Cohort and Year

Cohort	Item	Total	2007	2008	2009	2010
Heart Attack	Count	14,540	6,246	2,946	2,719	2,629
	Avg Log-LOS	1.332	1.336	1.331	1.318	1.338
	Days	3.8	3.8	3.8	3.7	3.8
Heart Failure	Count	23,856	9,965	4,770	4,746	4,375
	Avg Log-LOS	1.365	1.353	1.397	1.371	1.353
	Days	3.9	3.9	4.0	3.9	3.9
Pneumonia	Count	20,060	8,206	4,279	3,969	3,606
	Avg Log-LOS	1.458	1.464	1.451	1.463	1.449
	Days	4.3	4.3	4.3	4.3	4.3

Risk Adjustment Model: Within each patient category we fit a sequence of linear regression models to the log lengths of stay. The starting model in each case provided for those candidate risk factors (see Table 1 above) having statistically significant coefficients with signs consistent with clinical expectations. These starting models were further simplified by eliminating risk factors with relatively small coefficients and/or affecting a small percentage of discharges, with only minor reductions in model R^2 values.

Table 4 – Heart Attack Risk Adjustment Model (log LOS)

Variable	Param. Estimate	Standard Error	t Value	Pr > |t|
Intercept	0.91596	0.00998	91.8	<.0001
rf17 - CABG	1.07619	0.02130	50.5	<.0001
rf33 - Congestive heart failure	0.33293	0.01333	25.0	<.0001
rf085 - Pneumonia	0.41596	0.02086	19.9	<.0001
rf070 - Cardio-respiratory failure and shock	0.31862	0.01695	18.8	<.0001
rf050 - Age >= 65	0.19502	0.01243	15.7	<.0001
rf32 - Stroke or transient ischemic attack	0.48329	0.03216	15.0	<.0001
R-Square	27.9%			
Root MSE	0.7091			

Table 5 – Heart Failure Risk Adjustment Model (log LOS)

Variable	Param. Estimate	Standard Error	t Value	Pr > |t|
Intercept	1.13290	0.00641	176.9	<.0001
rf083 - Renal failure	0.22432	0.00969	23.2	<.0001
rf070 - Cardio-respiratory failure and shock	0.26810	0.01487	18.0	<.0001
rf119 - Septicemia/shock	0.96679	0.04742	20.4	<.0001
rf122 - Urinary tract infection	0.31973	0.01602	20.0	<.0001
rf085 - Pneumonia	0.26591	0.01414	18.8	<.0001
rf108 - Disorders of fluid/electrolyte/acid-base	0.21204	0.01174	18.1	<.0001
rf120 - Pleural effusion/pneumothorax	0.36356	0.02146	16.9	<.0001
R-Square	12.3%			
Root MSE	0.7039			

Table 6 – Pneumonia Risk Adjustment Model (log LOS)

Variable	Param. Estimate	Standard Error	t Value	Pr > |t|
Intercept	1.19487	0.00830	143.9	<.0001
rf45 - Respiratory failure	0.46753	0.01635	28.6	<.0001
rf33 - Congestive heart failure	0.20712	0.01197	17.3	<.0001
rf087 - Protein-calorie malnutrition	0.38731	0.02250	17.2	<.0001
rf112 - History of infection	0.31896	0.01731	18.4	<.0001
rf43 - Pleural effusion	0.32099	0.01973	16.3	<.0001
rf050 - Age >= 65	0.15722	0.01003	15.7	<.0001
rf44 - Septicemia	0.42378	0.02818	15.0	<.0001
R-Square	13.2%			
Root MSE	0.66744			

The formula for the expected log-length-of-stay for each model is of the form:

$E[\log(LOS)] = \alpha + \Sigma_j \beta_j rf_j$, where,

α is the model intercept,

β_j is the parameter estimate (effect) for the j^{th} risk factor, and,

rf_j is an indicator variable (zero or one) for the j^{th} risk factor.

So, the expected log-length-of-stay for a discharge is the intercept plus all of the estimated effects associated with the risk factors that apply to that discharge. Similarly, the expected average log-length-of-stay for a group of discharges is the model intercept plus the sum of the products of each risk factor effect and the percentage of discharges in the group with the risk factor.

These simple models yield modest R^2 values ranging from 12% to 28%. The coefficients are statistically significant and are positive.

Parameter estimates from each year of the NHDS are shown in Tables 7 through 9.

Table 7 – Heart Attack Parameters by Year

Variable	Parameter Estimates				
	All Yrs	2007	2008	2009	2010
Intercept	0.916	0.903	0.952	0.900	0.923
rf17 - CABG	1.076	1.084	1.078	1.086	1.041
rf33 - Congestive heart failure	0.333	0.378	0.220	0.355	0.318
rf085 - Pneumonia	0.416	0.376	0.449	0.446	0.428
rf070 - Cardio-respiratory failure and shock	0.319	0.251	0.333	0.367	0.407
rf050 - Age >= 65	0.195	0.220	0.211	0.161	0.154
rf32 - Stroke or transient ischemic attack	0.483	0.482	0.453	0.497	0.498

Table 8 – Heart Failure Parameters by Year

Variable	Parameter Estimates				
	All Yrs	2007	2008	2009	2010
Intercept	1.133	1.130	1.160	1.126	1.112
rf083 - Renal failure	0.224	0.217	0.209	0.260	0.229
rf070 - Cardio-respiratory failure and shock	0.268	0.291	0.313	0.242	0.237
rf119 - Septicemia/shock	0.967	1.052	0.995	0.948	0.716
rf122 - Urinary tract infection	0.320	0.309	0.366	0.345	0.266
rf085 - Pneumonia	0.266	0.272	0.280	0.243	0.267
rf108 - Disorders of fluid/electrolyte/acid-base	0.212	0.217	0.255	0.185	0.183
rf120 - Pleural effusion/pneumothorax	0.364	0.365	0.336	0.367	0.378

Table 9 – Pneumonia Parameters by Year

Variable	Parameter Estimates				
	All Yrs	2007	2008	2009	2010
Intercept	1.195	1.206	1.178	1.192	1.187
rf45 - Respiratory failure	0.468	0.600	0.512	0.369	0.450
rf33 - Congestive heart failure	0.207	0.251	0.156	0.183	0.166
rf087 - Protein-calorie malnutrition	0.387	0.410	0.408	0.365	0.372
rf112 - History of infection	0.319	0.312	0.357	0.269	0.343
rf43 - Pleural effusion	0.321	0.332	0.300	0.362	0.293
rf050 - Age >= 65	0.157	0.148	0.192	0.176	0.123
rf44 - Septicemia	0.424	0.409	0.351	0.377	0.500

While the model parameter estimates are relatively stable from year to year, we recommend that the estimates from all four years be used for the updated risk adjustment model. If the parameters are re-estimated each year from the NHDS, the oldest year of data should be dropped and the new year added, maintaining a rolling four-year base for the estimates. This should smooth the progression of values over time.

Discussion

These risk adjustment models remove some portion of the variation in hospital average lengths of stay, specifically that associated with the identified risk factors. Since the risk models only explain 12% to 28% of variation in patient log lengths of stay, a large portion of the variation remains. This residual variance can result in unreliable hospital averages, especially if the number of discharges is relatively small. That is, small hospital's average length of stay can be significantly affected by, 1) an unusual composition of "lurking" risk factors not considered by the risk adjustment model, or, 2) a single very long stay (i.e., an "outlier"). Large hospitals' patient profiles will trend toward a typical mix of risk factors (unless, for example, the hospital caters to a niche clientele) and the impact of an outlier or two will be diluted across a large number of discharges. Adoption of the log transformation (via the geometric mean) dampens the outlier impact on small hospital results.

Appendix A
National Hospital Discharge Survey File Layout Example (2007-9)

Item Number	Location	Number of Positions	Item description	Code description
1	1-2	2	Survey Year	05
2	3	1	Newborn status	1=Newborn 2=Not newborn
3	4	1	Units for age	1=Years 2=Months 3=Days
4	5-6	2	Age in years, months, or days	If units=years: 00-99* If units=months: 01-11 If units=days: 00-28 *Ages 100 and over were recoded to 99
5	7	1	Sex	1=Male 2=Female
6	8	1	Race	1=White 2=Black/African American 3=American Indian/Alaskan Native 4=Asian 5=Native Hawaiian or other Pacific Isldr 6=Other 8=Multiple race indicated 9=Not stated
7	9	1	Marital status	1=Married 2=Single 3=Widowed 4=Divorced 5=Separated 9=Not stated
8	10-11	2	Discharge month	01-12=January to December
9	12	1	Discharge Status	1=Routine/discharged home 2=Left against medical advice 3=Discharged/transferred to short-term facility 4=Discharged/transferred to long-term care institution 5=Alive, disposition not stated 6=Dead 9=Not stated or not reported
10	13-16	4	Days of care	Use to calculate number of days of care. Values of zero generated by the computer from admission and discharge dates were changed to one. (Discharges for which dates of admission and discharge are the same are identified in Item Number 11)

Item Number	Location	Number of Positions	Item description	Code description
11	17	1	Length of stay flag	0=Less than 1 day 1=One day or more
12	18	1	Geographic region	1=Northeast 2=Midwest 3=South 4=West
13	19	1	Number of beds, recode	1=6-99 2=100-199 3=200-299 4=300-499 5=500 and over
14	20	1	Hospital ownership	1=Proprietary 2=Government 3=Nonprofit, including church
15	21-25	5	Analysis weight	Use to obtain weighted estimates
16	26-27	2	First two digits of survey year	20
17	28-32	5	Diagnosis code #1	*
18	33-37	5	Diagnosis code #2	*
19	38-42	5	Diagnosis code #3	*
20	43-47	5	Diagnosis code #4	*
21	48-52	5	Diagnosis code #5	*
22	53-57	5	Diagnosis code #6	*
23	58-62	5	Diagnosis code #7	*
24	63-66	4	Procedure code#1	*
25	67-70	4	Procedure code#2	*
26	71-74	4	Procedure code#3	*
27	75-78	4	Procedure code#4	*

Item Number	Location	Number of Positions	Item description	Code description
28	79-80	2	Principal expected source of payment	01=Worker's compensation 02=Medicare 03=Medicaid 04=Other government 05=Blue Cross/Blue Shield 06=HMO/PPO 07=Other private insurance 08=Self-pay 09=No charge 10=Other 99=Not stated
29	81-82	2	Secondary expected source of payment	Same coding as item 28 above, except Not Stated left blank (not coded to 99)
30	83-85	3	Diagnosis-Related Groups (DRG)	Grouper version 22
31	86	1	Type of Admission	1 = Emergency 2 = Urgent 3 = Elective 4 = Newborn 9 = Not available
32	87-88	2	Source of Admission	01 = Physician referral 02 = Clinical referral 03 = HMO referral 04 = Transfer from a hospital 05 = Transfer from skilled nursing facility 06 = Transfer from other health facility 07 = Emergency room 08 = Court/law enforcement 09 = Other 99 = Not available

Appendix B
Patient Category and Risk Factor Specifications

Heart Attack – Case Count

Inclusion criteria:
• Discharge date within Reporting Time Period
• Inpatient discharges include deaths during the hospital stay
• A principal diagnosis code in the following table:

ICD-9-CM Diagnosis Codes

410.00	AMI (anterolateral wall) – episode of care unspecified
410.01	AMI (anterolateral wall) – initial episode of care
410.10	AMI (other anterior wall) – episode of care unspecified
410.11	AMI (other anterior wall) – initial episode of care
410.20	AMI (inferolateral wall) – episode of care unspecified
410.21	AMI (inferolateral wall) – initial episode of care
410.30	AMI (inferoposterior wall) – episode of care unspecified
410.31	AMI (inferoposterior wall) – initial episode of care
410.40	AMI (other inferior wall) – episode of care unspecified
410.41	AMI (other inferior wall) – initial episode of care
410.50	AMI (other lateral wall) – episode of care unspecified
410.51	AMI (other lateral wall) – initial episode of care
410.60	AMI (true posterior wall) – episode of care unspecified
410.61	AMI (true posterior wall) – initial episode of care
410.70	AMI (subendocardial) – episode of care unspecified
410.71	AMI (subendocardial) – initial episode of care
410.80	AMI (other specified site) – episode of care unspecified
410.81	AMI (other specified site) – initial episode of care
410.90	AMI (unspecified site) – episode of care unspecified
410.91	AMI (unspecified site) – initial episode of care

Exclusions:
• Patient age < 18
• Deaths in ER without inpatient admission

Heart Failure – Case Count

Inclusion criteria:
• Discharge date within Reporting Time Period
• Inpatient discharges include deaths during the hospital stay
• A principal diagnosis code in the following table:

ICD-9-CM diagnosis codes

402.01	Malignant hypertensive heart disease with congestive heart failure (CHF)
402.11	Benign hypertensive heart disease with CHF
402.91	Hypertensive heart disease with CHF
404.01	Malignant hypertensive heart and renal disease with CHF
404.03	Malignant hypertensive heart and renal disease with CHF & renal failure (RF)
404.11	Benign hypertensive heart and renal disease with CHF
404.13	Benign hypertensive heart and renal disease with CHF & RF
404.91	Unspecified hypertensive heart and renal disease with CHF
404.93	Hypertension and non-specified heart and renal disease with CHF & RF
428.0	Congestive heart failure, unspecified
428.1	Left heart failure
428.20	Systolic heart failure, unspecified
428.21	Systolic heart failure, acute
428.22	Systolic heart failure, chronic
428.23	Systolic heart failure, acute or chronic
428.30	Diastolic heart failure, unspecified
428.31	Diastolic heart failure, acute
428.32	Diastolic heart failure, chronic
428.33	Diastolic heart failure, acute or chronic
428.40	Combined systolic and diastolic heart failure, unspecified
428.41	Combined systolic and diastolic heart failure, acute
428.42	Combined systolic and diastolic heart failure, chronic
428.43	Combined systolic and diastolic heart failure, acute or chronic
428.9	Heart failure, unspecified

Exclusions:
• Patient age < 18
• Patients not admitted to this hospital for an inpatient stay, e.g., ambulatory procedures

Pneumonia – Case Count

Inclusion criteria:
• Discharge date within Reporting Time Period
• Inpatient discharges include deaths during the hospital stay
• A principal diagnosis code in the following table:

ICD-9-CM Diagnosis Codes

480.0	Pneumonia due to adenovirus
480.1	Pneumonia due to respiratory syncytial virus
480.2	Pneumonia due to parainfluenza virus
480.3	Pneumonia due to SARS-associated coronavirus
480.8	Viral pneumonia: pneumonia due to other virus not elsewhere classified
480.9	Viral pneumonia unspecified
481	Pneumococcal pneumonia [streptococcus pneumoniae pneumonia]
482.0	Pneumonia due to klebsiella pneumoniae
482.1	Pneumonia due to pseudomonas
482.2	Pneumonia due to hemophilus influenzae (h. influenzae)
482.30	Pneumonia due to streptococcus unspecified
482.31	Pneumonia due to streptococcus group a
482.32	Pneumonia due to streptococcus group b
482.39	Pneumonia due to other streptococcus
482.40	Pneumonia due to staphylococcus unspecified
482.41	Pneumonia due to staphylococcus aureus
482.42	Methicillin resistant pneumonia due to Staphylococcus aureus
482.49	Other staphylococcus pneumonia
482.81	Pneumonia due to anaerobes
482.82	Pneumonia due to escherichia coli [e.coli]
482.83	Pneumonia due to other gram-negative bacteria
482.84	Pneumonia due to legionnaires' disease
482.89	Pneumonia due to other specified bacteria
482.9	Bacterial pneumonia unspecified
483.0	Pneumonia due to mycoplasma pneumoniae
483.1	Pneumonia due to chlamydia
483.8	Pneumonia due to other specified organism
485	Bronchopneumonia organism unspecified
486	Pneumonia organism unspecified
487.0	Influenza with pneumonia
488.11	Influenza due to identified novel H1N1 influenza virus with pneumonia

Exclusions:
• Patient age < 18
• Patients not admitted to this hospital for an inpatient stay, e.g., ambulatory procedures

Risk Factor Definitions

RF17 -- CABG
Applies to Heart Attack
Any procedure . . .
ICD-9-CM Procedure Codes

36.10 to 36.19	Bypass anasthamosis for heart revascularization
36.2	Heart revascularization by arterial implant

or . . .
CPT-4 Procedure Codes

33510 to 33523	Coronary artery bypass graft
33533 to 33536	Coronary artery bypass graft

RF32 -- Stroke or transient ischemic attack
Applies to Heart Attack
Any diagnosis ICD-9-CM Diagnosis Codes

430.x	Subarachnoid hemorrhage
431.x	Intracerebral hemorrhage
432.x	Intracranial hem nec/nos
433.x1	Cerebral infarction
434.x1	Cerebral infarction
435.x	Transient cerebral ischemia
436.x	Acute, but ill-defined, cerebrovascular disease

RF33 -- Congestive heart failure
Applies to Heart Attack and Pneumonia
Any diagnosis ICD-9-CM Diagnosis Codes

428.x	Heart failure
402.01	Hypertensive heart disease, malignant, with heart failure failure
402.11	Hypertensive heart disease, benign, with heart failure failure
402.91	Hypertensive heart disease, unspecified, with heart failure
404.01	Hypertensive heart and renal disease, malignant, with congestive heart failure
404.03	Hypertensive heart and renal disease, malignant, with congestive heart failure and renal failure
404.11	Hypertensive heart and renal disease, benign, with congestive heart failure
404.13	Hypertensive heart and renal disease, benign, with congestive heart failure and renal failure

404.91	Hypertensive heart and renal disease, unspecified, with congestive heart failure
404.93	Hypertensive heart and renal disease, unspecified, with congestive heart failure and renal failure

RF43 -- Pleural effusion

Applies to Pneumonia

Any diagnosis ICD-9-CM Diagnosis Codes

511.9	Unspecified pleural effusion

RF44 -- Septicemia

Applies to Pneumonia

Any diagnosis ICD-9-CM Diagnosis Codes

038.0	Septicemia	
038.10	Staphylococcal septicemia, unspecified	
038.11	Staphylococcus aureus septicemia	
038.19	Other staphylococcal septicemia	
038.2	Pneumococcal septicemia	
038.3	Septicemia due to anaerobes	
038.40	Septicemia due to gram-negative organism, unspecified	v1.2
038.41	Septicemia due to hemophilus influenzae (h. influenzae)	
038.42	Septicemia due to escherichia coli (e. coli)	
038.43	Septicemia due to pseudomonas	
038.44	Septicemia due to serratia	
038.49	Other septicemia due to gram-negative organisms	
038.8	Other specified septicemias	
038.9	Unspecified septicemia	

RF45 -- Respiratory failure

Applies to Pneumonia

Any diagnosis ICD-9-CM Diagnosis Codes

518.81	Acute respiratory failure
518.84	Acute and chronic respiratory failure

Risk Factors from CMS Mortality/Re-Admission Measures

Description and Defining Codes

RF	Risk Factor Description	Codes*
rf050	Age >= 65	Age greater than or equal to 65
rf070	Cardio-respiratory failure and shock	CC 79
rf083	Renal failure	CC 131
rf085	Pneumonia	CC 111-113
rf087	Protein-calorie malnutrition	CC 21
rf108	Disorders of fluid/electrolyte/acid-base	CC 22, 23
rf112	History of infection	CC 1, 3-6
rf119	Septicemia/shock	CC 2
rf120	Pleural effusion/pneumothorax	CC 114
rf122	Urinary tract infection	CC 135

**CC codes are those used in the CMS mortality and re-admission risk factor definitions.*

Final Leapfrog Risk Factors

		CMS Hospital Compare Measures						Leapfrog Measures		
		AMI		HF		Pneumonia		Heart	Heart	Pneu-
RF	Risk Factor Description	Mort	Readm	Mort	Readm	Mort	Readm	Attack	Failure	monia
rf17	CABG							x		
rf32	Stroke or transient ischemic attack							x		
rf33	Congestive heart failure							x		x
rf43	Pleural effusion									x
rf44	Septicemia									x
rf45	Respiratory failure									x
rf050	Age >= 65	x	x	x	x	x	x	x		x
rf070	Cardio-respiratory failure and shock	x	x	x	x	x		x	x	
rf083	Renal failure	x	x	x	x	x	x		x	
rf085	Pneumonia	x	x	x	x	x	x	x	x	
rf087	Protein-calorie malnutrition	x	x	x	x	x	x			x
rf108	Disorders of fluid/electrolyte/acid-base		x		x		x		x	
rf112	History of infection		x				x			x
rf119	Septicemia/shock				x				x	
rf120	Pleural effusion/pneumothorax				x				x	
rf122	Urinary tract infection				x				x	

Table of ICD-9 Codes for Used CC Codes

CC	CC Description	ICD-9	ICD-9 Description
1	HIV/AIDS	042	Human immuno virus dis
		079.53	Hiv-2 infection oth dis
		V08	Asymp hiv infectn status
2	Septicemia/Shock	003.1	Salmonella septicemia
		020.2	Septicemic plague
		022.3	Anthrax septicemia
		036.2	Meningococcemia
		038.0	Streptococcal septicemia
		038.10	Staphylcocc septicem NOS
		038.11	Meth susc Staph aur sept
		038.12	MRSA septicemia
		038.19	Staphylcocc septicem NEC
		038.2	Pneumococcal septicemia
		038.3	Anaerobic septicemia
		038.40	Gram-neg septicemia NOS
		038.41	H. influenae septicemia
		038.42	E coli septicemia
		038.43	Pseudomonas septicemia
		038.44	Serratia septicemia
		038.49	Gram-neg septicemia NEC
		038.8	Septicemia NEC
		038.9	Septicemia NOS
		040.82	Toxic shock syndrome
		054.5	Herpetic septicemia
		771.81	NB septicemia [sepsis]
		785.52	Septic shock
		785.59	Shock w/o trauma NEC
3	Central Nervous System Infection	003.21	Salmonella meningitis
		006.5	Amebic brain abscess
		013.00	TB meningitis-unspec
		013.01	TB meningitis-no exam
		013.02	TB meningitis-exam unkn
		013.03	TB meningitis-micro dx
		013.04	TB meningitis-cult dx
		013.05	TB meningitis-histo dx
		013.06	TB meningitis-oth test
		013.10	Tubrclma meninges-unspec
		013.11	Tubrclma mening-no exam
		013.12	Tubrclma menin-exam unkn

CC	CC Description	ICD-9	ICD-9 Description
		013.13	Tubrclma mening-micro dx
		013.14	Tubrclma mening-cult dx
		013.15	Tubrclma mening-histo dx
		013.16	Tubrclma mening-oth test
		013.20	Tuberculoma brain-unspec
		013.21	Tubrcloma brain-no exam
		013.22	Tubrclma brain-exam unkn
		013.23	Tubrcloma brain-micro dx
		013.24	Tubrcloma brain-cult dx
		013.25	Tubrcloma brain-histo dx
		013.26	Tubrcloma brain-oth test
		013.30	TB brain abscess-unspec
		013.31	TB brain abscess-no exam
		013.32	TB brain absc-exam unkn
		013.33	TB brain absc-micro dx
		013.34	TB brain abscess-cult dx
		013.35	TB brain absc-histo dx
		013.36	TB brain absc-oth test
		013.40	Tubrclma sp cord-unspec
		013.41	Tubrclma sp cord-no exam
		013.42	Tubrclma sp cd-exam unkn
		013.43	Tubrclma sp crd-micro dx
		013.44	Tubrclma sp cord-cult dx
		013.45	Tubrclma sp crd-histo dx
		013.46	Tubrclma sp crd-oth test
		013.50	TB sp crd abscess-unspec
		013.51	TB sp crd absc-no exam
		013.52	TB sp crd absc-exam unkn
		013.53	TB sp crd absc-micro dx
		013.54	TB sp crd absc-cult dx
		013.55	TB sp crd absc-histo dx
		013.56	TB sp crd absc-oth test
		013.60	TB encephalitis-unspec
		013.61	TB encephalitis-no exam
		013.62	TB encephalit-exam unkn
		013.63	TB encephalitis-micro dx
		013.64	TB encephalitis-cult dx
		013.65	TB encephalitis-histo dx
		013.66	TB encephalitis-oth test
		013.80	Cns TB NEC-unspec
		013.81	Cns TB NEC-no exam

CC	CC Description	ICD-9	ICD-9 Description
		013.82	Cns TB NEC-exam unkn
		013.83	Cns TB NEC-micro dx
		013.84	Cns TB NEC-cult dx
		013.85	Cns TB NEC-histo dx
		013.86	Cns TB NEC-oth test
		013.90	Cns TB NOS-unspec
		013.91	Cns TB NOS-no exam
		013.92	Cns TB NOS-exam unkn
		013.93	Cns TB NOS-micro dx
		013.94	Cns TB NOS-cult dx
		013.95	Cns TB NOS-histo dx
		013.96	Cns TB NOS-oth test
		036.0	Meningococcal meningitis
		036.1	Meningococc encephalitis
		037	Tetanus
		045.00	Ac bulbar polio-type NOS
		045.01	Ac bulbar polio-type 1
		045.02	Ac bulbar polio-type 2
		045.03	Ac bulbar polio-type 3
		045.10	Paral polio NEC-type NOS
		045.11	Paral polio NEC-type 1
		045.12	Paral polio NEC-type 2
		045.13	Paral polio NEC-type 3
		045.20	Nonparaly polio-type NOS
		045.21	Nonparalyt polio-type 1
		045.22	Nonparalyt polio-type 2
		045.23	Nonparalyt polio-type 3
		045.90	Ac polio NOS-type NOS
		045.91	Ac polio NOS-type 1
		045.92	Ac polio NOS-type 2
		045.93	Ac polio NOS-type 3
		047.0	Coxsackie virus mening
		047.1	Echo virus meningitis
		047.8	Viral meningitis NEC
		047.9	Viral meningitis NOS
		048	Oth enteroviral cns dis
		049.0	Lymphocytic choriomening
		049.1	Adenoviral meningitis
		049.8	Viral encephalitis NEC
		049.9	Viral encephalitis NOS
		052.0	Postvaricella encephalit

CC	CC Description	ICD-9	ICD-9 Description
		052.2	Postvaricella myelitis
		053.0	Herpes zoster meningitis
		053.14	Herpes zoster myelitis
		054.3	Herpetic encephalitis
		054.72	H simplex meningitis
		054.74	Herpes simplex myelitis
		055.0	Postmeasles encephalitis
		056.01	Rubella encephalitis
		058.21	Human herpesvir 6 enceph
		058.29	Human herpesvr encph NEC
		062.0	Japanese encephalitis
		062.1	West equine encephalitis
		062.2	East equine encephalitis
		062.3	St Louis encephalitis
		062.4	Australian encephalitis
		062.5	California encephalitis
		062.8	Mosquit-borne enceph NEC
		062.9	Mosquit-borne enceph NOS
		063.0	Russia spr-summer enceph
		063.1	Louping ill
		063.2	Cent Europe encephalitis
		063.8	Tick-borne enceph NEC
		063.9	Tick-borne enceph NOS
		064	Vir enceph arthropod NEC
		066.2	Venezuelan equine fever
		066.40	West Nile Fever NOS
		066.41	West Nile Fever w/enceph
		066.42	West Nile neuro man NEC
		066.49	West Nile w complic NEC
		071	Rabies
		072.1	Mumps meningitis
		072.2	Mumps encephalitis
		090.40	Juvenile neurosyph NOS
		090.41	Congen syph encephalitis
		090.42	Congen syph meningitis
		090.49	Juvenile neurosyph NEC
		091.81	Acute syphil meningitis
		094.0	Tabes dorsalis
		094.1	General paresis
		094.2	Syphilitic meningitis
		094.3	Asymptomat neurosyphilis

CC	CC Description	ICD-9	ICD-9 Description
		094.81	Syphilitic encephalitis
		094.82	Syphilitic parkinsonism
		094.83	Syph dissem retinitis
		094.84	Syphilitic optic atrophy
		094.85	Syph retrobulb neuritis
		094.86	Syphil acoustic neuritis
		094.89	Neurosyphilis NEC
		094.9	Neurosyphilis NOS
		098.82	Gonococcal meningitis
		100.81	Leptospiral meningitis
		112.83	Candidal meningitis
		114.2	Coccidioidal meningitis
		115.01	Histoplasm capsul mening
		115.11	Histoplasm dubois mening
		115.91	Histoplasmosis meningit
		137.1	Late effect cns TB
		138	Late effect acute polio
		139.0	Late eff viral encephal
		320.0	Hemophilus meningitis
		320.1	Pneumococcal meningitis
		320.2	Streptococcal meningitis
		320.3	Staphylococc meningitis
		320.7	Mening in oth bact dis
		320.81	Anaerobic meningitis
		320.82	Mningts gram-neg bct NEC
		320.89	Meningitis oth spcf bact
		320.9	Bacterial meningitis NOS
		321.1	Mening in oth fungal dis
		321.2	Mening in oth viral dis
		321.3	Trypanosomiasis meningit
		321.4	Meningit d/t sarcoidosis
		321.8	Mening in oth nonbac dis
		322.0	Nonpyogenic meningitis
		322.1	Eosinophilic meningitis
		322.2	Chronic meningitis
		322.9	Meningitis NOS
		323.01	Enceph/encephmye oth dis
		323.02	Myelitis-oth viral dis
		323.1	Rickettsial encephalitis
		323.2	Protozoal encephalitis
		323.41	Ot encph/mye ot inf else

CC	CC Description	ICD-9	ICD-9 Description
		323.42	Oth myelitis ot inf else
		323.51	Enceph/myel folwg immune
		323.52	Myelitis follwg immune
		323.61	Inf ac dis encephalomyel
		323.62	Postinf encephalitis NEC
		323.63	Postinfectious myelitis
		323.81	Enceph & encephlalo NEC
		323.82	Myelitis cause NEC
		323.9	Encephalitis NOS
		324.0	Intracranial abscess
		324.1	Intraspinal abscess
		324.9	Cns abscess NOS
		325	Phlebitis intrcran sinus
		326	Late eff cns abscess
		341.20	Acute myelitis NOS
		341.21	Acute myelitis oth cond
		341.22	Idiopathc trans myelitis
4	Tuberculosis	010.00	Prim TB complex-unspec
		010.01	Prim TB complex-no exam
		010.02	Prim TB complex-exm unkn
		010.03	Prim TB complex-micro dx
		010.04	Prim TB complex-cult dx
		010.05	Prim TB complex-histo dx
		010.06	Prim TB complex-oth test
		010.10	Prim TB pleurisy-unspec
		010.11	Prim TB pleurisy-no exam
		010.12	Prim TB pleur-exam unkn
		010.13	Prim TB pleuris-micro dx
		010.14	Prim TB pleurisy-cult dx
		010.15	Prim TB pleuris-histo dx
		010.16	Prim TB pleuris-oth test
		010.80	Prim prog TB NEC-unspec
		010.81	Prim prog TB NEC-no exam
		010.82	Prim pr TB NEC-exam unkn
		010.83	Prim prg TB NEC-micro dx
		010.84	Prim prog TB NEC-cult dx
		010.85	Prim prg TB NEC-histo dx
		010.86	Prim prg TB NEC-oth test
		010.90	Primary TB NOS-unspec
		010.91	Primary TB NOS-no exam
		010.92	Primary TB NOS-exam unkn

CC	CC Description	ICD-9	ICD-9 Description
		010.93	Primary TB NOS-micro dx
		010.94	Primary TB NOS-cult dx
		010.95	Primary TB NOS-histo dx
		010.96	Primary TB NOS-oth test
		011.00	TB lung infiltr-unspec
		011.01	TB lung infiltr-no exam
		011.02	TB lung infiltr-exm unkn
		011.03	TB lung infiltr-micro dx
		011.04	TB lung infiltr-cult dx
		011.05	TB lung infiltr-histo dx
		011.06	TB lung infiltr-oth test
		011.10	TB lung nodular-unspec
		011.11	TB lung nodular-no exam
		011.12	TB lung nodul-exam unkn
		011.13	TB lung nodular-micro dx
		011.14	TB lung nodular-cult dx
		011.15	TB lung nodular-histo dx
		011.16	TB lung nodular-oth test
		011.20	TB lung w cavity-unspec
		011.21	TB lung w cavity-no exam
		011.22	TB lung cavity-exam unkn
		011.23	TB lung w cavit-micro dx
		011.24	TB lung w cavity-cult dx
		011.25	TB lung w cavit-histo dx
		011.26	TB lung w cavit-oth test
		011.30	TB of bronchus-unspec
		011.31	TB of bronchus-no exam
		011.32	TB of bronchus-exam unkn
		011.33	TB of bronchus-micro dx
		011.34	TB of bronchus-cult dx
		011.35	TB of bronchus-histo dx
		011.36	TB of bronchus-oth test
		011.40	TB lung fibrosis-unspec
		011.41	TB lung fibrosis-no exam
		011.42	TB lung fibros-exam unkn
		011.43	TB lung fibros-micro dx
		011.44	TB lung fibrosis-cult dx
		011.45	TB lung fibros-histo dx
		011.46	TB lung fibros-oth test
		011.50	TB bronchiectasis-unspec
		011.51	TB bronchiect-no exam

CC	CC Description	ICD-9	ICD-9 Description
		011.52	TB bronchiect-exam unkn
		011.53	TB bronchiect-micro dx
		011.54	TB bronchiect-cult dx
		011.55	TB bronchiect-histo dx
		011.56	TB bronchiect-oth test
		011.60	TB pneumonia-unspec
		011.61	TB pneumonia-no exam
		011.62	TB pneumonia-exam unkn
		011.63	TB pneumonia-micro dx
		011.64	TB pneumonia-cult dx
		011.65	TB pneumonia-histo dx
		011.66	TB pneumonia-oth test
		011.70	TB pneumothorax-unspec
		011.71	TB pneumothorax-no exam
		011.72	TB pneumothorx-exam unkn
		011.73	TB pneumothorax-micro dx
		011.74	TB pneumothorax-cult dx
		011.75	TB pneumothorax-histo dx
		011.76	TB pneumothorax-oth test
		011.80	Pulmonary TB NEC-unspec
		011.81	Pulmonary TB NEC-no exam
		011.82	Pulmon TB NEC-exam unkn
		011.83	Pulmon TB NEC-micro dx
		011.84	Pulmon TB NEC-cult dx
		011.85	Pulmon TB NEC-histo dx
		011.86	Pulmon TB NEC-oth test
		011.90	Pulmonary TB NOS-unspec
		011.91	Pulmonary TB NOS-no exam
		011.92	Pulmon TB NOS-exam unkn
		011.93	Pulmon TB NOS-micro dx
		011.94	Pulmon TB NOS-cult dx
		011.95	Pulmon TB NOS-histo dx
		011.96	Pulmon TB NOS-oth test
		012.00	TB pleurisy-unspec
		012.01	TB pleurisy-no exam
		012.02	TB pleurisy-exam unkn
		012.03	TB pleurisy-micro dx
		012.04	TB pleurisy-cult dx
		012.05	TB pleurisy-histolog dx
		012.06	TB pleurisy-oth test
		012.10	TB thoracic nodes-unspec

CC	CC Description	ICD-9	ICD-9 Description
		012.11	TB thorax node-no exam
		012.12	TB thorax node-exam unkn
		012.13	TB thorax node-micro dx
		012.14	TB thorax node-cult dx
		012.15	TB thorax node-histo dx
		012.16	TB thorax node-oth test
		012.20	Isol tracheal tb-unspec
		012.21	Isol tracheal tb-no exam
		012.22	Isol trach tb-exam unkn
		012.23	Isolat trach tb-micro dx
		012.24	Isol tracheal tb-cult dx
		012.25	Isolat trach tb-histo dx
		012.26	Isolat trach tb-oth test
		012.30	TB laryngitis-unspec
		012.31	TB laryngitis-no exam
		012.32	TB laryngitis-exam unkn
		012.33	TB laryngitis-micro dx
		012.34	TB laryngitis-cult dx
		012.35	TB laryngitis-histo dx
		012.36	TB laryngitis-oth test
		012.80	Resp TB NEC-unspec
		012.81	Resp TB NEC-no exam
		012.82	Resp TB NEC-exam unkn
		012.83	Resp TB NEC-micro dx
		012.84	Resp TB NEC-cult dx
		012.85	Resp TB NEC-histo dx
		012.86	Resp TB NEC-oth test
		014.00	TB peritonitis-unspec
		014.01	TB peritonitis-no exam
		014.02	TB peritonitis-exam unkn
		014.03	TB peritonitis-micro dx
		014.04	TB peritonitis-cult dx
		014.05	TB peritonitis-histo dx
		014.06	TB peritonitis-oth test
		014.80	Intestinal TB NEC-unspec
		014.81	Intestin TB NEC-no exam
		014.82	Intest TB NEC-exam unkn
		014.83	Intestin TB NEC-micro dx
		014.84	Intestin TB NEC-cult dx
		014.85	Intestin TB NEC-histo dx
		014.86	Intestin TB NEC-oth test

CC	CC Description	ICD-9	ICD-9 Description
		015.00	TB of vertebra-unspec
		015.01	TB of vertebra-no exam
		015.02	TB of vertebra-exam unkn
		015.03	TB of vertebra-micro dx
		015.04	TB of vertebra-cult dx
		015.05	TB of vertebra-histo dx
		015.06	TB of vertebra-oth test
		015.10	TB of hip-unspec
		015.11	TB of hip-no exam
		015.12	TB of hip-exam unkn
		015.13	TB of hip-micro dx
		015.14	TB of hip-cult dx
		015.15	TB of hip-histo dx
		015.16	TB of hip-oth test
		015.20	TB of knee-unspec
		015.21	TB of knee-no exam
		015.22	TB of knee-exam unkn
		015.23	TB of knee-micro dx
		015.24	TB of knee-cult dx
		015.25	TB of knee-histo dx
		015.26	TB of knee-oth test
		015.50	TB of limb bones-unspec
		015.51	TB limb bones-no exam
		015.52	TB limb bones-exam unkn
		015.53	TB limb bones-micro dx
		015.54	TB limb bones-cult dx
		015.55	TB limb bones-histo dx
		015.56	TB limb bones-oth test
		015.60	TB of mastoid-unspec
		015.61	TB of mastoid-no exam
		015.62	TB of mastoid-exam unkn
		015.63	TB of mastoid-micro dx
		015.64	TB of mastoid-cult dx
		015.65	TB of mastoid-histo dx
		015.66	TB of mastoid-oth test
		015.70	TB of bone NEC-unspec
		015.71	TB of bone NEC-no exam
		015.72	TB of bone NEC-exam unkn
		015.73	TB of bone NEC-micro dx
		015.74	TB of bone NEC-cult dx
		015.75	TB of bone NEC-histo dx

CC	CC Description	ICD-9	ICD-9 Description
		015.76	TB of bone NEC-oth test
		015.80	TB of joint NEC-unspec
		015.81	TB of joint NEC-no exam
		015.82	TB joint NEC-exam unkn
		015.83	TB of joint NEC-micro dx
		015.84	TB of joint NEC-cult dx
		015.85	TB of joint NEC-histo dx
		015.86	TB of joint NEC-oth test
		015.90	TB bone/joint NOS-unspec
		015.91	TB bone/jt NOS-no exam
		015.92	TB bone/jt NOS-exam unkn
		015.93	TB bone/jt NOS-micro dx
		015.94	TB bone/jt NOS-cult dx
		015.95	TB bone/jt NOS-histo dx
		015.96	TB bone/jt NOS-oth test
		016.00	TB of kidney-unspec
		016.01	TB of kidney-no exam
		016.02	TB of kidney-exam unkn
		016.03	TB of kidney-micro dx
		016.04	TB of kidney-cult dx
		016.05	TB of kidney-histo dx
		016.06	TB of kidney-oth test
		016.10	TB of bladder-unspec
		016.11	TB of bladder-no exam
		016.12	TB of bladder-exam unkn
		016.13	TB of bladder-micro dx
		016.14	TB of bladder-cult dx
		016.15	TB of bladder-histo dx
		016.16	TB of bladder-oth test
		016.20	TB of ureter-unspec
		016.21	TB of ureter-no exam
		016.22	TB of ureter-exam unkn
		016.23	TB of ureter-micro dx
		016.24	TB of ureter-cult dx
		016.25	TB of ureter-histo dx
		016.26	TB of ureter-oth test
		016.30	TB urinary NEC-unspec
		016.31	TB urinary NEC-no exam
		016.32	TB urinary NEC-exam unkn
		016.33	TB urinary NEC-micro dx
		016.34	TB urinary NEC-cult dx

CC	CC Description	ICD-9	ICD-9 Description
		016.35	TB urinary NEC-histo dx
		016.36	TB urinary NEC-oth test
		016.40	TB epididymis-unspec
		016.41	TB epididymis-no exam
		016.42	TB epididymis-exam unkn
		016.43	TB epididymis-micro dx
		016.44	TB epididymis-cult dx
		016.45	TB epididymis-histo dx
		016.46	TB epididymis-oth test
		016.50	TB male genit NEC-unspec
		016.51	TB male gen NEC-no exam
		016.52	TB male gen NEC-ex unkn
		016.53	TB male gen NEC-micro dx
		016.54	TB male gen NEC-cult dx
		016.55	TB male gen NEC-histo dx
		016.56	TB male gen NEC-oth test
		016.60	TB ovary & tube-unspec
		016.61	TB ovary & tube-no exam
		016.62	TB ovary/tube-exam unkn
		016.63	TB ovary & tube-micro dx
		016.64	TB ovary & tube-cult dx
		016.65	TB ovary & tube-histo dx
		016.66	TB ovary & tube-oth test
		016.70	TB female gen NEC-unspec
		016.71	TB fem gen NEC-no exam
		016.72	TB fem gen NEC-exam unkn
		016.73	TB fem gen NEC-micro dx
		016.74	TB fem gen NEC-cult dx
		016.75	TB fem gen NEC-histo dx
		016.76	TB fem gen NEC-oth test
		016.90	Gu TB NOS-unspec
		016.91	Gu TB NOS-no exam
		016.92	Gu TB NOS-exam unkn
		016.93	Gu TB NOS-micro dx
		016.94	Gu TB NOS-cult dx
		016.95	Gu TB NOS-histo dx
		016.96	Gu TB NOS-oth test
		017.00	TB skin/subcutan-unspec
		017.01	TB skin/subcut-no exam
		017.02	TB skin/subcut-exam unkn
		017.03	TB skin/subcut-micro dx

CC	CC Description	ICD-9	ICD-9 Description
		017.04	TB skin/subcut-cult dx
		017.05	TB skin/subcut-histo dx
		017.06	TB skin/subcut-oth test
		017.10	Erythema nodos tb-unspec
		017.11	Erythem nodos tb-no exam
		017.12	Erythem nod tb-exam unkn
		017.13	Erythem nod tb-micro dx
		017.14	Erythem nodos tb-cult dx
		017.15	Erythem nod tb-histo dx
		017.16	Erythem nod tb-oth test
		017.20	TB periph lymph-unspec
		017.21	TB periph lymph-no exam
		017.22	TB periph lymph-exam unk
		017.23	TB periph lymph-micro dx
		017.24	TB periph lymph-cult dx
		017.25	TB periph lymph-histo dx
		017.26	TB periph lymph-oth test
		017.30	TB of eye-unspec
		017.31	TB of eye-no exam
		017.32	TB of eye-exam unkn
		017.33	TB of eye-micro dx
		017.34	TB of eye-cult dx
		017.35	TB of eye-histo dx
		017.36	TB of eye-oth test
		017.40	TB of ear-unspec
		017.41	TB of ear-no exam
		017.42	TB of ear-exam unkn
		017.43	TB of ear-micro dx
		017.44	TB of ear-cult dx
		017.45	TB of ear-histo dx
		017.46	TB of ear-oth test
		017.50	TB of thyroid-unspec
		017.51	TB of thyroid-no exam
		017.52	TB of thyroid-exam unkn
		017.53	TB of thyroid-micro dx
		017.54	TB of thyroid-cult dx
		017.55	TB of thyroid-histo dx
		017.56	TB of thyroid-oth test
		017.60	TB of adrenal-unspec
		017.61	TB of adrenal-no exam
		017.62	TB of adrenal-exam unkn

CC	CC Description	ICD-9	ICD-9 Description
		017.63	TB of adrenal-micro dx
		017.64	TB of adrenal-cult dx
		017.65	TB of adrenal-histo dx
		017.66	TB of adrenal-oth test
		017.70	TB of spleen-unspec
		017.71	TB of spleen-no exam
		017.72	TB of spleen-exam unkn
		017.73	TB of spleen-micro dx
		017.74	TB of spleen-cult dx
		017.75	TB of spleen-histo dx
		017.76	TB of spleen-oth test
		017.80	TB esophagus-unspec
		017.81	TB esophagus-no exam
		017.82	TB esophagus-exam unkn
		017.83	TB esophagus-micro dx
		017.84	TB esophagus-cult dx
		017.85	TB esophagus-histo dx
		017.86	TB esophagus-oth test
		017.90	TB of organ NEC-unspec
		017.91	TB of organ NEC-no exam
		017.92	TB organ NEC-exam unkn
		017.93	TB of organ NEC-micro dx
		017.94	TB of organ NEC-cult dx
		017.95	TB of organ NEC-histo dx
		017.96	TB of organ NEC-oth test
		018.00	Acute miliary tb-unspec
		018.01	Acute miliary tb-no exam
		018.02	Ac miliary tb-exam unkn
		018.03	Ac miliary tb-micro dx
		018.04	Acute miliary tb-cult dx
		018.05	Ac miliary tb-histo dx
		018.06	Ac miliary tb-oth test
		018.80	Miliary TB NEC-unspec
		018.81	Miliary TB NEC-no exam
		018.82	Miliary TB NEC-exam unkn
		018.83	Miliary TB NEC-micro dx
		018.84	Miliary TB NEC-cult dx
		018.85	Miliary TB NEC-histo dx
		018.86	Miliary TB NEC-oth test
		018.90	Miliary TB NOS-unspec
		018.91	Miliary TB NOS-no exam

CC	CC Description	ICD-9	ICD-9 Description
		018.92	Miliary TB NOS-exam unkn
		018.93	Miliary TB NOS-micro dx
		018.94	Miliary TB NOS-cult dx
		018.95	Miliary TB NOS-histo dx
		018.96	Miliary TB NOS-oth test
5	Opportunistic Infections	007.4	Cryptosporidiosis
		031.0	Pulmonary mycobacteria
		031.2	DMAC bacteremia
		078.5	Cytomegaloviral disease
		112.4	Candidiasis of lung
		112.5	Disseminated candidiasis
		112.84	Candidal esophagitis
		117.3	Aspergillosis
		117.5	Cryptococcosis
		117.7	Zygomycosis
		130.0	Toxoplasm meningoenceph
		130.8	Multisystem toxoplasmos
		136.3	Pneumocystosis
		321.0	Cryptococcal meningitis
		484.1	Pneum w cytomeg incl dis
6	Other Infectious Diseases	001.0	Cholera d/t vib cholerae
		001.1	Cholera d/t vib el tor
		001.9	Cholera NOS
		002.0	Typhoid fever
		002.1	Paratyphoid fever a
		002.2	Paratyphoid fever b
		002.3	Paratyphoid fever c
		002.9	Paratyphoid fever NOS
		005.0	Staph food poisoning
		005.1	Botulism food poisoning
		005.2	Food pois d/t c. perfrin
		005.3	Food pois: clostrid NEC
		005.4	Food pois: v. parahaem
		005.81	Food poisn d/t v. vulnif
		005.89	Bact food poisoning NEC
		005.9	Food poisoning NOS
		006.0	Ac amebiasis w/o abscess
		006.1	Chr amebiasis w/o absces
		006.2	Amebic nondysent colitis
		006.8	Amebic infection NEC
		006.9	Amebiasis NOS

CC	CC Description	ICD-9	ICD-9 Description
		007.0	Balantidiasis
		007.1	Giardiasis
		007.2	Coccidiosis
		007.3	Intest trichomoniasis
		007.5	Cyclosporiasis
		007.8	Protozoal intest dis NEC
		007.9	Protozoal intest dis NOS
		008.61	Intes infec rotavirus
		008.62	Intes infec adenovirus
		008.63	Int inf norwalk virus
		008.64	Int inf oth sml rnd vrus
		008.65	Enteritis d/t calicivirs
		008.66	Intes infec astrovirus
		008.67	Int inf enterovirus NEC
		008.69	Other viral intes infec
		008.8	Viral enteritis NOS
		009.0	Infectious enteritis NOS
		009.1	Enteritis of infect orig
		009.2	Infectious diarrhea NOS
		009.3	Diarrhea of infect orig
		020.0	Bubonic plague
		020.8	Other types of plague
		020.9	Plague NOS
		021.0	Ulceroglandul tularemia
		021.1	Enteric tularemia
		021.3	Oculoglandular tularemia
		021.8	Tularemia NEC
		021.9	Tularemia NOS
		022.2	Gastrointestinal anthrax
		022.8	Other anthrax manifest
		022.9	Anthrax NOS
		023.0	Brucella melitensis
		023.1	Brucella abortus
		023.2	Brucella suis
		023.3	Brucella canis
		023.8	Brucellosis NEC
		023.9	Brucellosis NOS
		024	Glanders
		025	Melioidosis
		026.0	Spirillary fever
		026.1	Streptobacillary fever

CC	CC Description	ICD-9	ICD-9 Description
		026.9	Rat-bite fever NOS
		027.0	Listeriosis
		027.1	Erysipelothrix infection
		027.2	Pasteurellosis
		027.8	Zoonotic bact dis NEC
		027.9	Zoonotic bact dis NOS
		030.0	Lepromatous leprosy
		030.1	Tuberculoid leprosy
		030.2	Indeterminate leprosy
		030.3	Borderline leprosy
		030.8	Leprosy NEC
		030.9	Leprosy NOS
		031.8	Mycobacterial dis NEC
		031.9	Mycobacterial dis NOS
		032.0	Faucial diphtheria
		032.1	Nasopharynx diphtheria
		032.2	Ant nasal diphtheria
		032.3	Laryngeal diphtheria
		032.81	Conjunctival diphtheria
		032.89	Diphtheria NEC
		032.9	Diphtheria NOS
		033.0	Bordetella pertussis
		033.1	Bordetella parapertussis
		033.8	Whooping cough NEC
		033.9	Whooping cough NOS
		034.0	Strep sore throat
		034.1	Scarlet fever
		036.89	Meningococcal infect NEC
		036.9	Meningococcal infect NOS
		039.2	Abdominal actinomycosis
		039.3	Cervicofac actinomycosis
		039.4	Madura foot
		039.8	Actinomycosis NEC
		039.9	Actinomycosis NOS
		040.1	Rhinoscleroma
		040.3	Necrobacillosis
		040.41	Infant botulism
		040.42	Wound botulism
		040.81	Tropical pyomyositis
		040.89	Bacterial diseases NEC
		041.00	Streptococcus unspecf

CC	CC Description	ICD-9	ICD-9 Description
		041.01	Streptococcus group a
		041.02	Streptococcus group b
		041.03	Streptococcus group c
		041.04	Enterococcus group d
		041.05	Streptococcus group g
		041.09	Other streptococcus
		041.10	Staphylococcus unspcfied
		041.11	Mth sus Stph aur els/NOS
		041.12	MRSA elsewhere/NOS
		041.19	Other staphylococcus
		041.2	Pneumococcus infect NOS
		041.3	Klebsiella pneumoniae
		041.4	E. coli infect NOS
		041.5	H. influenzae infect NOS
		041.6	Proteus infection NOS
		041.7	Pseudomonas infect NOS
		041.81	Mycoplasma
		041.82	Bacteroides fragilis
		041.83	Clostridium perfringens
		041.84	Other anaerobes
		041.85	Oth gram negatv bacteria
		041.86	Helicobacter pylori
		041.89	Oth specf bacteria
		041.9	Bacterial infection NOS
		050.0	Variola major
		050.1	Alastrim
		050.2	Modified smallpox
		050.9	Smallpox NOS
		051.0	COWPOX
		051.1	Pseudocowpox
		051.2	Contagious pustular derm
		051.9	Paravaccinia NOS
		052.7	Varicella complicat NEC
		052.8	Varicella complicat NOS
		052.9	Varicella uncomplicated
		053.20	Herpes zoster of eyelid
		053.21	H zoster keratoconjunct
		053.29	Herpes zoster of eye NEC
		053.71	H zoster otitis externa
		053.79	H zoster complicated NEC
		053.8	H zoster complicated NOS

CC	CC Description	ICD-9	ICD-9 Description
		053.9	Herpes zoster NOS
		054.0	Eczema herpeticum
		054.10	Genital herpes NOS
		054.11	Herpetic vulvovaginitis
		054.12	Herpetic ulcer of vulva
		054.13	Herpetic infect of penis
		054.19	Genital herpes NEC
		054.2	Herpetic gingivostomat
		054.40	Herpes simplex eye NOS
		054.41	Herpes simplex of eyelid
		054.42	Dendritic keratitis
		054.43	H simplex keratitis
		054.49	Herpes simplex eye NEC
		054.6	Herpetic whitlow
		054.71	Visceral herpes simplex
		054.73	H simplex otitis externa
		054.79	H simplex complicat NEC
		054.8	H simplex complicat NOS
		054.9	Herpes simplex NOS
		055.2	Postmeasles otitis media
		055.71	Measles keratitis
		055.79	Measles complication NEC
		055.8	Measles complication NOS
		055.9	Measles uncomplicated
		056.00	Rubella nerve compl NOS
		056.09	Rubella nerve compl NEC
		056.79	Rubella complication NEC
		056.8	Rubella complication NOS
		056.9	Rubella uncomplicated
		057.0	Erythema infectiosum
		057.8	Viral exanthemata NEC
		057.9	Viral exanthemata NOS
		058.10	Roseola infantum NOS
		058.11	Roseola infant d/t HHV-6
		058.12	Roseola infant d/t HHV-7
		058.81	Human herpesvirus 6 infc
		058.82	Human herpesvirus 7 infc
		058.89	Human herpesvirs inf NEC
		059.00	Orthopoxvirus infect NOS
		059.01	Monkeypox
		059.09	Orthopoxvirus infect NEC

CC	CC Description	ICD-9	ICD-9 Description
		059.10	Parapoxvirus infectn NOS
		059.11	Bovine stomatitis
		059.12	Sealpox
		059.19	Parapoxvirus infectn NEC
		059.20	Yatapoxvirus infectn NOS
		059.21	Tanapox
		059.22	Yaba monkey tumor virus
		059.8	Poxvirus infections NEC
		059.9	Poxvirus infection NOS
		060.0	Sylvatic yellow fever
		060.1	Urban yellow fever
		060.9	Yellow fever NOS
		061	Dengue
		065.0	Crimean hemorrhagic fev
		065.1	Omsk hemorrhagic fever
		065.2	Kyasanur forest disease
		065.3	Tick-borne hem fever NEC
		065.4	Mosquito-borne hem fever
		065.8	Arthropod hem fever NEC
		065.9	Arthropod hem fever NOS
		066.0	Phlebotomus fever
		066.1	Tick-borne fever
		066.3	Mosquito-borne fever NEC
		066.8	Arthropod virus NEC
		066.9	Arthropod virus NOS
		070.1	Hepatitis A w/o coma
		070.9	Viral hepat NOS w/o coma
		072.0	Mumps orchitis
		072.71	Mumps hepatitis
		072.72	Mumps polyneuropathy
		072.79	Mumps complication NEC
		072.8	Mumps complication NOS
		072.9	Mumps uncomplicated
		073.7	Ornithosis complicat NEC
		073.8	Ornithosis complicat NOS
		073.9	Ornithosis NOS
		074.0	Herpangina
		074.1	Epidemic pleurodynia
		074.3	Hand, foot & mouth dis
		074.8	Coxsackie virus NEC
		075	Infectious mononucleosis

CC	CC Description	ICD-9	ICD-9 Description
		076.0	Trachoma, initial stage
		076.1	Trachoma, active stage
		076.9	Trachoma NOS
		077.0	Inclusion conjunctivitis
		077.1	Epidem keratoconjunctiv
		077.2	Pharyngoconjunct fever
		077.3	Adenoviral conjunct NEC
		077.4	Epidem hem conjunctivit
		077.8	Viral conjunctivitis NEC
		077.98	Unsp ds conjuc chlamydia
		077.99	Unsp ds conjuc viruses
		078.0	Molluscum contagiosum
		078.10	Viral warts NOS
		078.11	Condyloma acuminatum
		078.12	Plantar wart
		078.19	Oth specfd viral warts
		078.2	Sweating fever
		078.3	Cat-scratch disease
		078.4	Foot & mouth disease
		078.7	Arenaviral hem fever
		078.81	Epidemic vertigo
		078.82	Epidemic vomiting synd
		078.88	Oth spec dis chlamydiae
		078.89	Oth spec dis viruses
		079.0	Adenovirus infect NOS
		079.1	Echo virus infect NOS
		079.2	Coxsackie virus inf NOS
		079.3	Rhinovirus infect NOS
		079.4	Human papillomavirus
		079.50	Retrovirus, unspecified
		079.51	Htlv-1 infection oth dis
		079.52	Htlv-ii infectn oth dis
		079.59	Oth specfied retrovirus
		079.6	Resprtry syncytial virus
		079.83	Parvovirus B19
		079.88	Oth spcf chlamydial infc
		079.89	Oth specf viral infectn
		079.98	Chlamydial infection NOS
		079.99	Viral infection NOS
		080	Louse-borne typhus
		081.0	Murine typhus

CC	CC Description	ICD-9	ICD-9 Description
		081.1	Brill's disease
		081.2	Scrub typhus
		081.9	Typhus NOS
		082.0	Spotted fevers
		082.1	Boutonneuse fever
		082.2	North asian tick fever
		082.3	Queensland tick typhus
		082.40	Ehrlichiosis NOS
		082.41	Ehrlichiosis chafeensis
		082.49	Ehrlichiosis NEC
		082.8	Tick-borne ricketts NEC
		082.9	Tick-borne ricketts NOS
		083.0	Q fever
		083.1	Trench fever
		083.2	Rickettsialpox
		083.8	Rickettsioses NEC
		083.9	Rickettsiosis NOS
		084.0	Falciparum malaria
		084.1	Vivax malaria
		084.2	Quartan malaria
		084.3	Ovale malaria
		084.4	Malaria NEC
		084.5	Mixed malaria
		084.6	Malaria NOS
		084.7	Induced malaria
		084.8	Blackwater fever
		084.9	Malaria complicated NEC
		085.0	Visceral leishmaniasis
		085.1	Cutan leishmanias urban
		085.2	Cutan leishmanias asian
		085.3	Cutan leishmanias ethiop
		085.4	Cutan leishmanias amer
		085.5	Mucocutan leishmaniasis
		085.9	Leishmaniasis NOS
		086.0	Chagas disease of heart
		086.1	Chagas dis of oth organ
		086.2	Chagas disease NOS
		086.3	Gambian trypanosomiasis
		086.4	Rhodesian trypanosomias
		086.5	African trypanosoma NOS
		086.9	Trypanosomiasis NOS

CC	CC Description	ICD-9	ICD-9 Description
		087.0	Louse-borne relaps fever
		087.1	Tick-borne relaps fever
		087.9	Relapsing fever NOS
		088.0	Bartonellosis
		088.81	Lyme disease
		088.82	Babesiosis
		088.89	Oth arthropod-borne dis
		088.9	Arthropod-borne dis NOS
		090.3	Syphilitic keratitis
		090.5	Late congen syph symptom
		090.6	Late congen syph latent
		090.7	Late congen syph NOS
		090.9	Congenital syphilis NOS
		091.0	Primary genital syphilis
		091.1	Primary anal syphilis
		091.2	Primary syphilis NEC
		091.3	Secondary syph skin
		091.4	Syphilitic adenopathy
		091.50	Syphilitic uveitis NOS
		091.51	Syphilit chorioretinitis
		091.52	Syphilitic iridocyclitis
		091.61	Syphilitic periostitis
		091.69	Second syph viscera NEC
		091.7	Second syphilis relapse
		091.82	Syphilitic alopecia
		091.89	Secondary syphilis NEC
		091.9	Secondary syphilis NOS
		092.0	Early syph latent relaps
		092.9	Early syphil latent NOS
		095.0	Syphilitic episcleritis
		095.1	Syphilis of lung
		095.2	Syphilitic peritonitis
		095.4	Syphilis of kidney
		095.5	Syphilis of bone
		095.6	Syphilis of muscle
		095.7	Syphilis of tendon/bursa
		095.8	Late sympt syphilis NEC
		095.9	Late sympt syphilis NOS
		096	Late syphilis latent
		097.0	Late syphilis NOS
		097.1	Latent syphilis NOS

CC	CC Description	ICD-9	ICD-9 Description
		097.9	Syphilis NOS
		098.0	Acute gc infect lower gu
		098.10	Gc (acute) upper gu NOS
		098.11	Gc cystitis (acute)
		098.12	Gc prostatitis (acute)
		098.13	Gc orchitis (acute)
		098.14	Gc sem vesiculit (acute)
		098.15	Gc cervicitis (acute)
		098.16	Gc endometritis (acute)
		098.17	Acute gc salpingitis
		098.19	Gc (acute) upper gu NEC
		098.2	Chr gc infect lower gu
		098.30	Chr gc upper gu NOS
		098.31	Gc cystitis, chronic
		098.32	Gc prostatitis, chronic
		098.33	Gc orchitis, chronic
		098.34	Gc sem vesiculitis, chr
		098.35	Gc cervicitis, chronic
		098.36	Gc endometritis, chronic
		098.37	Gc salpingitis (chronic)
		098.39	Chr gc upper gu NEC
		098.40	Gonococcal conjunctivit
		098.42	Gonococcal endophthalmia
		098.43	Gonococcal keratitis
		098.49	Gonococcal eye NEC
		098.6	Gonococcal infec pharynx
		098.7	Gc infect anus & rectum
		098.81	Gonococcal keratosis
		098.85	Gonococcal heart dis NEC
		098.89	Gonococcal inf site NEC
		099.0	Chancroid
		099.1	Lymphogranuloma venereum
		099.2	Granuloma inguinale
		099.40	Unspcf nongnccl urethrts
		099.41	Chlmyd trachomatis ureth
		099.49	Nongc urth oth spf orgsm
		099.50	Oth VD chlm trch unsp st
		099.51	Oth VD chlm trch pharynx
		099.52	Oth VD chlm trch ans rct
		099.53	Oth VD chlm trch lowr gu
		099.54	Oth VD chlm trch oth gu

CC	CC Description	ICD-9	ICD-9 Description
		099.55	Ot VD chlm trch unspf gu
		099.56	Ot VD chlm trch prtoneum
		099.59	Oth VD chlm trch spcf st
		099.8	Venereal disease NEC
		099.9	Venereal disease NOS
		100.0	Leptospiros icterohem
		100.89	Leptospiral infect NEC
		100.9	Leptospirosis NOS
		101	Vincent's angina
		102.0	Initial lesions yaws
		102.1	Multiple papillomata
		102.2	Early skin yaws NEC
		102.3	Hyperkeratosis of yaws
		102.4	Gummata and ulcers, yaws
		102.5	Gangosa
		102.7	Yaws manifestations NEC
		102.8	Latent yaws
		102.9	Yaws NOS
		103.0	Pinta primary lesions
		103.1	Pinta intermed lesions
		103.2	Pinta late lesions
		103.3	Pinta mixed lesions
		103.9	Pinta NOS
		104.0	Nonvenereal endemic syph
		104.8	Spirochetal infect NEC
		104.9	Spirochetal infect NOS
		110.0	Dermatophyt scalp/beard
		110.1	Dermatophytosis of nail
		110.2	Dermatophytosis of hand
		110.3	Dermatophytosis of groin
		110.4	Dermatophytosis of foot
		110.5	Dermatophytosis of body
		110.6	Deep dermatophytosis
		110.8	Dermatophytosis site NEC
		110.9	Dermatophytosis site NOS
		111.0	Pityriasis versicolor
		111.1	Tinea nigra
		111.2	Tinea blanca
		111.3	Black piedra
		111.8	Dermatomycoses NEC
		111.9	Dermatomycosis NOS

CC	CC Description	ICD-9	ICD-9 Description
		112.0	Thrush
		112.2	Candidias urogenital NEC
		112.3	Cutaneous candidiasis
		112.82	Candidal otitis externa
		112.85	Candidal enteritis
		112.89	Candidiasis site NEC
		112.9	Candidiasis site NOS
		114.1	Prim cutan coccidioid
		114.3	Progress coccidioid NEC
		114.9	Coccidioidomycosis NOS
		115.00	Histoplasma capsulat NOS
		115.02	Histoplasm capsul retina
		115.09	Histoplasma capsulat NEC
		115.10	Histoplasma duboisii NOS
		115.12	Histoplasm dubois retina
		115.19	Histoplasma duboisii NEC
		115.90	Histoplasmosis NOS
		115.92	Histoplasmosis retinitis
		115.99	Histoplasmosis NEC
		116.0	Blastomycosis
		116.1	Paracoccidioidomycosis
		116.2	Lobomycosis
		117.0	Rhinosporidiosis
		117.1	Sporotrichosis
		117.2	Chromoblastomycosis
		117.4	Mycotic mycetomas
		117.6	Allescheriosis
		117.8	Dematiacious fungi inf
		117.9	Mycoses NEC & NOS
		118	Opportunistic mycoses
		120.0	Schistosoma haematobium
		120.1	Schistosoma mansoni
		120.2	Schistosoma japonicum
		120.3	Cutaneous schistosoma
		120.8	Schistosomiasis NEC
		120.9	Schistosomiasis NOS
		121.0	Opisthorchiasis
		121.1	Clonorchiasis
		121.3	Fascioliasis
		121.4	Fasciolopsiasis
		121.5	Metagonimiasis

CC	CC Description	ICD-9	ICD-9 Description
		121.6	Heterophyiasis
		121.8	Trematode infection NEC
		121.9	Trematode infection NOS
		122.2	Echinococc gran thyroid
		122.3	Echinococc granul NEC
		122.4	Echinococc granul NOS
		122.6	Echinococc multiloc NEC
		122.7	Echinococc multiloc NOS
		122.9	Echinococcosis NEC/NOS
		123.0	Taenia solium intestine
		123.1	Cysticercosis
		123.2	Taenia saginata infect
		123.3	Taeniasis NOS
		123.4	Diphyllobothrias intest
		123.5	Sparganosis
		123.6	Hymenolepiasis
		123.8	Cestode infection NEC
		123.9	Cestode infection NOS
		124	Trichinosis
		125.0	Bancroftian filariasis
		125.1	Malayan filariasis
		125.2	Loiasis
		125.3	Onchocerciasis
		125.4	Dipetalonemiasis
		125.5	Mansonella ozzardi infec
		125.6	Filariasis NEC
		125.7	Dracontiasis
		125.9	Filariasis NOS
		126.0	Ancylostoma duodenale
		126.1	Necator Americanus
		126.2	Ancylostoma braziliense
		126.3	Ancylostoma ceylanicum
		126.8	Ancylostoma NEC
		126.9	Ancylostomiasis NOS
		127.0	Ascariasis
		127.1	Anisakiasis
		127.2	Strongyloidiasis
		127.3	Trichuriasis
		127.4	Enterobiasis
		127.5	Capillariasis
		127.6	Trichostrongyliasis

CC	CC Description	ICD-9	ICD-9 Description
		127.7	Intest helminthiasis NEC
		127.8	Mixed intestine helminth
		127.9	Intest helminthiasis NOS
		128.0	Toxocariasis
		128.1	Gnathostomiasis
		128.8	Helminthiasis NEC
		128.9	Helminthiasis NOS
		129	Intestin parasitism NOS
		130.1	Toxoplasm conjunctivitis
		130.7	Toxoplasmosis site NEC
		130.9	Toxoplasmosis NOS
		132.0	Pediculus capitis
		132.1	Pediculus corporis
		132.2	Phthirus pubis
		132.3	Mixed pedicul & phthirus
		132.9	Pediculosis NOS
		133.0	Scabies
		133.8	Acariasis NEC
		133.9	Acariasis NOS
		134.0	Myiasis
		134.1	Arthropod infest NEC
		134.2	Hirudiniasis
		134.8	Infestation NEC
		134.9	Infestation NOS
		136.0	Ainhum
		136.2	FREE-LIVING AMEBA INFECT
		136.4	Psorospermiasis
		136.5	Sarcosporidiosis
		136.8	Infect/parasite dis NEC
		136.9	Infect/parasite dis NOS
		137.0	Late effect tb, resp/NOS
		137.2	Late effect gu TB
		137.3	Late eff bone & joint TB
		137.4	Late effect TB NEC
		139.1	Late effect of trachoma
		139.8	Late eff infect dis NEC
		573.1	Hepatitis in viral dis
		V09.0	Inf mcrg rstn pncllins
		V09.1	Inf mcrg rstn b-lactam
		V09.2	Inf mcrg rstn macrolides

CC	CC Description	ICD-9	ICD-9 Description
		V09.3	Inf mcrg rstn ttrcycln
		V09.4	Inf mcrg rstn amnglcsds
		V09.50	Inf mcr rst qn flr nt ml
		V09.51	Inf mcrg rstn qn flrq ml
		V09.6	Inf mcrg rstn sulfnmides
		V09.70	Inf mcr rst oth ag nt ml
		V09.71	Inf mcrg rstn oth ag mlt
		V09.80	Inf mcr rst ot drg nt ml
		V09.81	Inf mcrg rstn oth drg ml
		V09.90	Infc mcrg drgrst nt mult
		V09.91	Infc mcrg drgrst mult
21	Protein-Calorie Malnutrition	260	Kwashiorkor
		261	Nutritional marasmus
		262	Oth severe malnutrition
		263.0	Malnutrition mod degree
		263.1	Malnutrition mild degree
		263.2	Arrest devel d/t malnutr
		263.8	Protein-cal malnutr NEC
		263.9	Protein-cal malnutr NOS
		799.4	Cachexia
22	Other Significant Endocrine and Metabolic Disorders	036.3	Meningococc adrenal synd
		251.0	Hypoglycemic coma
		252.00	Hyperparathyroidism NOS
		252.01	Primary hyperparathyroid
		252.02	Sec hyprprthyrd nonrenal
		252.08	Hyperparathyroidism NEC
		252.1	Hypoparathyroidism
		252.8	Parathyroid disorder NEC
		252.9	Parathyroid disorder NOS
		253.0	Acromegaly and gigantism
		253.1	Ant pituit hyperfunc NEC
		253.2	Panhypopituitarism
		253.3	Pituitary dwarfism
		253.4	Anter pituitary dis NEC
		253.5	Diabetes insipidus
		253.6	Neurohypophysis dis NEC
		253.7	Iatrogenic pituitary dis
		253.8	Pituitary disorder NEC
		253.9	Pituitary disorder NOS
		254.0	Persist hyperplas thymus

CC	CC Description	ICD-9	ICD-9 Description
		254.1	Abscess of thymus
		254.8	Diseases of thymus NEC
		254.9	Disease of thymus NOS
		255.0	Cushing's syndrome
		255.10	Hyperaldosteronism NOS
		255.11	Glucrtcod-rem aldsternsm
		255.12	Conn's syndrome
		255.13	Bartter's syndrome
		255.14	Secondry aldosternsm NEC
		255.2	Adrenogenital disorders
		255.3	Corticoadren overact NEC
		255.4	CORTICOADRENAL INSUFFIC
		255.5	Adrenal hypofunction NEC
		255.6	Medulloadrenal hyperfunc
		255.8	Adrenal disorder NEC
		255.9	Adrenal disorder NOS
		258.0	WERMER'S SYNDROME
		258.1	Comb endocr dysfunct NEC
		258.8	Polyglandul dysfunc NEC
		258.9	Polyglandul dysfunc NOS
		270.0	Amino-acid transport dis
		270.1	Phenylketonuria - pku
		270.2	Arom amin-acid metab NEC
		270.3	Bran-chain amin-acid dis
		270.4	Sulph amino-acid met dis
		270.5	Dis histidine metabolism
		270.6	Dis urea cycle metabol
		270.7	Straig amin-acid met NEC
		270.8	Dis amino-acid metab NEC
		270.9	Dis amino-acid metab NOS
		271.0	Glycogenosis
		271.1	Galactosemia
		271.4	Renal glycosuria
		271.8	Dis carbohydr metab NEC
		271.9	Dis carbohydr metab NOS
		272.7	Lipidoses
		273.2	Paraproteinemia NEC
		273.3	Macroglobulinemia
		273.4	Alpha-1-antitrypsin def
		275.0	Dis iron metabolism

CC	CC Description	ICD-9	ICD-9 Description
		275.1	Dis copper metabolism
		275.3	Dis phosphorus metabol
		277.1	Dis porphyrin metabolism
		277.2	Purine/pyrimid dis NEC
		277.30	Amyloidosis NOS
		277.31	Fam Mediterranean fever
		277.39	Amyloidosis NEC
		277.5	Mucopolysaccharidosis
		277.6	Defic circul enzyme NEC
		277.7	Dysmetabolic syndrome x
		277.81	Primary carnitine defncy
		277.82	Crnitne def d/t nb met
		277.83	Iatrogenic carnitine def
		277.84	Sec carnitine defncy NEC
		277.85	Disorders acid oxidation
		277.86	Peroxisomal disorders
		277.87	Dis mitochondrial metab
		277.89	Metabolism disorder NEC
		588.81	Sec hyperparathyrd-renal
23	Disorders of Fluid/Electrolyte/Acid-Base Balance	276.0	Hyperosmolality
		276.1	Hyposmolality
		276.2	Acidosis
		276.3	Alkalosis
		276.4	Mixed acid-base bal dis
		276.50	Volume depletion NOS
		276.51	Dehydration
		276.52	Hypovolemia
		276.6	Fluid overload
		276.7	Hyperpotassemia
		276.8	Hypopotassemia
		276.9	Electrolyt/fluid dis NEC
		277.88	Tumor lysis syndrome
79	Cardio-Respiratory Failure and Shock	427.41	Ventricular fibrillation
		427.42	Ventricular flutter
		427.5	Cardiac arrest
		518.4	Acute lung edema NOS
		518.5	Post traum pulm insuffic
		518.81	Acute respiratry failure
		518.82	Other pulmonary insuff
		518.83	Chronic respiratory fail

CC	CC Description	ICD-9	ICD-9 Description
		518.84	Acute & chronc resp fail
		785.50	Shock NOS
		785.51	Cardiogenic shock
		798.0	Sudden infant death synd
		798.1	Instantaneous death
		798.2	Death within 24 hr sympt
		798.9	Unattended death
		799.01	Asphyxia
		799.02	Hypoxemia
111	Aspiration and Specified Bacterial Pneumonias	482.0	K. pneumoniae pneumonia
		482.1	Pseudomonal pneumonia
		482.40	Staphylococcal pneu NOS
		482.41	Meth sus pneum d/t Staph
		482.42	Meth res pneu d/t Staph
		482.49	Staph pneumonia NEC
		482.81	Pneumonia anaerobes
		482.82	Pneumonia e coli
		482.83	Pneumo oth grm-neg bact
		482.84	Legionnaires' disease
		482.89	Pneumonia oth spcf bact
		507.0	Food/vomit pneumonitis
		507.1	Oil/essence pneumonitis
		507.8	Solid/liq pneumonit NEC
112	Pneumococcal Pneumonia, Empyema, Lung Abscess	003.22	Salmonella pneumonia
		006.4	Amebic lung abscess
		020.3	Primary pneumonic plague
		020.4	Secondary pneumon plague
		020.5	Pneumonic plague NOS
		021.2	Pulmonary tularemia
		022.1	Pulmonary anthrax
		039.1	Pulmonary actinomycosis
		114.0	Primary coccidioidomycos
		114.4	Ch pl coccidioidomycosis
		114.5	Pl cocidioidomycosis NOS
		115.05	Histoplasm caps pneumon
		115.15	Histoplasm dub pneumonia
		115.95	Histoplasmosis pneumonia
		121.2	Paragonimiasis
		122.1	Echinococc granul lung
		130.4	Toxoplasma pneumonitis

CC	CC Description	ICD-9	ICD-9 Description
		221	Pulmonary anthrax
		481	Pneumococcal pneumonia
		482.2	H.influenzae pneumonia
		482.30	Streptococcal pneumn NOS
		482.31	Pneumonia strptococcus a
		482.32	Pneumonia strptococcus b
		482.39	Pneumonia oth strep
		484.6	Pneum in aspergillosis
		484.7	Pneum in oth sys mycoses
		510.0	Empyema with fistula
		510.9	Empyema w/o fistula
		513.0	Abscess of lung
		513.1	Abscess of mediastinum
		64	Amebic lung abscess
113	Viral and Unspecified Pneumonia, Pleurisy	052.1	Varicella pneumonitis
		055.1	Postmeasles pneumonia
		073.0	Ornithosis pneumonia
		079.81	Hantavirus infection
		079.82	SARS assoc coronavirus
		480.0	Adenoviral pneumonia
		480.1	Resp syncyt viral pneum
		480.2	Parinfluenza viral pneum
		480.3	Pneumonia due to SARS
		480.8	Viral pneumonia NEC
		480.9	Viral pneumonia NOS
		482.9	Bacterial pneumonia NOS
		483.0	Pneu mycplsm pneumoniae
		483.1	Pneumonia d/t chlamydia
		483.8	Pneumon oth spec orgnsm
		484.3	Pneumonia in whoop cough
		484.5	Pneumonia in anthrax
		484.8	Pneum in infect dis NEC
		485	Bronchopneumonia org NOS
		486	Pneumonia, organism NOS
		487.0	Influenza with pneumonia
		488.01	Flu dt iden avian w pneu
		488.11	Flu dt 2009 H1N1 w pneu
		511.0	Pleurisy w/o effus or TB
		514	Pulm congest/hypostasis
		521	Varicella pneumonitis

CC	CC Description	ICD-9	ICD-9 Description
		730	Ornithosis pneumonia
114	Pleural Effusion/Pneumothorax	511.1	Bact pleur/effus not TB
		511.8	PLEURAL EFFUS NEC NOT TB
		511.9	Pleural effusion NOS
		512.0	Spont tens pneumothorax
		512.1	Iatrogenic pneumothorax
		512.8	Spont pneumothorax NEC
131	Renal Failure	403.01	Mal hyp kid w cr kid V
		403.11	Ben hyp kid w cr kid V
		403.91	Hyp kid NOS w cr kid V
		404.02	Mal hy ht/kd st V w/o hf
		404.03	Mal hyp ht/kd stg V w hf
		404.12	Ben hy ht/kd st V w/o hf
		404.13	Ben hyp ht/kd stg V w hf
		404.92	Hy ht/kd NOS st V w/o hf
		404.93	Hyp ht/kd NOS st V w hf
		584.5	Ac kidny fail, tubr necr
		584.6	Ac kidny fail, cort necr
		584.7	Ac kidny fail, medu necr
		584.8	Acute kidney failure NEC
		584.9	Acute kidney failure NOS
		585.1	Chro kidney dis stage I
		585.2	Chro kidney dis stage II
		585.3	Chr kidney dis stage III
		585.4	Chr kidney dis stage IV
		585.5	Chron kidney dis stage V
		585.6	End stage renal disease
		585.9	Chronic kidney dis NOS
		586	Renal failure NOS
		753.14	Polycyst kid-autosom rec
135	Urinary Tract Infection	032.84	Diphtheritic cystitis
		590.00	Chr pyelonephritis NOS
		590.01	Chr pyeloneph w med necr
		590.10	Ac pyelonephritis NOS
		590.11	Ac pyelonephr w med necr
		590.2	Renal/perirenal abscess
		590.3	Pyeloureteritis cystica
		590.80	Pyelonephritis NOS
		590.81	Pyelonephrit in oth dis
		590.9	Infection of kidney NOS

CC	CC Description	ICD-9	ICD-9 Description
		595.0	Acute cystitis
		595.1	Chr interstit cystitis
		595.2	Chronic cystitis NEC
		595.3	Trigonitis
		595.4	Cystitis in oth dis
		595.81	Cystitis cystica
		595.82	Irradiation cystitis
		595.89	Cystitis NEC
		595.9	Cystitis NOS
		597.0	Urethral abscess
		597.80	Urethritis NOS
		597.81	Urethral syndrome NOS
		597.89	Urethritis NEC
		599.0	Urin tract infection NOS

Appendix C

Literature Review – 2008 to 2013

The following abstracts were obtained from a search of the literature from 2008 to date, looking for risk factors affecting hospital length of stay for heart attacks, heart failure and pneumonia. After scanning the intial set of 200+ articles, those below contain indications of diagnostic conditions (and other interesting, but non-diagnostic factors) correlated with longer hospital stays. These articles suggest the following candidate diagnostic factors:

- Heart attack: age, diabetes and obesity
- Heart failure: age, diabetes, COPD, previous AMI
- Pneumonia: age, liver disease, alcohol, pleural empyema, prior cardiovascular events

All of these, except obesity, are included as candidate variables for the current length-of-stay regression models. Obesity was a candidate factor in prior modeling and, at that time, was eliminated in favor of other risk factors.

Heart Attack

11. Am Heart J. 2011 Dec;162(6):1052-61. doi: 10.1016/j.ahj.2011.09.008.

Trends and predictors of length of stay after primary percutaneous coronary intervention: a report from the CathPCI registry.

Chin CT, Weintraub WS, Dai D, Mehta RH, Rumsfeld JS, Anderson HV, Messenger JC, Kutcher MA, Peterson ED, Brindis RG, Rao SV.

Duke Clinical Research Institute, Durham, NC, USA. chin.chee.tang@nhcs.com.sg

BACKGROUND: Post hoc analyses of clinical trials suggest that certain patients are eligible for early discharge after ST-segment elevation myocardial infarction. The extent to which ST-segment elevation myocardial infarction patients are discharged early after primary percutaneous coronary intervention (PPCI) in current practice is unknown.
METHODS: We examined 115,113 patients in the CathPCI Registry to assess temporal trends in length of stay (LOS) after PPCI. Baseline characteristics were compared between patients with LOS ≤2 and >2 days. Predictors of LOS >2 days were determined by logistic regression and adjusted for clustering among centers. Patterns of discharge within 2 days for low-risk patients with no inhospital complications were examined.
RESULTS: From January 2005 through March 2009, mean LOS (4.0 ± 3.0 to 3.6 ± 2.7 days) (P for trend <.001) and the proportion of patients discharged after 2 days decreased (72.0%-65.9%), while predicted inhospital mortality risk remained unchanged. **Patients with LOS >2 days (n = 77,471; 67.3%) were older and more likely to have had an intra-aortic balloon pump, cardiogenic shock, transfusions, and post-PPCI complications.** Of 958 hospitals, 437 (45.6%) discharged at least half of their low-risk patients with no inhospital complications within 2 days.
CONCLUSIONS: While the predicted risk profile has remained stable, there has been a significant decrease in LOS after PPCI. Nevertheless, hospitals vary in discharging low-risk and uncomplicated patients early. Discharge within 2 days was associated with specific patient, procedure, and hospital factors. Further study is needed to determine the safety of early discharge among patients undergoing PPCI.

PMID: 22137079 [PubMed - indexed for MEDLINE]

23. Catheter Cardiovasc Interv. 2010 Oct 1;76(4):484-90. doi: 10.1002/ccd.22515.

Does on- versus off-hours presentation impact in-hospital outcomes of ST-segment elevation myocardial infarction patients transferred to a tertiary care center?

Gonzalez MA, Ben-Dor I, Wakabayashi K, Maluenda G, Gaglia MA Jr, Hanna NN, Delhaye C, Collins SD, Syed AI, Mitulescu LP, Torguson R, Suddath WO, Lindsay J, Pichard AD, Satler LF, Waksman R.

Division of Cardiology, Washington Hospital Center, Washington, District of Columbia.

Comment in
Catheter Cardiovasc Interv. 2010 Oct 1;76(4):491-2.

OBJECTIVES: To determine whether in-hospital outcome differs for transferred patients with ST-segment elevation myocardial infarction (STEMI) presenting during business (ON) hours vs. after (OFF) hours.
BACKGROUND: Door-to-device (DTD) time is a prognostic factor in patients with STEMI and is longer during OFF hours. However, the in-hospital mortality is controversial.
METHODS: This registry study included 786 consecutive patients with STEMI referred for primary percutaneous coronary intervention to a tertiary care center with an on-site cardiac catheterization team 24 hrs a day/7 days (24/7) a week. ON hours were defined as weekdays 8 a.m. to 5 p.m., while OFF hours were defined as all other times, including holidays. The primary outcomes were in-hospital death, reinfarction, and length of stay (LOS).
RESULTS: ON hours (29.5%, n = 232) and OFF hours (70.5%, n = 554) groups had similar demographic and baseline characteristics. A significantly higher proportion of patients presenting ON hours had a DTD time ≤120 min compared to OFF hours patients (32.6% vs. 22.1%, P = 0.007). **The rates of in-hospital death (8.2% vs. 6%), reinfarction (0% vs. 1.1%), and mean LOS (5.7 ± 6 vs. 5.7 ± 5) were not significantly different in the ON vs. OFF hours groups, all P = nonsignificant.**
CONCLUSION: In a tertiary care center with an on-site cardiac catheterization team 24/7, there are no differences in in-hospital outcomes of transferred patients with STEMI during ON vs. OFF hours.

PMID: 20882649 [PubMed - indexed for MEDLINE]

26. Sichuan Da Xue Xue Bao Yi Xue Ban. 2008 Jan;39(1):126-9.

[Causes of rise of troponin after percutaneous coronary intervention and its clinical implication].

[Article in Chinese]

He Y, Zheng MX, Cui KJ, Zhang L, Feng Y, Hu HD, Huang DJ.

Department of Cardiology, West China Hospital, Sichuan University, Chengdu 610041, China.

OBJECTIVE: To analyse the clinical factors that contribute to the rise of the cardiac injury marker troponin after coronary intervention and the impact of the rise of troponin on the clinical outcomes.

METHODS: Troponin I was measured after elective coronary intervention in 129 patients whose baseline levels of troponin were normal. The clinical outcomes of the patients were follow-up.
RESULTS: The rise of troponin I was associated with side branch losses, flow impairments such as no flow or slow flow and diabetes. The incidence of myocardial infarction increased with the rise of troponin I. **The angina onsets were more common and the length of stay were longer in the patients with the rise of troponin I than those without.**
CONCLUSION: The rise of troponin after coronary intervention is related to the complex coronary lesions and the complications of intervention procedures. To a certain extent, the level of troponin can predict the patients' outcomes.

PMID: 18390219 [PubMed - indexed for MEDLINE]

27. Interact Cardiovasc Thorac Surg. 2012 Jul;15(1):28-32. doi: 10.1093/icvts/ivr130. Epub 2012 Apr 11.

Age and sex differences in perioperative myocardial infarction after cardiac surgery.

Javierre C, Ricart A, Manez R, Farrero E, Carrio ML, Rodriguez-Castro D, Torrado H, Ventura JL.

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We investigate age and sex differences in acute myocardial infarction (AMI) after cardiac surgery in a prospective study of 2038 consecutive patients undergoing cardiac surgery with cardiopulmonary bypass. An age of ≥ 70 years implied changes in the type of AMI from the ST-segment elevation myocardial infarction (STEMI) to non-ST-segment elevation myocardial infarction (non-STEMI). Men were more likely than women to suffer from AMI after cardiac surgery (11.8% vs. 5.6%), as a result of the higher frequency of STEMI (6% of men vs. 1.8% of women; $P < 0.001$) in both age groups. A troponin-I (Tn-I) peak was significantly higher in patients ≥ 70 years old. In-hospital mortality was higher in patients ≥ 70 (7.3%) than in those < 70 years old (3.3%), because of the increased mortality observed in men with non-AMI (2.1% vs. 6.3%) and women with STEMI (0% vs. 28.6%) and non-STEMI (0% vs. 36.8%, $P < 0.05$). **Old age was associated with a higher frequency of non-STEMI, Tn-I peak, mortality and length of stay in the intensive care unit (ICU).**
Regardless of age, men more often suffer from AMI (particularly STEMI). AMI in women had a notable impact on excess mortality and ICU stay observed in patients ≥ 70 years of age. Clinical and Tn-I peak differences are expected in relation to age and gender after AMI post-cardiac surgery.

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PMID: 22499802 [PubMed - indexed for MEDLINE]

28. Cardiol J. 2011;18(4):378-84.

What is the optimal length of stay in hospital for ST elevation myocardial infarction treated with primary percutaneous coronary intervention?

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BACKGROUND: The aim of this study was to evaluate the safety and practicality of very early (within 48 h) discharge with long-term follow-up results, and to

define an optimal length of stay in hospital for patients with ST elevation myocardial infarction (STEMI) according to their demographic characteristics and risk assessment.
METHODS: A total of 267 patients with STEMI successfully treated with primary coronary intervention were retrospectively analyzed. Patients was divided into four groups according to length of hospitalization: 24 hours, 48 hours, 72 hours, and more than 72 hours. The groups were compared in terms of the patients' demographic and clinical characteristics, short- and long-term follow-up results, mortality, revascularization and major adverse cardiac events (MACE).
RESULTS: More than two thirds of the patients were discharged within 48 hours (68.9%). No difference was observed between groups in terms of one month and one year MACE and one year restenosis. However, one month restenosis was slightly higher in the fourth group. At the end of the first year, there had been only four deaths, and these were in the third and fourth groups. There were no deaths among patients discharged within 48 hours. **Killip class, left ventricular ejection fraction, multi-vessel disease and diabetes were the major determinants of length of stay in hospital.**
CONCLUSIONS: Very early discharge is safe and feasible and does not increase the mortality rate. Uncomplicated STEMI patients with single vessel disease could be discharged after 24 hours. Patients with multi-vessel disease classified in the low risk group could be discharged after 48 hours.

PMID: 21769818 [PubMed - indexed for MEDLINE]

30. JAMA. 2012 Jan 4;307(1):66-74. doi: 10.1001/jama.2011.1926.

International variation in and factors associated with hospital readmission after myocardial infarction.

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Comment in
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CONTEXT: ST-segment elevation myocardial infarction (STEMI) treatment has improved outcomes and shortened hospital stay. Recently, 30-day readmission rates have been proposed as a metric for care of patients with STEMI. However, international rates and predictors of 30-day readmission after STEMI have not been studied.
OBJECTIVE: To determine international variation in and predictors of 30-day readmission rates after STEMI and country-level care patterns.
DESIGN, SETTING, AND PATIENTS: Post hoc analysis of the Assessment of Pexelizumab in Acute Myocardial infarction trial that enrolled 5745 patients with STEMI at 296 sites in the United States, Canada, Australia, New Zealand, and 13 European countries from July 13, 2004, to May 11, 2006. Multivariable logistic regression analysis was used to identify independent predictors of all-cause and nonelective 30-day postdischarge readmission.
MAIN OUTCOME MEASURES: Predictors of 30-day postdischarge all-cause and nonelective readmissions.
RESULTS: Of 5571 patients with STEMI who survived to hospital discharge, 631 (11.3%) were readmitted within 30 days. Thirty-day readmission rates were higher for the United States than other countries (14.5% vs 9.9%; P < .001). **Median length of stay was shortest for US patients (3 days; interquartile range, 2-4 days) and longest for Germany (8 days; interquartile range, 6-11 days).** In multivariable regression, the predictors of 30-day readmission included

multivessel disease (odds ratio [OR], 1.97; 95% CI, 1.65-2.35) and US location (OR, 1.68; 95% CI, 1.37-2.07). Excluding elective readmission for revascularization, US enrollment was still an independent predictor of readmission (OR, 1.53; 95% CI, 1.20-1.96). After adjustment of the models for country-level median length of stay, US location was no longer an independent predictor of 30-day all-cause or nonelective readmission. Location in the United States was not a predictor of in-hospital death (OR, 0.88; 95% CI, 0.60-1.30) or 30-day postadmission death (OR, 1.0; 95% CI, 0.72-1.39).
CONCLUSIONS: In this multinational study, there was variation across countries in 30-day readmission rates after STEMI, with readmission rates higher in the United States than in other countries. However, this difference was greatly attenuated after adjustment for length of stay.

PMID: 22215167 [PubMed - indexed for MEDLINE]

32. Am Heart J. 2010 Jan;159(1):117.e1-6. doi: 10.1016/j.ahj.2009.10.024.

Safety and feasibility of early hospital discharge in ST-segment elevation myocardial infarction--a prospective and randomized trial in low-risk primary percutaneous coronary intervention patients (the Safe-Depart Trial).

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BACKGROUND: Patients with ST-segment elevation myocardial infarction (STEMI) have traditionally been hospitalized for 5 to 7 days to monitor for serious complications such as heart failure, arrhythmias, reinfarction, and death. The Zwolle Primary Percutaneous Coronary Intervention (PCI) Index is an externally validated risk score that has been used to identify low-risk STEMI patients who have undergone primary PCI and can safely be discharged from hospital within 72 hours. Previous studies have shown that many low-risk patients remain in hospital significantly longer.
METHODS: We randomly assigned 54 low-risk STEMI patients treated with primary or rescue PCI to 1 of 2 groups. Patients in the intervention group (n = 27) were actively targeted for early hospital discharge (48-72 hours) and received outpatient follow-up with an advanced practice nurse (APN). In the control group (n = 27), discharge planning and follow-up were left to the treating physician, and there was no added nursing intervention. The 2 primary outcomes of this pilot study were to demonstrate feasibility and safety. Secondary outcomes included compliance with medications, smoking cessation, attendance at cardiac rehabilitation, and quality of life, measured in both groups at 6 weeks time.
RESULTS: In the intervention group, 74% of patients were discharged within 72 hours, 100% had follow-up with the APN within 3 days (74% in person, 26% by phone), and 100% had >/= 3 APN follow-ups in total, meeting our prespecified criteria for feasibility. **The median length of stay was 55 hours in both groups.** There were no deaths in either group, and there was no difference in rehospitalization between patients in the intervention and control groups (8% vs 4%, P = .56). There was no difference in rates of medication compliance, smoking cessation, attendance at cardiac rehabilitation, or quality of life between the 2 groups, although our small pilot study was not powered to detect a difference in these outcomes.
CONCLUSION: In low-risk STEMI patients treated with primary or rescue PCI, a strategy of early hospital discharge facilitated by close nursing follow-up is feasible. Although our study did not identify differences in compliance or quality of life between the 2 groups, it did provide a functional study design for a larger trial powered to detect these important clinical end points.

PMID: 20102876 [PubMed - indexed for MEDLINE]

33. Heart. 2010 Apr;96(8):584-7. doi: 10.1136/hrt.2009.171363. Epub 2009 Sep 23.

Early discharge after primary percutaneous coronary intervention.

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The length of hospital stay after a successful percutaneous coronary intervention (PCI) for acute myocardial infarction is subject of debate. Patients should not be kept in hospital longer than strictly needed in terms of safety, psycho-social reasons, adequate mobilisation and patient comfort. In many tertiary centres with a busy PCI program insufficient bed capacity is an ongoing concern. Moreover, it seems obvious that shorter hospital stay will lead to a significant cost reduction. In order to know if very early discharge after primary PCI is feasible and safe one should identify the events that might threaten the patient as well as the timing of occurrence of such events. As a result a relatively large proportion of patients with a very low risk of early complications can be defined and in those patients very early discharge is indicated.

PMID: 19778921 [PubMed - indexed for MEDLINE]

38. Interact Cardiovasc Thorac Surg. 2009 Sep;9(3):484-90. doi: 10.1510/icvts.2009.203836. Epub 2009 Jun 23.

Microalbuminuria and short-term prognosis in patients undergoing cardiac surgery.

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OBJECTIVES: To examine if preoperative microalbuminuria (MA) is associated with in increased risk of adverse outcomes in patients undergoing elective cardiothoracic surgery, and if adding information on MA could improve the accuracy of the additive EuroSCORE.
METHODS: In a follow-up study we included 962 patients undergoing elective cardiothoracic surgery from 1 April 2005 to 30 September 2007 at our department. MA (urine albumin/creatinine ratio between 2.5-25 mg/mmol) was assessed in a morning spot-urine sample. We used population-based medical registries for 30-day follow-up and compared the length of stay and adverse outcomes including (i) all-cause death, myocardial infarction, stroke, or atrial fibrillation, (ii) surgical reintervention, renal insufficiency, sternal wound infection, or septicaemia among patients with and without MA.
RESULTS: MA was found in 180 (18.7%) patients. The risk of both combined outcomes (adjusted odds ratios (ORs): 1.00 (95% confidence interval (CI): 0.77-1.30) and 1.18 (95% CI: 0.79-1.75), respectively) and most individual outcomes did not differ between the micro- and normoalbuminuric patients. The patients with MA and an additive EuroSCORE of 5 had a significantly prolonged median length of intensive care unit (ICU) stay (0.15 days [95% CI: 0.04-0.26]) and total hospital stay (0.5 days [95% CI: 0.04-0.96]). Patients with MA had a higher risk of postoperative septicaemia (OR: 12.1 [95% CI: 3.2-45.9]). Area under receiver operating characteristics curves of the EuroSCORE with regard to 30-day mortality was 0.86 both with and without MA.

CONCLUSIONS: Preoperative MA in patients undergoing elective cardiothoracic surgery was not associated with most early adverse outcomes. **However, risk of septicaemia was higher and patients with MA also had a marginally longer length of ICU and hospital stay.** Information on preoperative MA did not improve the accuracy of the additive EuroSCORE.

PMID: 19549646 [PubMed - indexed for MEDLINE]

53. Coron Artery Dis. 2011 Nov;22(7):458-62. doi: 10.1097/MCA.0b013e3283495d5f.

Predictors and importance of prolonged hospital stay after primary PCI for ST elevation myocardial infarction.

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OBJECTIVE: Although most patients with ST-elevation myocardial infarction treated by primary percutaneous coronary intervention (PCI) have a good prognosis and can be discharged from hospital very soon, some patients must be admitted longer. We performed the current analysis to assess predictors and the prognostic significance of prolonged hospital stay.
PATIENTS AND METHODS: In this prospective observational study, individual data from 2323 patients who survived at least 2 days after primary PCI in our hospital were recorded. Patients in the highest tertile of hospital stay were compared with the other patients. Both predictors and prognostic importance of prolonged hospital stay were evaluated.
RESULTS: Mean admission duration was 6.7 days (standard deviation=6.6). A total of 797 patients had a hospital stay for more than 6 days (highest tertile). Patients with a longer hospital stay were older, more often female, had more often a history of previous myocardial infarction and signs of heart failure on admission, and had more frequently Thrombolysis in Myocardial infarction flow 0 before PCI. **In addition, a low left ventricular ejection fraction was independently associated with prolonged hospital stay [odds ratio: 2.06 (95% confidence interval: 1.54-2.76)]**, but with a comparable risk of 1-year mortality [odds ratio: 1.3 (95% confidence interval: 0.8-2.0)]. CONSLUSION: According to this study, a low left ventricular ejection fraction is associated with prolonged hospital stay in patients after primary PCI. Predictors of prolonged hospital stay are age, female sex, previous myocardial infarction, heart failure on admission, and Thrombolysis in Myocardial infarction flow 0 before PCI.

PMID: 21811154 [PubMed - indexed for MEDLINE]

57. Ann Thorac Cardiovasc Surg. 2011;17(3):267-72.

Coronary artery bypass grafting for acute myocardial infarction in stent ERA.

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PURPOSE: We evaluated a treatment strategy for acute myocardial infarction (AMI) that percutaneous coronary intervention (PCI) is performed on a culprit lesion unless the culprit is an unprotected left main trunk. Emergent coronary artery bypass grafting (CABG) is done when the culprit is a left main trunk and a mechanical complication exists.

METHODS: From 1997 to 2008, 22 and 232 patients underwent CABG for AMI and non-AMI, respectively. Of the 22 patients of AMI, PCI was performed in 12 patients and not performed in 10 patients before surgery. We investigated complication, intubation period, in-hospital mortality and hospitalization period.
RESULTS: No in-hospital mortality was observed in all 22 AMI patients. There was no difference in in-hospital mortality and complication between the AMI and the non-AMI patients. **No significant difference was found in hospital stay, complication, intubation period, in-hospital mortality and hospitalization period between patients who received preceding PCI and not.**
CONCLUSIONS: These results suggest that our treatment strategy is reasonable. Further studies will be warranted to clarify the role of preceding PCI.

PMID: 21697788 [PubMed - indexed for MEDLINE]

60. J Thorac Cardiovasc Surg. 2009 Oct;138(4):873-9. doi: 10.1016/j.jtcvs.2009.02.019. Epub 2009 Apr 8.

Obesity is associated with increased morbidity after coronary artery bypass graft surgery in patients with renal insufficiency.

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OBJECTIVE: Although obesity is a major risk factor for cardiovascular disease, it is not clear whether obesity increases the risk of postoperative morbidity and mortality in patients undergoing coronary artery bypass grafting surgery. Increasing evidence suggests that both obesity and renal insufficiency are associated with increased systemic inflammation, thrombogenicity, and endothelial dysfunction. Cardiac surgical patients with comorbid obesity and renal insufficiency might thus be at greater risk for systemic proinflammatory and thrombotic states, which in turn might increase the risk of adverse perioperative outcomes. We investigated the influence of obesity on adverse postoperative outcomes after coronary artery bypass grafting surgery in patients with and without renal insufficiency.
METHODS: A retrospective cohort study was performed of patients (n = 10,863) undergoing primary coronary artery bypass grafting surgery with cardiopulmonary bypass between January 1995 and June 2005. Patients with preoperative renal insufficiency (n = 1385) and patients with preoperative normal renal function (n = 9478) were further classified as obese (body mass index, > or =30 kg/m(2)) or nonobese (body mass index, 18.5-29.9 kg/m(2)). Multivariate, stepwise logistic regression was performed, controlling for demographic factors, medications, and perioperative risk factors to determine whether obesity is independently associated with an increased risk of adverse postoperative outcomes after coronary artery bypass grafting surgery in patients with or without renal insufficiency.
RESULTS: Obese patients with preoperative renal insufficiency had higher rates of postoperative myocardial infarction (5.9% vs 3.4%) and low cardiac output syndrome (24.5% vs 18.6%) and increased hospital stay (14.9 +/- 13.7 vs 13.2 +/- 13.0 days) than nonobese patients with preoperative renal insufficiency (all outcomes, P < .05). Multivariate analysis revealed that obese patients with preoperative renal insufficiency were independently associated with an increased risk of postoperative myocardial infarction (odds ratio, 1.82; 95% confidence interval, 1.07-3.07; P < .05) and low cardiac output syndrome (odds ratio, 1.53; 95% confidence interval, 1.15-2.03; P < .01) and increased hospital stay (P < .05). In contrast, obese patients with normal preoperative renal function were independently associated only with an increased risk of postoperative sternal wound infection (odds ratio, 2.55; 95% confidence interval, 1.40-4.67; P < .01) and leg wound infection (odds ratio, 2.27; 95% confidence interval, 1.71-3.02; P

< .01).
CONCLUSION: **Obesity is an independent risk factor for increased cardiovascular morbidity and prolonged hospital stay in patients with preoperative renal insufficiency undergoing primary coronary artery bypass grafting surgery.**

PMID: 19660351 [PubMed - indexed for MEDLINE]

2. Am Heart J. 2009 Oct;158(4):644-52. doi: 10.1016/j.ahj.2009.07.034.

Characteristics and in-hospital outcomes for nonadherent patients with heart failure: findings from Get With The Guidelines-Heart failure (GWTG-HF).

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BACKGROUND: Medication and dietary nonadherence are precipitating factors for heart failure (HF) hospitalization; however, the characteristics, outcomes, and quality of care of patients with nonadherence are unknown. Recognizing features of nonadherent patients may provide a means to reduce rehospitalization for this population.
METHODS: GWTG-HF registry data were collected from 236 hospitals and 54,322 patients from January 1, 2005 to December 30, 2007. Demographics, clinical characteristics, in-hospital outcomes, and quality of care were stratified by precipitating factor for HF admission. Multivariate logistic regression analysis was used to determine the association of nonadherence with length of stay (LOS) and in-hospital mortality.
RESULTS: Clinicians documented dietary and/or medication nonadherence as the reason for admission in 5576 (10.3%) of HF hospitalizations. Nonadherent patients were younger and more likely to be male, minority, uninsured, and have nonischemic HF. These patients had lower ejection fractions (34.9% vs 39.6%, P < .0001), more frequent previous HF hospitalizations, higher brain natriuretic peptide levels (1813 vs 1371 pg/mL, P < .0001), and presented with greater signs of congestion. **Despite this, nonadherent patients had shorter LOS (odds ratio 0.94, 95% CI 0.92-0.97) and lower in-hospital mortality (odds ratio 0.65, 95% CI 0.51-0.83) in multivariate analysis.** Although nonadherent patients received high rates of Joint Commission core measures, rates of other evidence-based treatments were less optimal.
CONCLUSIONS: Nonadherence is a common precipitant for HF admission. Despite a higher risk profile, nonadherent patients had lower in-hospital mortality and LOS, suggesting that it may be easier to stabilize nonadherent patients by reinstituting sodium and/or fluid restriction and resuming medical therapy.

PMID: 19781426 [PubMed - indexed for MEDLINE]

6. Circ Cardiovasc Qual Outcomes. 2012 May;5(3):308-13. doi: 10.1161/CIRCOUTCOMES.112.966069. Epub 2012 May 10.

Procedure intensity and the cost of care.

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BACKGROUND: The intensive practice style of hospitals with high procedure rates may result in higher costs of care for medically managed patients. We sought to determine how costs for patients with heart failure (HF) not receiving procedures compare between hospital groups defined by their overall use of procedures.
METHODS AND RESULTS: We identified all 2009 to 2010 adult HF hospitalizations in

hospitals capable of performing invasive procedures that had at least 25 HF hospitalizations in the Perspective database from Premier, Inc. We divided hospitals into 2 groups by the proportion of patients with HF receiving invasive percutaneous or surgical procedures: low (>0%-10%) and high (≥ 10%). The standard costs of hospitalizations at each hospital were risk adjusted using patient demographics and comorbidities. We used the Wilcoxon rank sum test to assess cost, length of stay, and mortality outcome differences between the 2 groups. Median risk-standardized costs among low-procedural HF hospitalizations were $5259 (interquartile range, $4683-$6814) versus $6965 (interquartile range, $5981-$8235) for hospitals with high procedure use (P<0.001). Median length of stay was 4 days for both groups. Risk-standardized mortality rates were 5.4% (low procedure) and 5.0% (high procedure) (P=0.009). We did not identify any single service area that explained the difference in costs between hospital groups, but these hospitals had higher costs for most service areas.
CONCLUSION: **Among patients who do not receive invasive procedures, the cost of HF hospitalization is higher in more procedure-intense hospitals compared with hospitals that perform fewer procedures.**

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PMID: 22576844 [PubMed - indexed for MEDLINE]

11. Congest Heart Fail. 2008 May-Jun;14(3):117-20.

Admission hyperglycemia and length of hospital stay in patients with diabetes and heart failure: a prospective cohort study.

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The authors assessed the relationship between glycemia and length of hospital stay (LOS) in a prospective cohort study of patients with diabetes mellitus and heart failure (HF). Of 212 patients with acute HF exacerbation, 119 (56%) also had diabetes. The mean age of the cohort was 63+/-0.87 years, and the mean body mass index was 29.3 kg/m2. **Diabetic patients had significantly longer LOS compared with the nondiabetics (5.0+/-0.29 vs 3.4+/-0.19; P<.001).** In patients with diabetes, the mean glycated hemoglobin A1c was 8.3%, admission blood glucose (BG) was 169+/-7.7 mg/dL, and average BG was 196+/-8.1 mg/dL. **After adjusting for age, sex, weight, hypertension, renal function, and anemia, LOS was significantly correlated with admission BG (r=0.31; P<.001) and average BG (r=0.34; P=.001). In patients with acute HF exacerbation, diabetes significantly prolonged LOS. Hyperglycemia correlated with LOS.**

PMID: 18550921 [PubMed - indexed for MEDLINE]

19. Am J Cardiol. 2010 Oct 15;106(8):1139-45. doi: 10.1016/j.amjcard.2010.06.026.

Impact of worsening renal function during hospital admission on resource utilization in patients with heart failure.

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Renal impairment frequently accompanies heart failure (HF) and is a recognized

independent risk factor for morbidity and mortality. Few data are available assessing the impact of worsening renal function (WRF) during hospitalization on health care resource use in patients with HF. Health Insurance Portability and Accountability Act-compliant, de-identified, clinical, laboratory, and economic data for patients admitted to a tertiary care medical center with a primary diagnosis of HF were extracted by MedMining and reviewed retrospectively by the authors. Patients were excluded if they had no previous HF or were admitted for acute coronary syndrome or coronary artery bypass grafting within 30 days of index hospitalization. WRF was defined as ≥ 0.3 mg/dl increase in serum creatinine from baseline at any time during hospitalization. Of 5,803 hospitalized patients with primary HF diagnosis, 827 patients (14%) fulfilled all prespecified inclusion and exclusion criteria (74 ± 14 years of age, 43% men, 98% white, admission serum creatinine 1.4 ± 0.9 mg/dl, estimated glomerular filtration rate < 90 ml/min/1.73 m(2) at admission in 83%). During index hospitalization, WRF was identified in nearly 33%. Compared to patients without WRF, those with WRF had greater prevalence of diabetes (54% vs 43%), lower estimated glomerular filtration rate (44 ± 30 vs 62 ± 35 ml/min/1.73 m(2)), higher serum potassium (4.3 ± 0.7 vs 4.2 ± 0.7 mEq/L), and higher B-type natriuretic peptide (845 ± 821 vs 795 ± 947 pg/ml) at baseline (all p values < 0.05). Patients developing WRF incurred higher total inpatient costs ($10,977, range 671 to 212,819, vs $7,820, range 697 to 269,797, p < 0.001) and longer hospital stay (8.2 ± 6.8 vs 5.7 ± 5.5 days, p < 0.001). **In conclusion, occurrence of WRF during HF-related hospitalization is associated with higher hospitalization costs and longer hospital stay.**

PMID: 20920654 [PubMed - indexed for MEDLINE]

23. J Card Fail. 2008 Mar;14(2):127-32. doi: 10.1016/j.cardfail.2007.10.017.

Venous thromboembolism prophylaxis in hospitalized heart failure patients.

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BACKGROUND: Venous thromboembolism (VTE) is a concerning problem for hospitalized heart failure (HF) patients. Current recommendations are that all hospitalized New York Heart Association Class III or IV HF patients should receive VTE prophylaxis. Our purpose was to describe the rate of use and the characteristics of patients receiving VTE prophylaxis in the Acute Decompensated Heart failure National Registry (ADHERE).
METHODS AND RESULTS: HF hospitalization episodes in ADHERE were analyzed. Patients were excluded from analysis if they were receiving Coumadin or intravenous heparin, had elevated troponin levels, underwent cardiac catheterization or dialysis before or during hospitalization, or were initially admitted to the intensive care unit. VTE prophylaxis was defined as low-molecular-weight or subcutaneous unfractionated heparin administered at any time during hospitalization and intravenous vasoactive therapy was defined as any inotrope, inodilator, or vasodilator. Chi-square, analysis of variance, and Wilcoxon tests were used for univariate and multivariate analyses. Logistic regression was used to evaluate outcomes. A total of 155,073 entries were evaluated, with 71,376 eligible for VTE prophylaxis; 21,847 (31%) received VTE prophylaxis. VTE prophylaxis patients were more often African American (28% versus 21%) or admitted from the emergency department (84% versus 79%), compared

with those who did not receive VTE prophylaxis (both P < .0001). Medical history and initial presentation characteristics were similar, except edema, which was more likely in VTE prophylaxis patients (71% versus 66%, P < .0001). Patients receiving VTE prophylaxis more often received an intravenous vasoactive agent (23% versus 18%), angiotensin-converting enzyme inhibitor (61% versus 54%), or beta-blocker (63% versus 58%) during their hospitalization and were more likely discharged on an angiotensin-converting enzyme inhibitor (53% versus 49%) or beta-blocker (57% versus 54%) than non-VTE prophylaxis patients, all P < .0001. **VTE prophylaxis patients were more often admitted to the intensive care unit (4.8% versus 2.5%, P < .0001) and had longer median hospital stays (4.2 versus 3.8 days, P < .0001).** Mortality was similar between cohorts (3.0% versus 2.9%, P = .69).
CONCLUSIONS: Despite recommendations that all hospitalized New York Heart Association III and IV CHF patients receive venous thromboembolic disease prophylaxis, less than one third of eligible patients receive this guideline recommended therapy.

PMID: 18325459 [PubMed - indexed for MEDLINE]

27. Eur J Cardiovasc Nurs. 2009 Oct;8(4):251-8. doi: 10.1016/j.ejcnurse.2009.05.001. Epub 2009 Jun 17.

Perceived loneliness and social support in patients with chronic heart failure.

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Self-reported conditions have become increasingly important in patient care, and perceived loneliness and social relationships in patients with chronic heart failure (CHF) are not sufficiently investigated.AIM: The aim was to investigate perceived loneliness and social support in patients with CHF. Further, to investigate whether loneliness and social support might be associated with gender, age, healthcare utilization and mortality.
METHODS: One hundred and forty nine patients with CHF, hospitalised at least once during a 4-month period in 2006, completed a self-reported questionnaire including measurements about loneliness and social support. Healthcare utilization was assessed prospectively by frequency of readmissions and number of days hospitalised during 1 year.
RESULTS: Loneliness was reported by 29 (20%) participants. They were more often women (p<0.001) and younger (p=0.024). Patients who perceived loneliness had fewer social contacts (p=0.033), reported lower occurrence of emotional contacts (p=0.004), were less satisfied with social contacts and close relationships (p<0.001). **Those reporting loneliness had more days hospitalised (p=0.044), and more readmissions to hospital (p=0.027), despite not having more severe CHF.**
CONCLUSION: Loneliness is a health-related risk indicator in that patients with CHF who perceived loneliness have more healthcare utilization than those who do not report loneliness despite not having more severe CHF.

PMID: 19539533 [PubMed - indexed for MEDLINE]

32. Eur J Anaesthesiol. 2011 Mar;28(3):220-4. doi: 10.1097/EJA.0b013e328342659c.

Factors associated with and consequences of unplanned post-operative intubation in elderly vascular and general surgery patients.

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OBJECTIVE: Unplanned post-operative intubation (UPI) may be associated with significant morbidity and/or mortality after surgery. The purpose of this investigation was to determine the incidence and predictors of UPI in elderly patients who underwent general and vascular surgical procedures.
METHODS: Data from the American College of Surgeons National Surgical Quality Improvement Program Participant Use Data File was used to calculate the incidence of UPI in all elderly vascular and general surgery patients undergoing operations from 2005 to 2008. UPI was defined as a requirement for the placement of an endotracheal tube and mechanical or assisted ventilation because of the onset of respiratory or cardiac failure manifested by severe respiratory distress, hypoxia, hypercarbia or respiratory acidosis within 30 days of the index operation. Univariate factors associated with UPI were identified. Multivariate stepwise logistic regression was used to calculate odds ratios (ORs) for UPI after controlling for known clinically relevant cofactors.
MAIN OUTCOME MEASURES: Incidence of UPI as well as morbidity and mortality associated with UPI.
RESULTS: Among 115 692 patients, 3.3% required UPI. **Univariate predictors of UPI were older age group, chronic obstructive pulmonary disease, low pre-operative functional status as well as emergency operation. UPI was associated with an 18-fold increased risk of death as well as significantly increased hospital length of stay. Multivariate analysis identified several predictors of UPI with re-operation having the greatest odds for UPI (OR = 4.5; 95% confidence interval = 4.29-4.86, P < 0.001).**
CONCLUSION: Although the incidence of UPI in this elderly surgical cohort was low, it was associated with significant morbidity and mortality as well as prolonged hospital length of stay, underscoring the need for accurately identifying modifiable risk factors.

PMID: 21191304 [PubMed - indexed for MEDLINE]

38. Am J Cardiol. 2012 Oct 15;110(8):1150-5. doi: 10.1016/j.amjcard.2012.05.059. Epub 2012 Jul 3.

In-hospital resource use and medical costs in the last year of life by mode of death (from the HF-ACTION randomized controlled trial).

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Patterns of medical resource use near the end of life may differ across modes of death. The aim of this study was to characterize patterns of inpatient resource use and direct costs for patients with heart failure (HF) who died of sudden cardiac death (SCD), HF, other cardiovascular causes, or noncardiovascular causes during the last year of life. Data were from a randomized trial of exercise training in patients with HF. Mode of death was adjudicated by an end point committee. Generalized estimating equations were used to compare hospitalizations, inpatient days, and inpatient costs incurred during the final year of life in patients who died of different causes, adjusting for clinical and treatment characteristics. Of 2,331 patients enrolled in the trial, 231 died after ≥1 year of follow-up with an adjudicated mode of death, including 72 of SCD, 80 of HF, 34 of other cardiovascular causes, and 45 of noncardiovascular

causes. **Patients who died of SCD were younger, had less severe HF, and incurred fewer hospitalizations, fewer inpatient days, and lower inpatient costs than patients who died of other causes.** After adjustment for patient characteristics, inpatient resource use varied by 2 to 4 times across modes of death, suggesting that cost-effectiveness analyses of interventions that reduce mortality from SCD compared to other causes should incorporate mode-specific end-of-life costs. In conclusion, resource use and associated medical costs in the last year of life differed markedly in patients with HF who experienced SCD and patients who died of other causes.

PMCID: PMC3462294 [Available on 2013/10/15]
PMID: 22762718 [PubMed - indexed for MEDLINE]

41. Anadolu Kardiyol Derg. 2012 Mar;12(2):123-31. doi: 10.5152/akd.2012.038. Epub 2012 Jan 26.

[Evaluation of clinical and demographic characteristics and their association with length of hospital stay in patients admitted to cardiac intensive care unit with the diagnosis of acute heart failure].

[Article in Turkish]

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OBJECTIVE: Despite increasing incidence, data regarding clinical and demographic characteristics of patients with acute heart failure (AHF) admitted to cardiac intensive care unit (ICU) are inconclusive. The aim of this study was to assess the presentation characteristics and factors determining the length of hospital stay in this particular patient population.
METHODS: We conducted a single-center, prospective study involving 150 patients hospitalized to cardiac ICU with the primary diagnosis of AHF. Chi-square and Student t tests were used for the analysis of categorical and continuous variables, respectively. Linear regression analysis (LRA) was used to determine the factors affecting the length of hospital stay.
RESULTS: Forty-nine percent of the patients had new-onset AHF and 25% had preserved left ventricular ejection fraction (LVEF). In 25.3% of all patients and 46.6% of the patients with new-onset HF the precipitating factor was acute coronary syndrome. Atrial fibrillation and valvular heart disease as precipitating factors were more common in patients with preserved EF, when compared to low EF group. **LRA showed that presence of anemia [β=1.62; 95% CI 0.08-3.15; p=0.039)] and severe mitral regurgitation (β=2.55; 95% CI 0.06-5.05; p=0.045) and systolic blood pressure (β=-0.03; 95% CI -0.06 - -0.002; p=0.039) and blood urea nitrogen (β=0.034; 95% CI 0.006 - 0.06; p=0.016) were the independent predictors of length of stay.**
CONCLUSION: Underlying cardiovascular risk factors, comorbidities and precipitating pathologies were diverse and highlighted the inhomogeneous characteristics of AHF syndromes. However, in-hospital mortality was high and initial clinical presentation characteristics were significantly associated with in-hospital outcome.

PMID: 22281792 [PubMed - indexed for MEDLINE]

43. Coron Artery Dis. 2011 Nov;22(7):458-62. doi: 10.1097/MCA.0b013e3283495d5f.

Predictors and importance of prolonged hospital stay after primary PCI for ST elevation myocardial infarction.

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OBJECTIVE: Although most patients with ST-elevation myocardial infarction treated by primary percutaneous coronary intervention (PCI) have a good prognosis and can be discharged from hospital very soon, some patients must be admitted longer. We performed the current analysis to assess predictors and the prognostic significance of prolonged hospital stay.
PATIENTS AND METHODS: In this prospective observational study, individual data from 2323 patients who survived at least 2 days after primary PCI in our hospital were recorded. Patients in the highest tertile of hospital stay were compared with the other patients. Both predictors and prognostic importance of prolonged hospital stay were evaluated.
RESULTS: Mean admission duration was 6.7 days (standard deviation=6.6). A total of 797 patients had a hospital stay for more than 6 days (highest tertile). Patients with a longer hospital stay were older, more often female, had more often a history of previous myocardial infarction and signs of heart failure on admission, and had more frequently Thrombolysis in Myocardial infarction flow 0 before PCI. **In addition, a low left ventricular ejection fraction was independently associated with prolonged hospital stay [odds ratio: 2.06 (95% confidence interval: 1.54-2.76)],** but with a comparable risk of 1-year mortality [odds ratio: 1.3 (95% confidence interval: 0.8-2.0)]. CONSLUSION: According to this study, a low left ventricular ejection fraction is associated with prolonged hospital stay in patients after primary PCI. **Predictors of prolonged hospital stay are age, female sex, previous myocardial infarction, heart failure on admission, and Thrombolysis in Myocardial infarction flow 0 before PCI.**

PMID: 21811154 [PubMed - indexed for MEDLINE]

60. J Med Pract Manage. 2008 May-Jun;23(6):350-7.

Congestive heart failure admissions: factors related to hospital length of stay.

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Congestive heart failure (CHF) is an illness that affects millions of Americans each year; the cost associated with treatment and care is extensive. This study was based on a total of 480 patients admitted to the Mercy Hospital in Miami, Florida, during 2005. **Average length of stay was significantly different based upon type of health insurance, race/ethnicity, marital status, admission source, attending physician specialty, discharge disposition, number of consultations while admitted, surgical procedure, and illness severity.** The study results provide hospital executives with vital information for clinical and administrative CHF-related admissions management.

PMID: 18616003 [PubMed - indexed for MEDLINE]

61. Pol Merkur Lekarski. 2011 Jan;30(175):10-8.

[The impact of prior revascularization procedures on outcome of percutaneous coronary intervention in ACS].

[Article in Polish]

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Development of interventional cadriology is cause of increasing number of acute coronary syndrome (ACS) patients with prior revascularization procedures in the past.THE AIM OF THE STUDY: To evaluate the clinical feature of ACS patients with and without prior revascularization procedures and to compare in-hospital and long-term outcome following percutaneous coronary intervention (PCI) in these groups.
MATERIAL AND METHODS: There were 325 ACS consecutive patients included to the study who underwent PCI procedures. There were 175 patients after PCI or coronary artery by-pass grafting in the past. Control group consisted of 150 subjects with ACS with no history of PCI procedures. We analyzed baseline characteristic as well as the inhospital, 30- and 180-day outcomes.
RESULTS: The baseline characteristic revealed higher rate of patients with heart failure in case-history (18.0% vs. 26.9%, p = 0.03), diabetes (16.0% vs. 25.1%, p = 0.04), and multi-vessels coronary disease (85.2% vs. 60.6%, p = 0.003) in the subgroup of prior revascularization. The rate of non-STEMI was higher (28.0% vs. 40.6%, p = 0.02) and the rate of STEMI was lower (47.4% vs. 63.3%, p = 0.004) as a form of ACS in previously revascularized subjects. **The analysis of inhospital outcome revealed significantly longer time of hospitalization of the patients with prior revascularization (7.7 +/- 4.6 vs. 5.4 +/- 4.1, p < 0.0001).** There were no significant differences in clinical characteristics at 6-months after ACS.
CONCLUSION: Patients undergoing PCI in ACS with prior revascularization procedures are characterized by a higher level of atherosclerosis risk factors, more advanced changes in coronary arteries and higher NSTEMI occurance than ACS patients without PCI history. Baseline and long-term results of revascularization, frequency and nature of complications are comparable in both groups, but length of hospitalization period and significantly longer in patients with revascularization in the past.

PMID: 21542238 [PubMed - indexed for MEDLINE]

62. Eur J Heart Fail. 2010 May;12(5):462-8. doi: 10.1093/eurjhf/hfq027. Epub 2010 Mar 1.

Understanding changing patterns of survival and hospitalization for heart failure over two decades in New Zealand: utility of 'days alive and out of hospital' from epidemiological data.

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AIMS: To describe changes in heart failure (HF) epidemiology in New Zealand between 1988 and 2008 using the number of days alive and out of hospital after a first hospitalization for HF, and to use these data to evaluate the overall impact of changing patterns of hospitalization and survival.
METHODS AND RESULTS: We performed a population analysis of all HF hospitalization and mortality data from 1 January 1988 to 31 December 2008 in New Zealand. The

main outcome measures were: days alive and out of hospital, age standardized hospitalization rates, and mortality after an index hospitalization for HF. The number of days alive and out of hospital at 2 years increased by 2 months over the two decades of the study (from 448.8 to 511.3 days). Age standardized index HF hospitalization rates increased from 1988 to 1999, and declined thereafter, current rates are 106.9/100 000 for women and 174.3/100 000 for men. **Patient age at index admission progressively increased, and hospital length of stay decreased.** Mortality rates progressively decreased until 2000, but there has been no further decrease since then. Total hospital days have decreased up to 2008. CONCLUSION: There have been major changes in the epidemiology of HF in New Zealand between 1988 and 2008, during which time there have been important changes in HF management. Despite increasing age, hospitalization rates are now declining and patients with HF are surviving longer out of hospital and with fewer hospital days. These results support the need for continued emphasis on delivery of effective community-based care for patients with this long-term condition.

PMID: 20194215 [PubMed - indexed for MEDLINE]

Pneumonia

18. BMC Med Res Methodol. 2011 Oct 26;11:144. doi: 10.1186/1471-2288-11-144.

How to handle mortality when investigating length of hospital stay and time to clinical stability.

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BACKGROUND: Hospital length of stay (LOS) and time for a patient to reach clinical stability (TCS) have increasingly become important outcomes when investigating ways in which to combat Community Acquired Pneumonia (CAP). Difficulties arise when deciding how to handle in-hospital mortality. Ad-hoc approaches that are commonly used to handle time to event outcomes with mortality can give disparate results and provide conflicting conclusions based on the same data. To ensure compatibility among studies investigating these outcomes, this type of data should be handled in a consistent and appropriate fashion.
METHODS: Using both simulated data and data from the international Community Acquired Pneumonia Organization (CAPO) database, we evaluate two ad-hoc approaches for handling mortality when estimating the probability of hospital discharge and clinical stability: 1) restricting analysis to those patients who lived, and 2) assigning individuals who die the "worst" outcome (right-censoring them at the longest recorded LOS or TCS). Estimated probability distributions based on these approaches are compared with right-censoring the individuals who died at time of death (the complement of the Kaplan-Meier (KM) estimator), and treating death as a competing risk (the cumulative incidence estimator). Tests for differences in probability distributions based on the four methods are also contrasted.
RESULTS: The two ad-hoc approaches give different estimates of the probability of discharge and clinical stability. Analysis restricted to patients who survived is conceptually problematic, as estimation is conditioned on events that happen at a future time. Estimation based on assigning those patients who died the worst outcome (longest LOS and TCS) coincides with the complement of the KM estimator based on the subdistribution hazard, which has been previously shown to be equivalent to the cumulative incidence estimator. However, in either case the time to in-hospital mortality is ignored, preventing simultaneous assessment of patient mortality in addition to LOS and/or TCS. The power to detect differences in underlying hazards of discharge between patient populations differs for test statistics based on the four approaches, and depends on the underlying hazard ratio of mortality between the patient groups.
CONCLUSIONS: **Treating death as a competing risk gives estimators which address the clinical questions of interest, and allows for simultaneous modelling of both in-hospital mortality and TCS / LOS. This article advocates treating mortality as a competing risk when investigating other time related outcomes.**

PMCID: PMC3269825
PMID: 22029846 [PubMed - indexed for MEDLINE]

23. Clin Microbiol Infect. 2012 Nov;18(11):1134-42. doi: 10.1111/j.1469-0691.2011.03692.x. Epub 2011 Nov 1.

Pulmonary complications of pneumococcal community-acquired pneumonia: incidence, predictors, and outcomes.

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The aim of this study was to evaluate the clinical characteristics, predictors and outcomes of pneumococcal pneumonia developing pulmonary complications and the distribution of pneumococcal serotypes. It was a prospective study including all adult patients admitted to the Hospital Clinic of Barcelona, Spain (2001-2009) with the diagnosis of pneumococcal pneumonia. Microbiological investigation was systematically performed, including antimicrobial susceptibility and serotype distribution (only invasive strains isolated during 2006-2009). Complicated pneumonia was defined as the presence of one or more pulmonary complications: pleural effusion, empyema, or multilobar infiltrates. We included 626 patients, and 235 (38%) had the following pulmonary complications: pleural effusion, 122 (52%); empyema, 18 (8%); and multilobar infiltration, 151 (64%). Forty-six (20%) patients had more than one complication. **Patients with pulmonary complications showed a higher rate of intensive-care unit admission (34% vs. 13%, p <0.001), a higher rate of shock (16% vs. 7%, p <0.001), a longer length of stay (9 days vs. 6 days, p <0.001), and a lower rate of penicillin resistance (14% vs. 25%, p 0.013), but similar mortality (9% vs. 8%).** No significant differences were observed in the serotype distribution between complicated and uncomplicated pneumonia. **Chronic obstructive pulmonary disease (COPD) (OR 0.38, 95% CI 0.23-0.63; p <0.001) was a protective factor against pulmonary complications, whereas chronic liver disease (OR 3.60, 95% CI 1.71-7.60; p 0.001), admission C-reactive protein level ≥18 mg/dL (OR 2.77, 95% CI 1.91-4.00; p <0.001) and admission creatinine level >1.5 mg/dL (OR 2.01, 95% CI 1.31-3.08; p 0.001) were risk factors for pulmonary complications.** Complicated pneumonia was characterized by a more severe clinical presentation, but was not associated with increased mortality. Resistance to antibiotics was lower in complicated cases. No significant differences were observed in the serotype distribution between complicated and uncomplicated pneumonia. In the multivariate analysis, COPD was a protective factor against pulmonary complications.

PMID: 22044658 [PubMed - indexed for MEDLINE]

35. Postgrad Med. 2010 Mar;122(2):130-41. doi: 10.3810/pgm.2010.03.2130.

Burden of community-acquired pneumonia in North American adults.

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To determine the burden of community-acquired pneumonia (CAP) affecting adults in North America, a comprehensive literature review was conducted to examine the incidence, morbidity and mortality, etiology, antibiotic resistance, and economic impact of CAP in this population. In the United States, there were approximately 4.2 million ambulatory care visits for pneumonia in 2006. Pneumonia and influenza continue to be a common cause of death in the United States (ranked eighth) and Canada (ranked seventh). In 2005, there were >60,000 deaths due to pneumonia in persons aged>or=15 years in the United States alone. The hospitalization rate for all infectious diseases increased from 1525 hospitalizations per 100 000 persons in 1998 to 1667 per 100 000 persons in 2005. Admission to an intensive care unit

was required in 10% to 20% of patients hospitalized with pneumonia. The mean length of stay for pneumonia was >or=5 days and the 30-day rehospitalization rate was as high as 20%. Mortality was highest for CAP patients who were hospitalized; the 30-day mortality rate was as high as 23%. All-cause mortality for CAP patients was as high as 28% within 1 year. Streptococcus pneumoniae continues to be the most frequently identified pathogen associated with CAP, and pneumococcal resistance to antimicrobials may make treatment more difficult. The economic burden associated with CAP remains substantial at >$17 billion annually in the United States. Despite the availability and widespread adherence to recommended treatment guidelines, CAP continues to present a significant burden in adults. Furthermore, given the aging population in North America, clinicians can expect to encounter an increasing number of adult patients with CAP. Given the significance of the disease burden, the potential benefit of pneumococcal vaccination in adults is substantial.

PMID: 20203464 [PubMed - indexed for MEDLINE]

37. BMC Infect Dis. 2011 Jul 6;11:188. doi: 10.1186/1471-2334-11-188.

A clinical pathway for community-acquired pneumonia: an observational cohort study.

Frei CR, Bell AM, Traugott KA, Jaso TC, Daniels KR, Mortensen EM, Restrepo MI, Oramasionwu CU, Ruiz AD, Mylchreest WR, Sikirica V, Raut MR, Fisher A, Schein JR.

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BACKGROUND: Six hospitals instituted a voluntary, system-wide, pathway for community acquired pneumonia (CAP). We proposed this study to determine the impact of pathway antibiotics on patient survival, hospital length of stay (LOS), and total hospital cost.
METHODS: Data were collected for adults from six U.S. hospitals with a principal CAP discharge diagnosis code, a chest infiltrate, and medical notes indicative of CAP from 2005-2007. Pathway and non-pathway cohorts were assigned according to antibiotics received within 48 hours of admission. Pathway antibiotics included levofloxacin 750 mg monotherapy or ceftriaxone 1000 mg plus azithromycin 500 mg daily. Multivariable regression models assessed 90-day mortality, hospital LOS, total hospital cost, and total pharmacy cost.
RESULTS: Overall, 792 patients met study criteria. Of these, 505 (64%) received pathway antibiotics and 287 (36%) received non-pathway antibiotics. Adjusted means and p-values were derived from Least Squares regression models that included Pneumonia Severity Index risk class, patient age, heart failure, chronic obstructive pulmonary disease, and admitting hospital as covariates. After adjustment, patients who received pathway antibiotics experienced lower adjusted 90-day mortality ($p = 0.02$), shorter mean hospital LOS (3.9 vs. 5.0 days, $p < 0.01$), lower mean hospital costs ($2,485 vs. $3,281, $p = 0.02$), and similar mean pharmacy costs ($356 vs. $442, $p = 0.11$).
CONCLUSIONS: **Pathway antibiotics were associated with improved patient survival, hospital LOS, and total hospital cost for patients admitted to the hospital with CAP.**

PMCID: PMC3142517
PMID: 21733161 [PubMed - indexed for MEDLINE]

38. Clin Ther. 2010 Feb;32(2):293-9. doi: 10.1016/j.clinthera.2010.02.006.

Guideline-concordant antibiotic use and survival among patients with community-acquired pneumonia admitted to the intensive care unit.

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OBJECTIVE: This study evaluated the survival benefit of US community-acquired pneumonia (CAP) practice guidelines in the intensive care unit (ICU) setting.
METHODS: We conducted a retrospective cohort study of adult patients with CAP who were admitted to 5 community hospital ICUs between November 1, 1999, and April 30, 2000. The guidelines for antibiotic prescriptions were the 2007 Infectious Diseases Society of America/American Thoracic Society guidelines. Guideline-concordant antimicrobial therapy was defined as a beta-lactam plus fluoroquinolone or macrolide, antipseudomonal beta-lactam plus fluoroquinolone, or antipseudomonal beta-lactam plus aminoglycoside plus fluoroquinolone or macrolide. Patients with a documented beta-lactam allergy were considered to have received guideline-concordant therapy if they received a fluoroquinolone with or without clindamycin, or aztreonam plus fluoroquinolone with or without aminoglycoside. All other antibiotic regimens were considered to be guideline discordant. Time to clinical stability, time to oral antibiotics, length of hospital stay, and in-hospital mortality were evaluated with regression models that included the outcome as the dependent variable, guideline-concordant antibiotic therapy as the independent variable, and the Pneumonia Severity Index (PSI) score and facility as covariates.
RESULTS: The median age of the 129 patients included in the study was 71 years (interquartile range, 60-79 years). Sixty-two of 129 patients (48%) were male. Comorbidities included liver dysfunction (7 patients [5%]), heart failure (62 [48%]), renal dysfunction (39 [30%]), cerebrovascular disease (21 [16%]), and cancer (14 [11%]). The median (25th-75th percentile) PSI score was 119 (98-142), and overall mortality was 19% (25 patients). Patient demographics were similar between groups. Fifty-three patients (41%) received guideline-endorsed therapies. Guideline-discordant therapy was associated with an increase in inpatient mortality (25% vs 11%; odds ratio = 2.99 [95% CI, 1.08-9.54]). **Receipt of guideline-concordant antibiotics was not associated with reductions in time to clinical stability, time to oral antibiotics, or length of hospital stay when patients who died were excluded from the analysis.**
CONCLUSION: Guideline-concordant empiric antibiotic therapy was associated with improved survival among these patients with CAP who were admitted to 5 ICUs.

PMID: 20206787 [PubMed - indexed for MEDLINE]

39. Clin Microbiol Infect. 2008 Apr;14(4):322-9. doi: 10.1111/j.1469-0691.2007.01915.x. Epub 2008 Jan 8.

Factors impacting on length of stay and mortality of community-acquired pneumonia.

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A 1-year retrospective multicentre study was performed to identify factors influencing hospital length of stay (LOS) and mortality of patients (n = 3233)

admitted to hospital because of community-acquired pneumonia (CAP). **Pneumonia severity index (PSI) high-risk classes (IV and V), positive blood culture, admission to an intensive care unit (ICU), multi-lobar involvement and alcohol consumption were associated independently with prolonged LOS. Tobacco smoking was associated with a reduced LOS.** The LOS varied markedly among centres. Only PSI high-risk class, admission to ICU and multi-lobar involvement were associated with early, late and global mortality. Positive blood cultures, antimicrobial therapy according to treatment guidelines and the establishment of an aetiological diagnosis were linked to reduced late and global mortality. These data suggest that early mortality associated with CAP is highly dependent on the clinical status of the patient at presentation. Conversely, late mortality seems to be associated more closely with clinical management factors; hence, an aetiological diagnosis and compliance with appropriate therapeutic guidelines have a significant influence on outcome.

PMID: 18190569 [PubMed - indexed for MEDLINE]

40. Enferm Infecc Microbiol Clin. 2009 Mar;27(3):160-4. doi: 10.1016/j.eimc.2008.06.004. Epub 2009 Feb 11.

[Factors associated with prolonged hospital stay in community-acquired pneumonia].

[Article in Spanish]

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INTRODUCTION: The length of hospital stay in patients with community-acquired pneumonia (CAP) varies considerably, even though this factor has a great impact on the cost of care for this condition. The objective of this study was to identify factors associated with prolonged hospitalization in these patients (>8 days).
METHODS: Observational analysis of a prospective cohort of nonimmunosuppressed adults with CAP requiring hospitalization from 1995 through 2006.
RESULTS: We documented a total of 2688 consecutive episodes of CAP. Patients who required intensive care unit admission from the emergency room (n=107), those who died during hospitalization (n=200), and patients hospitalized for more than 30 days (n=60) were excluded from the analysis. The median duration of hospital stay was 8 days (IQR, 6-11). **Factors independently associated with prolonged hospital stay by stepwise multiple logistic regression analysis were advanced age (OR=1.58; 95% CI, 1.002-2.503), alcohol abuse (OR=2.07; 95% CI, 1.341-3.199), high-risk Pneumonia Severity Index class (OR=1.72; 95% CI, 1.094-2.703), aspiration pneumonia (OR=4.57; 95% CI, 1.085-19.285), pleural empyema (OR=3.73; 95% CI, 1.978-7.04), and time to clinical stability (OR=1.13; 95% CI, 1.065-1.196).**
CONCLUSIONS: Several factors that were independently associated with longer hospital stay in adult patients with CAP. These factors should be considered when evaluating the adequacy of the duration of hospitalization in a specific center and when designing future studies investigating new strategies to reduce the length of hospital stay.

PMID: 19306716 [PubMed - indexed for MEDLINE]

53. Respir Med. 2012 Dec;106(12):1778-87. doi: 10.1016/j.rmed.2012.08.010. Epub 2012 Sep 14.

Outcomes in elderly Danish citizens admitted with community-acquired pneumonia. Regional differencties, in a public healthcare system.

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OBJECTIVES: To evaluate regional differences in and risk factors for admission, length of stay, mortality, and readmission for community-acquired pneumonia in elderly Danish patients.
METHODS: National registry study on elderly Danish citizens with an acute admission in 2009 owing to community-acquired pneumonia. We studied differences among hospitals in length of stay, in-hospital mortality, mortality within 30 days of discharge, and readmission within 30 days after discharge using Cox regression models with adjustments for age, sex, ventilatory support, and co-morbidity by Charlson's index score.
RESULTS: A total of 11,332 elderly citizens were admitted with community-acquired pneumonia. Mortality during admission and 30-days from discharge were 11.6% and 16.2%, respectively. Readmission rates within 30 days of discharge were 12.3%. **There were significantly differences between hospitals in length of stay.** A high Charlson index score and advanced age were significantly risk factors for death during admission and within 30 days of discharge. Male sex and high Charlson index score were significant risk factors for readmission. Admission to large bed capacity hospital was a significant risk factor for death and readmission within 30 days of discharge.
CONCLUSIONS: Length of stay, rate of admission, mortality and readmission in elderly Danish patients with community-acquired pneumonia follows international findings. There are regional differences between hospitals. In depth investigation in regional differences could reveal potential feasible clinical interventions with an improvement of readmission-, mortality rates and cost.

PMID: 22981322 [PubMed - indexed for MEDLINE]

61. Epidemiol Infect. 2011 Sep;139(9):1307-16. doi: 10.1017/S0950268810002402. Epub 2010 Oct 26.

Outcomes of hospitalized patients with bacteraemic and non-bacteraemic community-acquired pneumonia caused by Streptococcus pneumoniae.

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In contrast to bacteraemic pneumococcal community-acquired pneumonia (CAP), there is a paucity of data on the clinical characteristics and outcomes of non-bacteraemic pneumococcal CAP. This retrospective study compared the outcome of hospitalized patients with bacteraemic and non-bacteraemic pneumococcal CAP treated at a medical centre from 2004 to 2008. Data on clinical outcomes including all-cause mortality, length of hospital stay, need for intensive-care unit admission and extrapulmonary involvement were analysed. In all, 221 patients with pneumococcal pneumonia (87 bacteraemic, 134 non-bacteraemic) were included. Patients with bacteraemic pneumococcal pneumonia (BPP) were older than those with non-BPP (46·2 ± 30·7 years vs. 21·7 ± 30·8 years, P<0·001) and were more likely

to have underlying medical diseases (66·7% vs. 33·6%, P<0·001). The overall mortality rates at 7, 14, and 30 days were significantly higher in BPP than non-BPP patients (12·6% vs. 2·2%, 14·9% vs. 3·7%, 19·5% vs. 5·1%, all P<0·01). Multivariate logistic regression analysis showed that pneumococcal bacteraemia was correlated with extrapulmonary involvement (odds ratio 5·46, 95% confidence interval 1·97-15·16, P=0·001). In conclusion, S. pneumoniae bacteraemia increased the risk of mortality and extrapulmonary involvement in patients with pneumococcal CAP.

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Vascular complications are associated with poor outcome in community-acquired pneumonia.

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BACKGROUND: Recognition of cardiovascular risk factors is important for primary and secondary prevention strategies. Recent evidence has linked lower respiratory tract infections with the development of acute myocardial infarction.
AIM: The aim of this study was to determine the frequency of cardiovascular and cerebrovascular events and the clinical outcomes, during hospitalization for community-acquired pneumonia (CAP).
DESIGN: We performed a retrospective study of 4408 patients with CAP presenting to five hospitals over a 2-year period. Clinical information, co-morbidities, cardiovascular events and 90-day mortality were collected from review of medical case notes. The relationship between cardiovascular events and outcomes were analysed using multivariable logistic regression.
RESULTS: From a total of 4408 patients, 2.2% developed stroke, 5% acute coronary syndrome or myocardial infarction and 9.3% new onset atrial fibrillation. These were associated with increased 90-day mortality [odds ratio (OR), 1.49 95% CI 1.18-1.87, P=0.0006]. **Vascular events were independently associated with increased length of hospital stay-median 12 days (IQR 5-22), compared to patients with no vascular events 8 days (IQR 3-17 days, P<0.0001).**
CONCLUSION: Cardiovascular and cerebrovascular events are common during hospitalization for CAP and are associated with increased 90-day mortality.

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Risk factors and clinical characteristics associated with hospitalization for community-acquired bacterial pneumonia in HIV-positive patients according to the presence of liver cirrhosis.

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BACKGROUND: Community-acquired bacterial pneumonia (CABP) represents an important cause of morbidity and mortality for cirrhotic and HIV-infected patients, respectively. However, little is known on CABP in HIV-positive patients with cirrhosis. A study was performed to describe the clinical features and factors predictive of mortality and prolonged hospitalization in cirrhotic HIV-infected patients with a diagnosis of CABP.
METHODS: Demographic and clinical characteristics of cirrhotic HIV-positive subjects, hospitalized for CABP in our department from June 2000 to December 2006, were compared with those of non-cirrhotic HIV-infected patients with the same diagnosis hospitalized from June 2000 to November 2001. Variables with $p < 0.10$ in univariate analysis were tested for their predictive value for mortality and length of hospitalization with uni- and multivariate logistic regression analysis.
RESULTS: Twenty-nine cirrhotic and 73 non-cirrhotic HIV-positive patients with CABP were compared. Age and alcohol abuse were significantly higher in cirrhotics. At hospital admission, cirrhotic patients had more frequently mental status alterations (7.26 [2.21-23.82], p = 0.001) and milder symptoms and signs (temperature > 37.5 C: 0.27 [0.10-0.75], p = 0.01; respiratory rate > 20: 0.34 [0.13-0.92], p = 0.033; systemic inflammatory response syndrome (SIRS): 0.39 [0.16-0.95], p = 0.038). Adjusting for age, cirrhosis was associated with a higher mortality (5.96 [1.05-33.57]; p = 0.043). **Adjusting for age, gender, and concomitant antiretroviral treatment, cirrhosis was also associated with a prolonged hospitalization (> 7 days: 9.30 [1.84-46.82]; p = 0.007).**
CONCLUSION: The diagnosis of CABP can be difficult in cirrhotic HIV-positive patients because clinical presentation is milder. However, CABP needs to be promptly recognized because mortality is higher in these patients.

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[Factors effecting the duration of hospitalization and mortality in patients with community-acquired pneumonia].

[Article in Turkish]

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Community-acquired pneumonia (CAP) is a common infectious disease with high morbidity and mortality. In this study, demographic features, underlying conditions, causative pathogens and factors affecting length of hospital stay and mortality were retrospectively investigated in patients who were diagnosed as CAP and followed-up in our unit between January 2005-December 2007. Among 97 patients 65 (67%) were male, 32 (33%) were female and the mean age was 62.7 (age range: 18-94) years. Patients were grouped according to criteria of Turkish Thoracic Society into four groups; 22 were group 2 (patients with risk factors, without aggrevating factors), 59 were group 3 (patients with aggrevating factors), and 16 were group 4 (patients who have necessity for intensive care) CAP. The patients have also been grouped according to criteria of American Thoracic Society (CURB-65 score = Confusion, Urea > 7 mmol/L, Respiratory rate > or = 30/min, low Blood pressure and being > or = 65 years old), as group I (n = 65), group II (n = 20), and group III (n = 12). During follow-up 11 (11.3%) patients required mechanical ventilation support and 6 (6.2%) patients have died. Causative pathogens were isolated from 14 (23.3%) out of 27 well-qualified sputum samples obtained from 60 patients who could produce sputum (8 Streptococcus pneumoniae, 2 methicillin-sensitive Staphylococcus aureus, 2 Klebsiella pneumoniae, 1

Haemophilus influenzae, 1 Moraxella catarrhalis). Thirty-seven of cases were treated with levofloxacin, 10 with moxifloxacin, 24 with ceftriaxone +/- clarithromycin, 16 with sulbactam-ampicillin +/- ciprofloxacin, 10 with beta-lactam/beta-lactamase inhibitor combinations, and fever declined within 2.5 days in 83 (85.6%) of them. The mean duration of hospital stay was estimated as 11.1 days. **In the evaluation of the factors that affect the length of hospital stay, being > or = 65 years old, gender, underlying conditions, central venous catheterisation, presence of nasogastric tube, positive culture result, previous antibiotic treatment, fever continuing for > 3 days despite antibiotic therapy and scoring groups were not determined as risk factors (p > 0.05 for all of these parameters). However, mechanical ventilation was found as a significant risk factor (p < 0.05).** In the evaluation of the factors that affect mortality, mechanical ventilation (p < 0.001), staying in intensive care unit (p < 0.001), being group 4 CAP (p < 0.001) and fever continuing for > 3 days despite antibiotic therapy (p = 0.05) were found to be significant risk factors. In conclusion, length of hospital stay, mortality and treatment costs in CAP patients could be reduced by defining the risk factors and starting empirical antibiotic therapy according to the national and international guidelines.

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Trends in mortality and medical spending in patients hospitalized for community-acquired pneumonia: 1993-2005.

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BACKGROUND: Community-acquired pneumonia (CAP) is the most common infectious cause of death in the United States. To understand the effect of efforts to improve quality and efficiency of care in CAP, we examined the trends in mortality and costs among hospitalized CAP patients.
METHODS: Using the National Inpatient Sample between 1993 and 2005, we studied 569,524 CAP admissions. The primary outcome was mortality at discharge. We used logistic regression to evaluate the mortality trend, adjusting for age, gender, and comorbidities. To account for the effect of early discharge practices, we also compared daily mortality rates and performed a Cox proportional hazards model. We used a generalized linear model to analyze trends in hospitalization costs, which were derived using cost-to-charge ratios.
RESULTS: **Over time, length of stay declined, while more patients were discharged to other facilities.** The frequency of many comorbidities increased. Age/gender-adjusted mortality decreased from 8.9% to 4.1% (P < 0.001). In multivariable analysis, the mortality risk declined through 2005 (odds ratio, 0.50; 95% confidence interval, 0.48-0.53), compared with the reference year 1993. The daily mortality rates demonstrated that most of the mortality reduction occurred early during hospitalization. After adjusting for early discharge practices, the risk of mortality still declined through 2005 (hazard ratio, 0.74; 95% confidence interval, 0.70-0.78). Median hospitalization costs exhibited a moderate reduction over time, mostly because of reduced length of stay.
CONCLUSIONS: Mortality among patients hospitalized for CAP has declined. Lower in-hospital mortality at a reduced cost suggests that pneumonia is a case of improved productivity in health care.

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Bacteremia in Staphylococcus aureus pneumonia: outcomes and epidemiology.

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PURPOSE: Staphylococcus aureus represents a major cause of pneumonia in critically ill patients. Although bacteremia may complicate S aureus pneumonia, the epidemiology of and outcomes associated with bacteremia in this syndrome are poorly described.
MATERIALS AND METHODS: We retrospectively identified (January 2005-December 2007) all patients admitted to the hospital with S aureus pneumonia necessitating mechanical ventilation. All subjects underwent lower airway and concurrent blood cultures. The prevalence of bacteremia served as a primary end point. We assessed the impact of bacteremia on mortality and length of stay via either logistic regression or a Cox proportional hazard model, respectively. In both models, we controlled for multiple covariates (eg, demographics, severity of illness, comorbidities, and appropriateness of initial antibiotics). We subsequently developed a prediction rule to identify subjects likely to have concurrent bacteremia based on variables assessed at the time of presentation.
RESULTS: The cohort included 59 patients (mean ± SD age, 58.0 ± 17.4 years; 55.9% male, 59.3% methicillin resistant, 39.0% crude mortality). Bacteremia complicated nearly 20% of cases. The mortality rate in those with bacteremia was 39.1% vs 8.3% in persons without bacteremia (P = .007). Three variables were independently associated with mortality in S aureus pneumonia: age, need for vasopressors, and concurrent bacteremia. Bacteremia independently conferred a 6-fold increase in the risk for death (adjusted odds ratio, 5.96; 95% confidence interval [CI], 1.08-33.10). **Bacteremia also correlated with a longer length of stay. The adjusted hazard ratio for remaining hospitalized if bacteremic was 2.65 (95% CI, 1.14-6.18).** For the clinical prediction rule for concurrent bacteremia, we assigned points as follows: 2 points if the patient had received prior antibiotic therapy and 1 point each for acute lung injury and for the need for vasopressors. As the total score increased, the prevalence of bacteremia increased (P < .001). As a screening test for bacteremia in S aureus pneumonia, the scoring system had good predictive value. The area under the receiver operating curve measured 0.83 (95% CI, 0.72-0.94).
CONCLUSIONS: Bacteremia often arises in S aureus pneumonia and is associated with both increased morbidity and mortality. Several simple clinical factors to determine clinical features identify patients with S aureus pneumonia likely to have simultaneous bacteremia.

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