

Paper 164-2010

## Using the GLIMMIX Procedure to Model Hospital Quality Measured by CMS: Comparing the City-Owned Hospitals, Other Safety Net Hospitals, and Hospitals for the Well Insured

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### ABSTRACT

Health care quality, costs, and methods to control them are debated. Medicare (CMS) measures quality. We studied New York City hospitals, divided into three groups by funding source. PROC GLIMMIX enabled us to study proportions of compliance of hospitals nested within funding type, with repeated measures over time. Public hospitals performed better on the CMS measures than the other safety net hospitals and, generally, better than those hospitals that are funded mostly by private insurance.

### INTRODUCTION

The appropriate role of government in US health care has been a subject of considerable ongoing debate. Proponents argue that government, unlike private financial interests, lacks an inherent conflict of interest with patients. Opponents argue that government is inherently an inefficient, expensive way to provide mediocre health care. These opponents argue that government employees lack financial incentive to excel so that government programs can not achieve high quality. One role the federal government has recently assumed is to measure and publicly report quality of health care. In addition to the public reporting, CMS plans to tie future reimbursement levels to these quality measures: pay for performance, (P4P). In theory, P4P would apply capitalistic incentives to medical care, incentivizing improved performance. Werner, in a recent JAMA article, suggested that the federal program may have an unintended, perverse effect: reducing funding to safety net hospitals which care for a disproportionate share of poor patients. She proposed that, when P4P is implemented, it may have the unintended consequence of worsening disparity of care: safety net hospitals would enter a downward spiral of low scores→lower reimbursement→fewer resources for improvement→minimal improvement→still lower relative scores. Since most safety net hospitals are disproportionately government funded, the P4P program itself might be an example of inefficient government programs working at cross purposes.

We wanted to see if our government operated safety net hospitals: 1) were at risk at entering the downward spiral proposed by Werner 2) performed at the same level as safety net hospitals which are not run by governmental agencies.

The role of government in safety net hospitals varies greatly. Involvement may include actually running the hospitals as it does for the largest two government operated health care systems are the VA system, run by the federal government, and New York City Health and Hospitals Corporation (HHC), which is owned and operated by New York City. There are differences between states in terms of rates of Medicaid reimbursement, rules about what services and who should be covered, labor rates, union rules, and rules governing "obs units." To eliminate the effect of these variables on quality outcome measures, we limit our study to one city, New York. Within that city, these rates and regulations are constraint.

We divided the 53 acute care hospitals in New York City into 3 groups by safety net status: government run safety net hospitals (HHC, 11 hospitals), other safety net hospitals (OSN), and non-safety net hospitals (NSN) which care for a proportionately large number of well insured patients (NSN). To define safety net status, we chose an arbitrary cutoff of total hospital income of at least 30% Medicaid. After limiting the study to New York and dividing hospitals into groups of similar hospitals, there is still unwanted variability. Within each group, there are some consistent differences between individual hospitals (fig 1). For CQI purposes, the differences between hospitals are interesting, but they are not the focus of this paper. We are looking for differences between the three payment groups. For the hypotheses being considered here, differences between hospitals are nuisance variables. Time trends are interesting for two reasons: 1) an improvement over time bolsters the AHRQ hypothesis that collecting and publicly reporting data will spur improvement and 2) if we find a group\*time interaction, with non-safety net hospitals improving at a relatively fast rate, that would support Werner's concern; in this case, that public reporting alone was having the adverse effect she predicted. Until P4P is implemented, we can not fully test Werner's hypothesis.

The sources of variance we can model for are: hospitals within payment group, between groups, over time, the time by group interaction, and, of course, random variation. The response variable we chose is the composite core measure score. If we used a traditional ANCOVA model, we would not be able to model what, for these questions, is the nuisance variable of hospitals within group. The best way to model these sources of variance is as a generalized linear mixed model, treating hospital within group as an R side random effect, and group and time as fixed effects. We used SAS® PROC GLIMMIX.

## METHODS

**Source of data:** Core measures are calculated by the US Agency for Healthcare Research and Quality (AHRQ). There scores are derived from data submitted as bills for Medicare patients. There are seven process of care measures for the care of myocardial infarction (MI) patients, six process of care measures for the care of pneumonia patients and four measures for congestive heart failure (CHF). These process of care measures have changed little over the 4 years of data we present. In 2008, there were eight process of care measures of surgical care; this number grew from two in 2004. Records from these patients are checked to see if a certain expected process of care was met: for example, was an EKG done promptly in a patient suspected of having a myocardial infarction (MI)? Assuming contraindications were absent, did all MI patients get aspirin soon after diagnosis? If the patient smoked, did (s)he get advice on quitting? For any given patient, there are usually several measurements made. The AHRQ data can be downloaded as an Microsoft Access® database (Download Database). We downloaded the data then converted them to SAS® databases. In addition to reporting the scores of the 25 process of care measures, AHRQ also reports the composite score as a measure of overall performance. AHRQ has calculated these composite scores as the total of the numerators divided by the total of the denominators. We use these composite scores for the bulk of our analyses. Because the character of the surgical measures changed over the four years, we recalculated the composite scores using only the more stable three process of care measures (MI, CHF, pneumonia). We present both the 3 aspect (table 1) and 4 aspect (table 2) tables for comparison.

AHRQ developed these process of care core measures as a way to compare standard care, given at most US hospitals. The measures are not meant to measure cutting edge care given at a few major centers. We compared AHRQ composite scores to the cutting edge measures of care, reported by US News and World Report in the Honor Roll of Top Hospitals (Comarow, 2009).

**Statistical Analysis:** We used Chi-squared was used for preliminary bivariate comparisons. We compared the AHRQ composite score to the US News and World Report hospital honor roll ranking. We converted the AHRQ News and World report Honor Roll of Top 25 Hospitals. We converted those ranks to 1-4, with 4 being assigned to the 49 hospitals who are not on the honor roll. A quick look at the comparison between the two ranking systems shows a marked differences; we did formally test the difference with a Kolmogorov-Smirnov test. The major questions of interest were modeled as generalized linear mixed models: safety net group is treated as a categorical fixed effect and time as a continuous fixed effect. Hospital nested within safety net group is treated as an R side Random effect. We used SAS 9.2®.

**Results:** Some measure of care was made 657,774 times.

**Performance of Individual Hospitals:** The composite yearly score for each hospital is plotted, along with trend lines, on Figure 1. Table 1 shows the performance of the individual hospitals on processes involving three diseases: MI, CHF and pneumonia. We analyzed these separately because the criteria of analysis changed little of the four year period of the study. Table 2 shows the individual hospital performance for all four measures: MI, CHF, pneumonia and surgical care. As noted above, the number of processes for surgical care increased from two to eight over the time span we report on. The composite scores on table one are summed scores for all of the disease processes considered and also summed over the four years of study. The scores are from lowest to highest. Generally, the tables differ little from each other. The hospitals whose ranking changed the most are the hospitals which specialize in surgical cases. New York Eye and Ear Infirmary reported not taking care of any patients with a discharge diagnosis of MI, CHF or pneumonia, so it does not appear in table 1. The Hospital for Joint Diseases and Orthopedic Surgery, Manhattan Eye and Ear, and The Hospital for Special Surgery took care of relatively few "medical" patients with MI, CHF and pneumonia, and those surgically oriented hospitals performed relatively poorly on "medical" measures of care. When surgical processes are included, those hospitals moved from poorest performance to much better performance: the Hospital for Special Surgery had the best performance on Table 2.

**Safety Net Status:** All 11 HHC hospitals are safety net hospitals, as are 22 other hospitals; 19 hospitals derived a relatively high portion of their income from well insured patients (see tables 1 and 2). Bivariate comparison of safety net status shows HHC having 90% adherence to AHRQ standards, compared to 85% for NSN and 84% for OSN ( $p < .0001$ ).

**Time:** Graphically, a clear trend of improvement over time, for all groups, can be seen on figures 1 and 2. Testing for statistical significance requires modeling for the inter-dependent observations and is discussed below.

**Aspects of Care:** Table 4 shows that, overall, some aspects of care (diseases types) were easier for hospitals to care for than others. Hospitals met MI criteria around 93% of the time, compared to 82% of the time for pneumonia patients. The overall test of  $\chi^2$  test of significance for difference between the four aspects of care shows  $p < .0001$ .

**Comparing AHRQ to the US News Honor Roll:** Within New York City, US News and World Report rankings are: New York Presbyterian #1 (22<sup>nd</sup> from top on table 2), NYU #2 (34<sup>th</sup> best on table 2), and Mount Sinai #3 (16<sup>th</sup> best on table 2). The other hospitals, which are not on the honor roll, are ranked 4. It is intuitively obvious that these rankings vary markedly from each other; the Kolmogorov-Smirnov test shows  $p < .0001$ .

**Multivariate Modeling:** The SAS® code for the modeling is:

```
title "GLMM of Composite Scores: NYC";
PROC GLIMMIX data=nycq.nyc_composite;
class safety provider_number;
model composite_ed3_treated/composite_ed3_size=safety year
/dist=bin link=logit corrb;
random _residual/_subject=provider_number(safety);
estimate "HHC vs NSN" safety 1 -1 0/cl exp;
estimate "HHC vs OSN" safety 1 0 -1/cl exp;
estimate "NSN vs OSN" safety 0 1 -1/cl exp;
output out=safehat pred=p resid=r;
run;
```

Some of the basic output of the model is shown on table 5. We see a statistically significant trend to improvement over time. The government run HHC hospitals outperformed the privately run other safety net (OSN) hospitals ( $p < .0001$ ) and the privately run hospitals catering to well insured patients (non-safety net, NSN,  $p = .0006$ ). There was no statistically significant difference between the two types of privately run hospitals. When the safety\*year term is added to the model, it is not significant and it reduced the model fit, so we eliminated the term from the final model.

**Discussion:** Much of the current health care debate relates to concerns that increased government involvement will worsen care. Proponents of more government involvement point to years of increasing runaway costs under the status quo. Health care has some features which do not fit well into traditional economic models. Demand for most consumer goods is inherent: clothes, cars, food, lodging, vacations. Most medical care is not inherently desirable to patients, except to the extent that patients wish to purchase preventive care to forestall even more expensive and uncomfortable treatment of disease, or death. Aside from decisions to purchase preventive care, decisions to "purchase" advanced level care are usually made by a physician consulting his or her colleagues. While both sides of the debate argue that health care decisions should be made by a patient and his/her doctor; third party payers are usually substantially involved when expensive care is "purchased." A fundamental assumption of basic capitalism is "transparency": both the potential seller and potential buyer know what they are buying and what alternatives exist. This assumption often fails for medical purchases, when neither the patient nor their doctor may know the cost of a purchase: often the price of a drug or procedure varies several fold, depending on who does the buying or what contracts are involved. Patients without insurance are typically billed for twice as much as an insurance company would pay for the same care.

The argument against government care is that decision makers have no motivation to work efficiently or improve processes to make them more efficient. The argument against privately run insurance programs is that there is an inherent conflict of interest when a patient could indeed benefit from expensive care, which was often the main reason to carry insurance in the first place.

There has been general, if not universal agreement, that "quality" should be measured, to improve transparency. By this assumption, patients are more likely to get good care if they purchase the care from a hospital with a history of providing good care. Similar systems of grading physicians are under development, as are grading systems for other aspects of care, such as pediatric care, safety within the hospital.... The "Core Measures" we used are the most developed and the only ones that have been publicly reported thus far. By analogy, the grades given to a hospital can be compared to grades given to a hospital. A student's grade on one test corresponds to a hospital meeting one

measure for one patient; the student's grade in a course is similar to a hospital's score on one measure (e.g. EKG done quickly for all MI patients); the student's semester GPA corresponds to the yearly composite score and the student's overall GPA corresponds to the hospital's composite scores on tables 1 and 2. Just as some subjects may be "easier" than others, hospitals seem to perform better on some aspects than others (table 3). Figure 1 shows the heterogeneity within safety net status groups; we accounted for this as best we could by using PROC GLIMMIX. Some health process measures we look at are also influenced by unmeasured co-variables. Intuitively, these co-variables should work against the safety net hospitals (HHC and OSN) which care for a disproportionately large share of poor patients and undocumented foreigners. Prior research shows that these patients have disproportionately low rates of immunization, health literacy, primary preventive care and the ability to afford prescriptions.

**Conclusions:** We studied one large city to compare different ways of funding hospitals and the impact on measured health care quality. The AHRQ rankings for care of common conditions vary considerably from "honor roll" rankings awarded for complex procedures done at prestigious hospitals. The federal government sought to improve quality by improving transparency: publicly reporting their measures of quality. This effort seems to have had the desired effect in New York: we see an overall improvement over the four year time of our study. While all health care systems have room to improve, we do not see that the city government system is inherently worse than the others; to the contrary the city government run system has consistently outperformed the private, non-profit hospitals which are not run by the government but get a substantial (>30%) part of their budget as Medicaid reimbursement. The city run hospitals also consistently outperformed the hospitals which care primarily for well insured patients and get a small proportion of their funding from Medicaid.

	Name	sns	Chances	Standard_Met	Pct_Correct
1	HOSPITAL FOR JOINT DISEASES ORTHOPAEDIC INSTIT	NSN	24	14	58%
2	HOSPITAL FOR SPECIAL SURGERY	NSN	17	10	59%
3	CABRINI MEDICAL CENTER	NSN	3852	2328	60%
4	OUR LADY OF MERCY MEDICAL CENTER	OSN	6155	4605	75%
5	ST LUKE'S ROOSEVELT HOSPITAL	OSN	13255	10018	76%
6	BETH ISRAEL MEDICAL CENTER	OSN	13673	10620	78%
7	INTERFAITH MEDICAL CENTER	OSN	5165	4023	78%
8	PARKWAY HOSPITAL	NSN	4131	3220	78%
9	PENINSULA HOSPITAL CENTER	NSN	6924	5470	79%
10	ST VINCENT'S MIDTOWN HOSPITAL	OSN	2061	1639	80%
11	VICTORY MEMORIAL HOSPITAL	NSN	6128	4886	80%
12	NEW YORK DOWNTOWN HOSPITAL	NSN	5916	4772	81%
13	LENOX HILL HOSPITAL	NSN	14422	11694	81%
14	NORTH GENERAL HOSPITAL	OSN	5450	4478	82%
15	BRONX-LEBANON HOSPITAL CENTER	OSN	9640	7934	82%
16	NEW YORK METHODIST HOSPITAL	NSN	11458	9433	82%
17	BROOKLYN HOSPITAL CENTER AT DOWNTOWN CAMPUS	OSN	9389	7769	83%
18	NYU HOSPITALS CENTER	NSN	10168	8424	83%
19	BROOKDALE HOSPITAL MEDICAL CENTER	OSN	10021	8303	83%
20	CARITAS HEALTH CARE, INC	OSN	11362	9451	83%

	Name	sns	Chances	Standard_Met	Pct_Correct
21	ST JOHN'S EPISCOPAL HOSPITAL AT SOUTH SHORE	OSN	5432	4539	84%
22	UNIVERSITY HOSPITAL OF BROOKLYN ( DOWNSTATE )	OSN	10200	8549	84%
23	KINGS COUNTY HOSPITAL CENTER	HHC	12127	10207	84%
24	LONG ISLAND JEWISH MEDICAL CENTER	NSN	11188	9425	84%
25	LONG ISLAND COLLEGE HOSPITAL	OSN	10123	8528	84%
26	FOREST HILLS HOSPITAL	NSN	6541	5564	85%
27	RICHMOND UNIVERSITY MEDICAL CENTER	OSN	7606	6481	85%
28	JACOBI MEDICAL CENTER	HHC	8972	7656	85%
29	LUTHERAN MEDICAL CENTER	OSN	10625	9082	85%
30	WYCKOFF HEIGHTS MEDICAL CENTER	OSN	9011	7725	86%
31	NORTH CENTRAL BRONX HOSPITAL	HHC	3897	3342	86%
32	MONTEFIORE MEDICAL CENTER	OSN	15583	13381	86%
33	NEW YORK-PRESBYTERIAN HOSPITAL	NSN	32089	27625	86%
34	MOUNT SINAI HOSPITAL	NSN	13725	11891	87%
35	JAMAICA HOSPITAL MEDICAL CENTER	OSN	7969	6941	87%
36	SVCMC-ST VINCENT'S CTRS NY & WEST BRANCHES	OSN	9537	8346	88%
37	NEW YORK HOSPITAL MEDICAL CENTER OF QUEENS	NSN	11698	10255	88%
38	FLUSHING HOSPITAL MEDICAL CENTER	OSN	5926	5209	88%
39	MAIMONIDES MEDICAL CENTER	OSN	19007	16776	88%
40	NEW YORK COMMUNITY HOSPITAL OF BROOKLYN, INC.	NSN	5808	5128	88%
41	ELMHURST HOSPITAL CENTER	HHC	11493	10232	89%
42	HARLEM HOSPITAL CENTER	HHC	5222	4658	89%
43	QUEENS HOSPITAL CENTER	HHC	6231	5559	89%
44	KINGSBROOK JEWISH MEDICAL CENTER	NSN	6623	5934	90%
45	LINCOLN MEDICAL & MENTAL HEALTH CENTER	HHC	14465	13028	90%
46	BELLEVUE HOSPITAL CENTER	HHC	14621	13219	90%
47	WOODHULL MEDICAL AND MENTAL HEALTH CENTER	HHC	8327	7679	92%
48	METROPOLITAN HOSPITAL CENTER	HHC	4543	4211	93%
49	NEW YORK WESTCHESTER SQUARE MEDICAL CENTER	NSN	9146	8540	93%
50	STATEN ISLAND UNIVERSITY HOSPITAL	NSN	13811	12987	94%
51	ST BARNABAS HOSPITAL	OSN	8850	8341	94%
52	CONEY ISLAND HOSPITAL	HHC	12226	11780	96%

Table 1: Composite scores for three stable measures (MI, CHF, Pneumonia) for the 52 acute care New York City hospitals providing that care.

Obs	name	sns	Chances	Standard_Met	Pct_Correct
1	NY EYE AND EAR INFIRMARY	OSN	13	0	.00%
2	CABRINI MEDICAL CENTER	NSN	3852	2328	60%
3	OUR LADY OF MERCY MEDICAL CENTER	OSN	7276	5552	76%
4	INTERFAITH MEDICAL CENTER	OSN	5780	4500	78%
5	PARKWAY HOSPITAL	NSN	4998	3917	78%
6	VICTORY MEMORIAL HOSPITAL	NSN	7076	5550	78%
7	PENINSULA HOSPITAL CENTER	NSN	7814	6175	79%
8	ST VINCENT'S MIDTOWN HOSPITAL	OSN	2061	1639	80%
9	ST LUKE'S ROOSEVELT HOSPITAL	OSN	18399	14695	80%
10	NORTH GENERAL HOSPITAL	OSN	6031	4970	82%
11	BETH ISRAEL MEDICAL CENTER	OSN	18791	15498	82%
12	CARITAS HEALTH CARE, INC	OSN	12973	10769	83%
13	BROOKLYN HOSPITAL CENTER AT DOWNTOWN CAMPUS	OSN	12784	10631	83%
14	BROOKDALE HOSPITAL MEDICAL CENTER	OSN	12425	10379	84%
15	BRONX-LEBANON HOSPITAL CENTER	OSN	11644	9736	84%
16	NEW YORK DOWNTOWN HOSPITAL	NSN	8002	6727	84%
17	ST JOHN'S EPISCOPAL HOSPITAL AT SOUTH SHORE	OSN	6256	5267	84%
18	LENOX HILL HOSPITAL	NSN	20974	17675	84%
19	NYU HOSPITALS CENTER	NSN	16239	13749	85%
20	UNIVERSITY HOSPITAL OF BROOKLYN ( DOWNSTATE )	OSN	13839	11765	85%
21	RICHMOND UNIVERSITY MEDICAL CENTER	OSN	10364	8841	85%
22	LONG ISLAND COLLEGE HOSPITAL	OSN	15366	13113	85%
23	MONTEFIORE MEDICAL CENTER	OSN	22685	19391	85%
24	NEW YORK METHODIST HOSPITAL	NSN	16956	14532	86%
25	KINGS COUNTY HOSPITAL CENTER	HHC	15396	13242	86%
26	WYCKOFF HEIGHTS MEDICAL CENTER	OSN	12017	10369	86%
27	SVCMC-ST VINCENT'S CTRS NY & WEST BRANCHES	OSN	13691	11840	86%
28	LUTHERAN MEDICAL CENTER	OSN	19730	17078	87%
29	NORTH CENTRAL BRONX HOSPITAL	HHC	4593	3979	87%
30	JACOBI MEDICAL CENTER	HHC	11335	9867	87%
31	NEW YORK-PRESBYTERIAN HOSPITAL	NSN	45159	39390	87%



Obs	name	sns	Chances	Standard_Met	Pct_Correct
32	HOSPITAL FOR JOINT DISEASES ORTHOPAEDIC INSTIT	NSN	1309	1145	87%
33	LONG ISLAND JEWISH MEDICAL CENTER	NSN	16340	14317	88%
34	FOREST HILLS HOSPITAL	NSN	9929	8719	88%
35	JAMAICA HOSPITAL MEDICAL CENTER	OSN	10870	9558	88%
36	HARLEM HOSPITAL CENTER	HHC	6337	5618	89%
37	MOUNT SINAI HOSPITAL	NSN	21418	19059	89%
38	NEW YORK COMMUNITY HOSPITAL OF BROOKLYN, INC.	NSN	6661	5935	89%
39	FLUSHING HOSPITAL MEDICAL CENTER	OSN	8391	7481	89%
40	NEW YORK HOSPITAL MEDICAL CENTER OF QUEENS	NSN	17419	15608	90%
41	MAIMONIDES MEDICAL CENTER	OSN	29111	26090	90%
42	ELMHURST HOSPITAL CENTER	HHC	14102	12660	90%
43	KINGSBROOK JEWISH MEDICAL CENTER	NSN	8202	7388	90%
44	QUEENS HOSPITAL CENTER	HHC	8453	7646	90%
45	LINCOLN MEDICAL & MENTAL HEALTH CENTER	HHC	17374	15775	91%
46	BELLEVUE HOSPITAL CENTER	HHC	20418	18547	91%
47	WOODHULL MEDICAL AND MENTAL HEALTH CENTER	HHC	9914	9096	92%
48	METROPOLITAN HOSPITAL CENTER	HHC	7073	6600	93%
49	NEW YORK WESTCHESTER SQUARE MEDICAL CENTER	NSN	11781	11028	94%
50	ST BARNABAS HOSPITAL	OSN	9979	9419	94%
51	STATEN ISLAND UNIVERSITY HOSPITAL	NSN	18693	17657	94%
52	CONEY ISLAND HOSPITAL	HHC	14110	13592	96%
53	HOSPITAL FOR SPECIAL SURGERY	NSN	5371	5263	98%

Table 2: Composite scores for 53 New York City acute care hospitals, all measures (MI, CHF, Pneumonia and Surgical Care), summed scores over 2005-2008.

<b>Table of SNS by Pass/Fail</b>			
<b>Safety Net</b>	<b>Pass/Fail</b>		
<b>Frequency Row Pct</b>	<b>Fail</b>	<b>Pass</b>	<b>Total</b>
<b>HHC</b>	12483 9.67	116622 90.33	129105
<b>NSN</b>	32031 12.91	216162 87.09	248193
<b>OSN</b>	41895 14.94	238581 85.06	280476
<b>Total</b>	86409	571365	657774

Table 3: Table of safety net status and overall pass/fail performance. The city run hospitals are labeled “HHC”, the private hospitals with a large proportion of safety net patients are labeled “OSN”, and the non-safety net “NSN” hospitals care mostly for well insured patients.

<b>Table of aspect by pass/Fail</b>			
<b>aspect</b>	<b>Pass/Fail</b>		
<b>Frequency Row Pct</b>	<b>Fail</b>	<b>Pass</b>	<b>Total</b>
<b>CHF</b>	22725 15.44	124489 84.56	147214
<b>MI</b>	8653 6.90	116784 93.10	125437
<b>Pneumonia</b>	38546 18.43	170636 81.57	209182
<b>Surgical</b>	16485 9.37	159456 90.63	175941
<b>Total</b>	86409	571365	657774

Table 4: Table of aspect of care (disease process being cared for) by pass/fail performance. Congestive heart failure is abbreviated “CHF”; myocardial infarction (heart attack) is abbreviated “MI”.



Dimensions	
R-side Cov. Parameters	1
Columns in X	5
Columns in Z per Subject	0
Subjects (Blocks in V)	54
Max Obs per Subject	4

Type III Tests of Fixed Effects				
Effect	Num DF	Den DF	F Value	Pr > F
safety	2	49	11.21	<.0001
year	1	145	130.79	<.0001

Estimates									
Label	Estimate	Standard Error	DF	t Value	Pr >  t	Alpha	Lower	Upper	Exponentiated Estimate
HHC vs NSN	0.3637	0.09852	49	3.69	0.0006	0.05	0.1657	0.5617	1.4386
HHC vs OSN	0.4501	0.09543	49	4.72	<.0001	0.05	0.2584	0.6419	1.5685
NSN vs OSN	0.08646	0.07222	49	1.20	0.2370	0.05	-0.05867	0.2316	1.0903

Table 5: Basic elements of GLIMMIX model

### Trend Plots for Each of the 53 NYC Hospitals

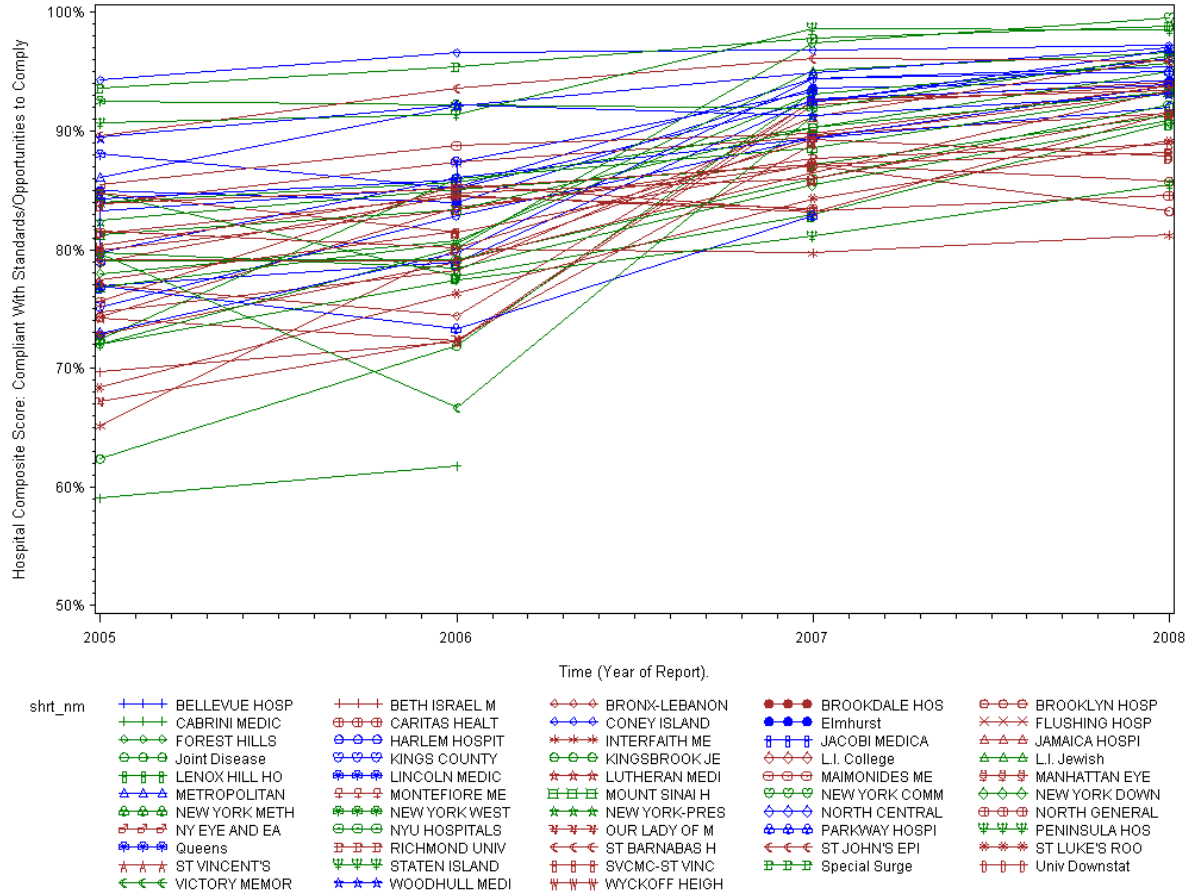


Figure 1: Trend Plots of composite score for each hospital, each year. HHC Hospitals are identified by blue symbols and trend lines; other safety net (OSN) hospitals by brown, and non-safety net hospitals (NSN) by green.

## Composite Performance on AHRQ Core Measures

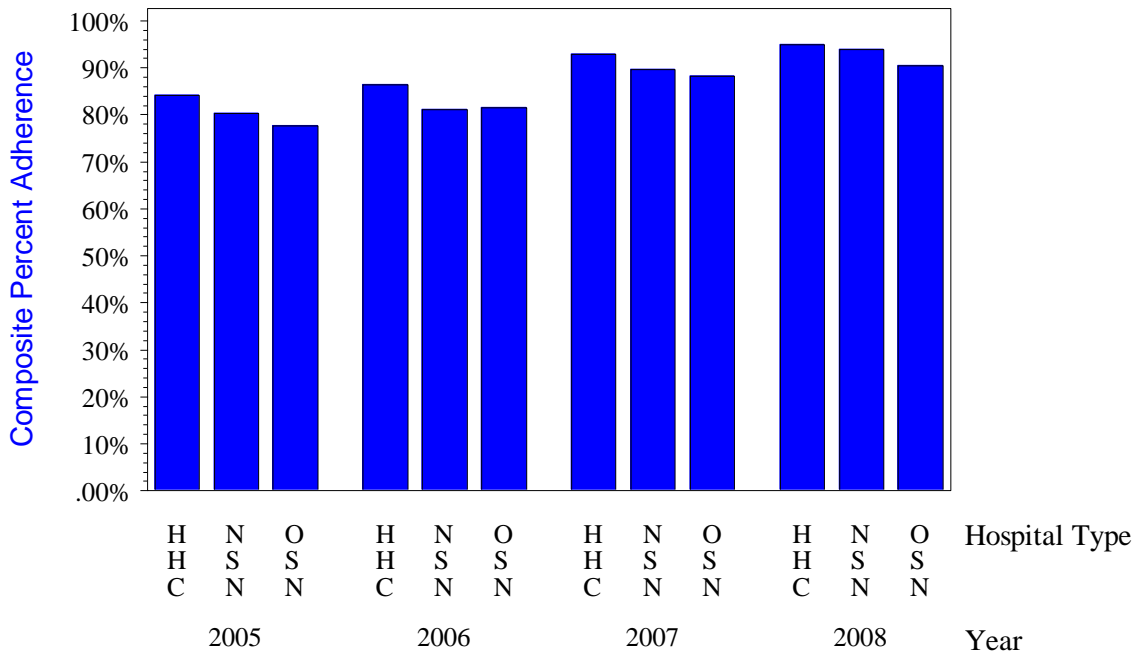


Figure 2: Bar chart showing composite performance of the three hospital groups over time.

### REFERENCES

The AHRQ data can be downloaded from: <http://www.medicare.gov/Download/DownloadDB.asp>

The US News and World Report Honor Roll of Hospitals can be found at:

<http://health.usnews.com/health/best-hospitals>

### CONTACT INFORMATION

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