APPROACH: W205-5 Exercise 1

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Introduction:

This exercise references three types of data from the Centers for Medicare and Medicaid Services (CMS) Hospital Compare project:

1. measures around timely and effective care for common, serious medical conditions
2. measures for 30-day readmissions and deaths
3. survey data from patients on hospital quality

These data represent different ways to measure high-quality care, and are not easy to combine due to:

1. Dissimilar measuring methods: readmissions and deaths measures are better when values are small, while measures for care are better when high. Likewise, survey data scores are better when high.
2. Varying levels of sparsity: some of the best-ranked hospitals on surveys have very sparse care data.
3. Different perspectives on quality: hospitals scoring high on surveys do not correspond to high-scoring care measures or readmissions and deaths measures.

Data Sources and Transformations:

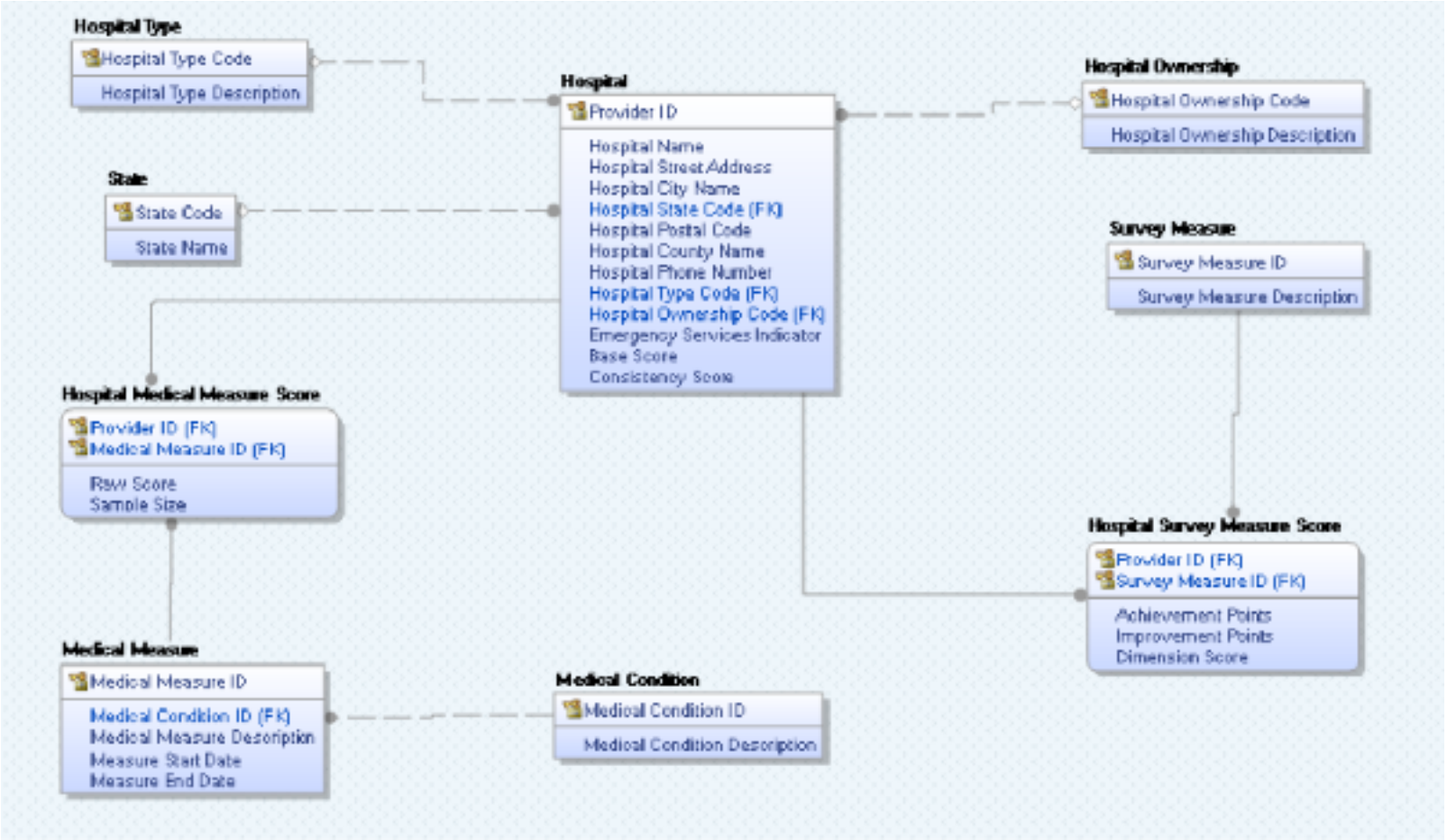
The data come from five main sources:

1. A general hospital file, “Hospital General Information.csv”, which includes hospital name, address, type and ownership
2. A survey of patient responses: “HCAHPS - Hospital.csv”.
3. A lookup file for different types of measures and their active dates: “Measure Dates.csv”

4. Hospital care measures: “Timely and Effective Care - Hospital.csv”
5. Hospital readmissions and deaths measures: “Readmissions and Deaths - Hospital.csv”

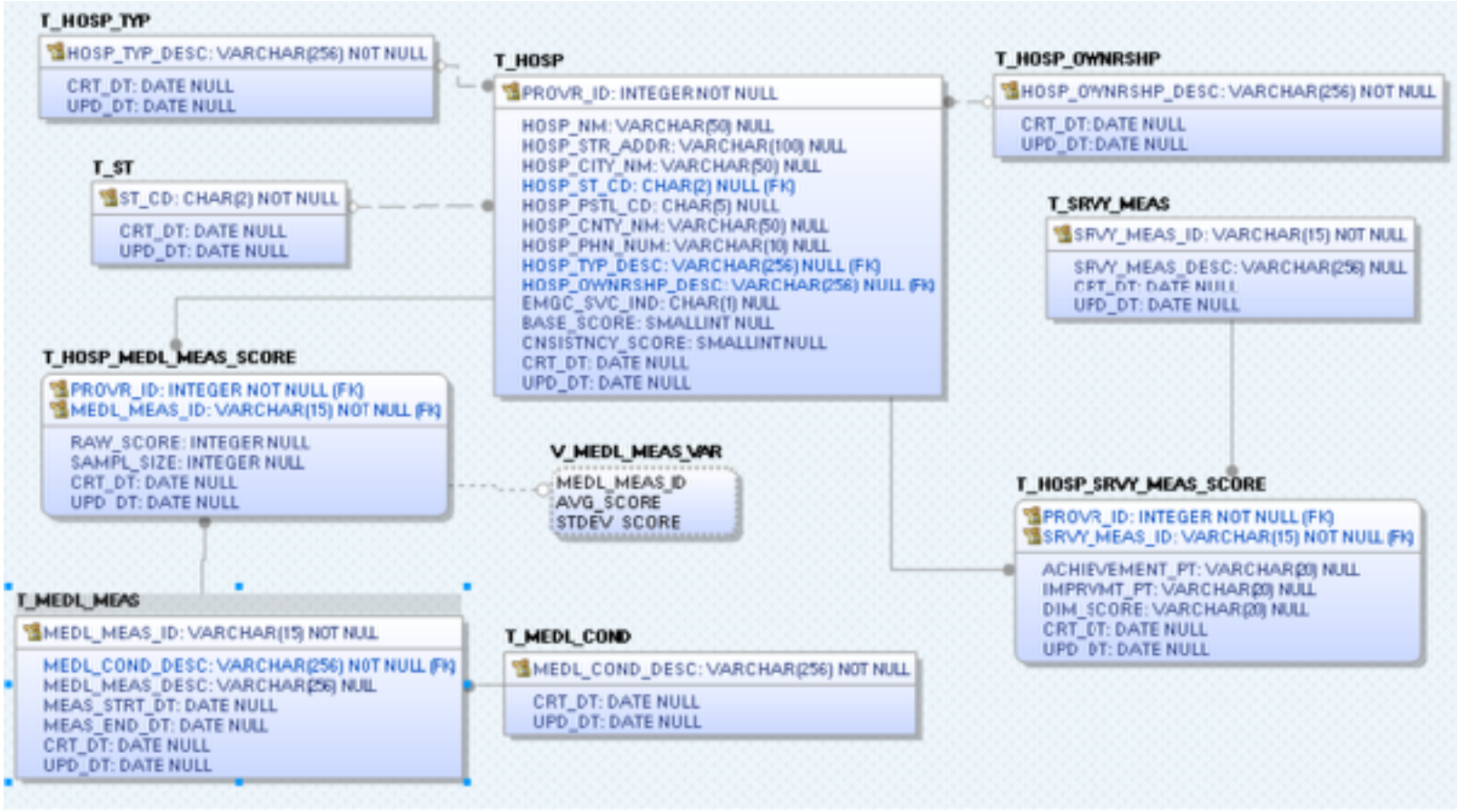
There is a state-level file, but granular hospital-level data was aggregated for state-level analysis.

Logical Data Model:



The logical data model is fairly simple. Measures for effective care and readmissions and deaths form a single structure in the Hospital Medical Measure Score entity. Survey measures and scores are separated into different entities based because metrics and measure hierarchies are different. State, Hospital Type and Hospital Ownership were normalized from the base hospital data to form code tables. Medical Conditions were pulled out from the Effective Care raw data, and Survey Measures were manually created from Survey Headings. Hospital Survey Measures were normalized from a flattened raw structure, with base and consistency scores moved to the hospital entity for normalization.

Physical Data Model:



The physical model maps fairly closely to the logical model. Descriptions were used as primary keys instead of codes in some dimension tables, rather than fabricating codes manually. And one crucial view holds averages and standard deviations of measure scores for comparison. Additional views were created in the analysis phase, specific to answering particular questions.

Analysis Assumptions:

A number of assumptions have been made in aggregating and analyzing the CMS data.

1. Excluded data: Measures that co not conform to the 1-100 scalse, such as Emergency Services (measure ID ED_1b), will be excluded from aggregations of measures, as they are not comparable with other scores
2. Minimum thresholds: Hospitals must have a minimum of complete score information to be considered in 'best' rankings. As a threshold, we use 2/3 of the total possible measures in each category. This threshold was lowered when combining survey and effective care measures, as the effective care data was too sparse for hospitals with high survey scores.
3. Comparison metric: Hospitals passing the threshold for a minimum number of score values will be compared based upon standard deviations from the mean for each measure.
4. Combining measures: Higher score values for timely and effective care represent higher quality care, while low score values for mortality and readmissions are preferred. In addition, there are fewer mortality and readmission measures (14) than those for care (38). There is no guarantee that manipulating death and readmission scores at the pre-aggregated state (by subtracting the values from 100, for example), would result in an aggregation of equal measures. As such, hospital quality will be ranked as follows:
    1. Highest scoring hospitals on care measures
    2. Lowest scoring hospitals on death and readmission measures
    3. Highest scoring hospitals on care measures, filtering on hospitals which also have low scores on deaths and readmissions.

Analysis Results:

Null measure scores made even comparisons between hospitals impossible. Those hospitals that did meet the minimum number of scores differed in which scores were populated in each case. Those meeting the threshold were compared using standard deviations from the mean measures to account for measure variance. See SQL files under the 'investigations' folder for details.

I. High Quality Hospitals:

A. Care Measures:

Hospital ID	HOSP_NM	BASE_ SCORE	CONST_ SCORE	CARE_AVG_ SCORE	CARE_AVG_ SD_SCORE	RANK
10087	UNIVERSITY OF SOUTH ALABAMA MEDICAL CENTER	27	20	93.17	0.6	1
170023	ST CATHERINE HOSPITAL	20	20	93.22	0.58	2
460003	SALT LAKE REGIONAL MEDICAL CENTER	30	18	94.2	0.58	2
10035	CULLMAN REGIONAL MEDICAL CENTER	38	20	91.26	0.55	4
140148	MEMORIAL MEDICAL CENTER	26	17	90.09	0.54	5
150010	ST JOSEPH HOSPITAL & HEALTH CENTER INC	24	20	92.54	0.54	5
50426	WEST ANAHEIM MEDICAL CENTER	3	10	95.44	0.53	7
450203	WEATHERFORD REGIONAL MEDICAL CENTER	22	18	93.14	0.52	8
490126	LEWISGALE HOSPITAL ALLEGHANY	15	15	95.75	0.51	9
100030	HEALTH CENTRAL	15	14	92.88	0.49	10

B. Death and Readmission Measures

Deaths and Readmissions aim for low scores. A minimum of 14 populated scores was required for comparison eligibility.

Hospital ID	HOSP_NM	BASE_ SCORE	CONST_ SCORE	DAR_AVG _SCORE	DAR_AVG_ SD_SCORE	RANK
160029	MERCY HOSPITAL	32	19	11.74	-1.35	1
50625	CEDARS-SINAI MEDICAL CENTER	22	18	11.61	-1.33	2
150115	MEMORIAL HOSPITAL AND HEALTH CARE CENTER	54	20	12.65	-1.27	3
50573	EISENHOWER MEDICAL CENTER	9	18	12.01	-1.21	4
390057	GRAND VIEW HOSPITAL	21	16	12.59	-1.21	5
330182	ST FRANCIS HOSPITAL, ROSLYN	42	19	11.97	-1.19	6
260179	ST LUKES HOSPITAL	46	20	11.83	-1.19	7
130006	ST LUKE'S REGIONAL MEDICAL CENTER	38	20	12.04	-1.17	8
30103	MAYO CLINIC HOSPITAL	65	20	11.97	-1.15	9
220077	BAYSTATE MEDICAL CENTER	12	14	12.05	-1.13	10

C. Care Measures Filtered on Low Death and Readmissions

High care and low mortality rates did not align as one might expect. Here are the hospitals with the highest effect care scores, which also showed low mortality and readmission rates.

PROVR_ID	HOSP_NM	BASE_SCORE	CONST_SCORE	CARE_SUM_SCORE	CARE_AVG_SCORE	CARE_AVG_SD_SCORE	DAR_SUM_SCORE	DAR_AVG_SCORE	DAR_AVG_SD_SCORE	RANK
50424	SCRIPPS GREEN HOSPITAL	39	20	2980.0	96.13	0.43	170.7	12.19	-1.03	1
50024	PARADISE VALLEY HOSPITAL	12	13	2933.0	91.66	0.42	147.5	13.41	-1.1	2
100267	ENGLEWOOD COMMUNITY HOSPITAL	0	15	2762.0	95.24	0.4	147.3	13.39	-0.64	3
220077	BAYSTATE MEDICAL CENTER	12	14	3340.0	90.27	0.4	168.7	12.05	-1.13	3
430013	AVERA QUEEN OF PEACE	41	20	2683.0	92.52	0.4	159.5	13.29	-0.69	3
450021	BAYLOR UNIVERSITY MEDICAL CENTER	24	18	3064.0	90.12	0.39	176.2	12.59	-0.69	6
420087	ROPER HOSPITAL	45	20	3244.0	92.69	0.39	171.2	12.23	-0.99	6
50503	SCRIPPS MEMORIAL HOSPITAL - ENCINITAS	12	16	3254.0	90.39	0.39	159.4	13.28	-0.71	6
100070	VENICE REGIONAL MEDICAL CENTER - BAYFRONT HEALTH	0	8	3064.0	92.85	0.39	172.5	12.32	-0.94	6
50498	SUTTER AUBURN FAITH HOSPITAL	29	20	2863.0	95.43	0.38	157.8	13.15	-0.75	10

II. High quality states

Care measures were aggregated from the detail to find the best scoring states, using hospitals with a minimum of null measure scores.

HOSP_ST_CD	STATE_BASE_SCORE	STATE_CONST_SCORE	STATE_AVG_SD_SCORE	RANK
UT	30.0	18.0	0.58	1
KS	20.0	20.0	0.58	1
AL	38.0	20.0	0.55	3
TX	22.0	18.0	0.52	4
VA	15.0	15.0	0.51	5
VA	24.0	18.0	0.49	6
AL	23.0	18.0	0.49	6
PA	12.0	8.0	0.49	6
FL	15.0	14.0	0.49	6
VA	34.0	17.0	0.48	10

III. Procedure score variability (excluding volume measures)

A. 10 Highest

The following measures showed the highest variance in scores:

MEDL_MEAS_ID	MEDL_MEAS_DESC	VARIANCE
STK_4	Thrombolytic Therapy	481.99
OP_23	Head CT Scan Results for Acute Ischemic Stroke or Hemorrhagic Stroke Patients who Received Head CT or MRI Scan Interpretation Within 45 Minutes of ED Arrival	477.19
AMI_7a	Fibrinolytic Therapy Received within 30 Minutes of Hospital Arrival	352.67
OP_2	Fibrinolytic Therapy Received Within 30 Minutes of ED Arrival	325.75
VTE_5	Venous Thromboembolism Warfarin Therapy Discharge Instructions	265.79
VTE_1	Venous Thromboembolism Prophylaxis	232.79
STK_8	Stroke Education	196.37
CAC_3	Home Management Plan of Care (HMPC) Document Given to Patient/ Caregiver	161.78
IMM_2	Influenza Immunization	142.68
HF_1	Discharge Instructions	139.9

B. Ten Lowest

These measures showed the lowest variance in scores:

MEDL_MEAS_ID	MEDL_MEAS_DESC	VARIANCE
STK_5	Antithrombotic Therapy By End of Hospital Day 2	28.85
OP_4	Aspirin at Arrival	27.1
OP_6	Timing of Antibiotic Prophylaxis	25.7
SCIP_VTE_2	Surgery Patients Who Received Appropriate Venous Thromboembolism Prophylaxis Within 24 Hours Prior to Surgery to 24 Hours After Surgery	22.02
OP_7	Prophylactic Antibiotic Selection for Surgical Patients	15.33
STK_2	Discharged on Antithrombotic Therapy	15.07
AMI_2	Aspirin Prescribed at Discharge	14.49
OP_22	Patient left without being seen	2.95
CAC_2	Systemic Corticosteroids for Inpatient Asthma	1.65
CAC_1	Relievers for Inpatient Asthma	0.02

IV. Procedural quality vs Survey quality

Revisit the quality scores above to find survey measures (base and consistency scores) for highest ranked hospitals using care or readmissions and deaths. Surprisingly, some of the highest rated hospitals, on care measures, have very low patient survey scores.

Twenty three hospitals scored 80 on Base and 20 on Consistency for a total of 100 points - the highest possible score in the survey data. Here are the top ranked hospitals, based on patient surveys, ordered by care measures.

Note that the minimum number of care scores was dropped to 10 for this result, as no hospitals scoring 100 points met the minimum requirement for non-null data.

PROVR_ID	HOSP_NM	SURVEY_SCORE	MEAS_COUNT	SD_SCORE	RANK
450875	QUAIL CREEK SURGICAL HOSPITAL	100.0	12	0.49	1
520194	ORTHOPAEDIC HOSPITAL OF WISCONSIN	100.0	12	0.44	2
430091	BLACK HILLS SURGICAL HOSPITAL LLP	100.0	12	0.42	3
110200	NORTHSIDE MEDICAL CENTER	100.0	13	0.37	4
430092	DAKOTA PLAINS SURGICAL CENTER LLP	100.0	12	0.34	5
170190	MANHATTAN SURGICAL HOSPITAL LLC	100.0	11	0.32	6
670049	NORTH CENTRAL SURGICAL CENTER LLP	100.0	14	0.3	7
360352	SURGICAL HOSPITAL AT SOUTHWOODS	100.0	12	0.28	8
280131	MIDWEST SURGICAL HOSPITAL LLC	100.0	12	0.25	9
190263	HEART HOSPITAL OF LAFAYETTE	100.0	20	0.23	10

No hospital scored well on all three quality measures: the patient survey, effective care, and readmissions and deaths. However a few hospitals did fairly well on both the survey and effective care measures. They are listed here:

PROVR_ID	HOSP_NM	SURVEY_SCORE	CARE_AVG_SCORE	CARE_AVG_SD_SCORE	RANK
180044	PIKEVILLE MEDICAL CENTER	90	90.67	0.42	1
40134	ARKANSAS HEART HOSPITAL, LLC	88.0	95.37	0.42	2
100315	VIERA HOSPITAL	84.0	95.39	0.42	3
340115	FIRSTHEALTH MOORE REGIONAL HOSPITAL	88.0	91.45	0.39	4
420015	BAPTIST EASLEY HOSPITAL	81.0	92.7	0.38	5
190004	THIBODAUX REGIONAL MEDICAL CENTER	79.0	89.29	0.37	6

Summary:

This disparity in measures and scores makes recommending and choosing a good hospital very difficult. As an example, in San Mateo County, I found the following hospitals survey scores:

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050007   MILLS-PENINSULA MEDICAL CENTER    51
050113   SAN MATEO MEDICAL CENTER  14
050197   SEQUOIA HOSPITAL 15
050541   KAISER FOUNDATION HOSPITAL - REDWOOD CITY  41
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PROVR_ID	HOSP_NM	SRVY_MEAS_ID	SRVY_MEAS_DESC	DIM_SCORE
50007	MILLS-PENINSULA MEDICAL CENTER	CWN	Communication with Nurses	3 out of 10
50007	MILLS-PENINSULA MEDICAL CENTER	CWD	Communication with Doctors	5 out of 10
50007	MILLS-PENINSULA MEDICAL CENTER	RHS	Responsiveness of Hospital Staff	0 out of 10
50007	MILLS-PENINSULA MEDICAL CENTER	PM	Pain Management	7 out of 10
50007	MILLS-PENINSULA MEDICAL CENTER	CAM	Communication about Medicines	2 out of 10
50007	MILLS-PENINSULA MEDICAL CENTER	CAQ	Cleanliness and Quietness of Hospital Environment	3 out of 10
50007	MILLS-PENINSULA MEDICAL CENTER	DI	Discharge Information	3 out of 10
50007	MILLS-PENINSULA MEDICAL CENTER	ORH	Overall Rating of Hospital	9 out of 10

It might seem that Mills-Peninsula is the best choice, but the dimension scores have no consistency, and it has Yelp score of 2 out of 5 stars. Of these hospitals, only Kaiser has a high effective care score, while Mills and Sequoia are on the low mortality and readmissions list.

Recommendations:

For future measurements of hospital quality, the following changes to data collection are recommended.

1. Standardize measurements. There is no way to confidently combine care measures with mortality and readmissions.
2. Combine patient experience of care with expert analysis of care. Use auditors to record all measures, consistently and expertly.
3. Combine scores into a single measure and rank hospitals clearly. Allow hospitals to see clearly how they can improve scores the following year.