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NATIONWIDE READMISSIONS DATABASE
FINAL FEASIBILITY REPORT
DELIVERABLE #1633.2E

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Prepared by:

Marguerite Barrett
Susan Raetzman
Jared Lane Maeda
Minya Sheng

Submitted to:
Jenny Schnaier, Project Officer
Agency for Healthcare Research and Quality
540 Gaither Road
Rockville, MD 20850

Submitted by:
Thomson Reuters
5425 Hollister Ave, Suite 140
Santa Barbara, CA 93111

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EXECUTIVE SUMMARY

Reducing hospital readmission rates is a key strategy for improving the quality of health care; a secondary benefit is a reduction in associated costs. Sequential inpatient stays may occur for a variety of reasons and can be separated by days, weeks, months, or years. Multiple hospital visits by the same patient may, in fact, be unrelated. Determining if visits are related requires an understanding of whether patients are seen in the hospital for expected follow-up treatment, or conversely, for unexpected complications.

The Healthcare Cost and Utilization Project (HCUP) State Inpatient Databases (SID) have been used for the National Healthcare Quality Report (NHQR) and journal articles to examine inpatient readmissions, but analyses were restricted to state-level or combined-state-level results.[1,2] The SID are created by the Agency for Healthcare Research and Quality (AHRQ) through a Federal-State-Industry partnership and capture information on all inpatient stays, regardless of payer, from hospitals within each state.

In the present report, we discuss the feasibility of creating a Nationwide Readmissions Database (NRD) using the 2008 HCUP SID. This pilot database would be used for internal AHRQ research until it is fully tested and approved for public release. In 2008, the SID from 42 states encompass over 95 percent of all U.S. community hospital discharges. Fifteen states (AR, CA, FL, HI, LA, MA, MO, NE, NH, NY, SC, TN, UT, VA, and WA) contain reliable, verified synthetic patient identifiers that can be used to track a person across hospitals within a state. These 15 states are geographically dispersed and account for 42 percent of the total U.S. resident population and 41 percent of the total U.S. hospitalizations.

The pilot NRD was constructed using one calendar year of SID data from the 15 states. The following types of hospitals and discharges were excluded from the SID:

1. Non-community or rehabilitation hospitals
2. Specialty hospitals
3. Discharges younger than 1 year (age 0)
4. Discharges with unverified or missing patient identifiers
5. Discharges with suspect patient identifiers (e.g., 20 or more visits in the year)
6. Discharges with suspect patient identifiers (e.g., discharged dead with subsequent admission)
7. Discharges from hospitals with more than 50 percent of total discharges excluded for any cause.

Information on the target universe of 2008 inpatient admissions from community, non-rehabilitation, non-specialty hospitals in the United States was available from the American Hospital Association (AHA) Annual Survey of Hospitals. Because of exclusions, the sampling frame was limited to discharges for patients who were ages one and older with verified patient

[1] Chapter 6 of the 2010 NHQR presents estimates of readmissions for congestive heart failure.
[2] HCUP Methods Series #2011-01 *Methodological Issues when Studying Readmissions and Revisits Using Hospital Administrative Data* includes a list of journal article using HCUP data published before December 2010. Available at http://www.hcupus.ahrq.gov/reports/methods/methods.jsp.

identifiers treated at community, non-rehabilitation, non-specialty hospitals in the 15 HCUP states.

The pilot NRD was constructed as a sample of convenience consisting of 100 percent of the eligible discharges. Sampling discharges from the set of eligible discharges was not recommended because the sample needed to address the ability to develop accurate readmission estimates for *common* conditions such as chronic illnesses and injuries and also readmissions for *rare* diseases such as sickle cell anemia. Developing the database using a 100 percent sample allowed the research team to study both all-cause and condition-specific readmissions. Conditions that generally do not get readmitted, such as childbirth and discharges that result in death, were also represented. The 15 states together included about 12.3 million discharges in the sampling frame (after exclusions), which was larger than the Nationwide Inpatient Sample (about 8 million records per year) but smaller than the HCUP Nationwide Emergency Department Sample (about 28 million records per year).

Discharge weights for national estimates were developed using the target universe as the standard. Hospitals were post-stratified on hospital characteristics to ensure generalizability, and discharges were stratified by age before the calculation of weights to account for the lower percentage of verified patient identifiers in ages 1 to 17 years and the higher percentage of verified patient identifiers in ages 65 years and older.

Data elements have been added to the pilot NRD to facilitate readmission analyses. In addition, pairs of discharge records representing transfers were retained in such a way that readmission analyses could consider these admissions as separate events or as one continuous event. No attempt was made when creating the pilot NRD to determine whether repeat visits were related or unrelated. This decision was left to the analyst using the NRD.

The strength of the NRD is that it will be the first all-payer readmissions database that can be used by researchers to identify the patterns of hospital readmissions nationwide. The limitations of the pilot NRD were caused by limitations in the underlying data. These included inconsistent reporting of patient identifiers for pediatric cases and state-level identifiers that track patients within and across hospitals in a single state. We have used exclusions on certain types of hospitals and discharges and post-stratified weighting to minimize these limitations.

<Note: information of the validity of the NRD and final recommendations to be added after the 2008 NRD rates are calculated and compared to other data sources.>

INTRODUCTION

Reducing hospital readmission rates is a key strategy for improving the quality of health care while containing the associated costs. Sequential inpatient stays may occur for any reason and can be separated by days or years. Multiple hospital visits by the same patient may, in fact, be clinically unrelated. Determining if visits are related requires, in part, being able to distinguish between patients being seen in the hospital for expected follow-up treatment and, conversely, those returning due to unexpected complications.

The Healthcare Cost and Utilization Project (HCUP) State Inpatient Databases (SID) have been used for the National Healthcare Quality Report (NHQR) and journal articles to examine inpatient readmissions, but analyses were restricted to state-level or combined-state-level results.[3,4] The SID are created by the Agency for Healthcare Research and Quality (AHRQ) through a Federal-State-Industry partnership and capture information on all inpatient stays, regardless of payer, from hospitals within each state. These databases are often characterized as being "discharge-level" files, meaning that each record in a database represents one discharge abstract from a hospital. Thus, if the same individual visited the hospital multiple times in a given year, the SID would include separate records for each stay. To facilitate analyses that focus on repeat hospital stays by the same person, AHRQ created a set of supplemental data elements to track patient visits within and across hospitals in a state. These data elements adhere to strict privacy regulations.

In this report, we provide a comprehensive overview of the feasibility of a Nationwide Readmissions Database (NRD) and the creation of a pilot database using the 2008 HCUP SID. The purpose of the NRD is to support national analyses of repeat hospital use for all types of patients, regardless of the type of health insurance. Outcomes of interest include readmission rates, reasons for returning to the hospital for care, and the hospital costs for discharges with and without readmissions. The pilot NRD is to be used for intramural AHRQ research until it is fully tested and approved by the HCUP Partners for public release.

If feasible, the NRD would be the first database for researchers to identify the patterns in all-payer readmissions nationwide. We provide details regarding the assessment of available HCUP discharge data and the NRD database design. To assess the validity and reliability of the pilot NRD, we considered estimates of readmission rates from existing Federal and non-Federal data sources. Finally, we discuss the timing and costs related to producing the NRD as a publicly available HCUP database and make recommendations for the future.

ASSESSMENT OF AVAILABLE DISCHARGE DATA

This section assesses the available HCUP discharge data with respect to building a nationwide readmissions database and determines necessary state, hospital, and discharge-level exclusions for the pilot NRD. We consider the following:

- Availability of 2008 SID with patient identifiers

[3] Chapter 6 of the 2010 NHQR presents estimates of readmissions for congestive heart failure.
[4] HCUP Methods Series #2011-01 *Methodological Issues when Studying Readmissions and Revisits Using Hospital Administrative Data* includes a list of journal article using HCUP data published before December 2010. Available at http://www.hcupus.ahrq.gov/reports/methods/methods.jsp.

- Types of hospitals in the SID
- Variations in the reporting of patient identifiers
- Limitations of state-specific patient identifiers
- Specialty hospitals
- Hospitals with a large percentage of excluded discharges.

After the discussion of these considerations, we summarize the impact on the number of discharges and hospitals that were excluded from the pilot NRD.

Availability of 2008 SID with Patient Identifiers

In 2008, the SID from 42 states accounted for more than 95 percent of all U.S. community hospital discharges. Data from 16 states (AR, CA, FL, HI, KS, LA, MA, MO, NE, NH, NY, SC, TN, UT, VA, and WA) contained the HCUP-verified synthetic patient identifier that can be used to track a person within and across hospitals within a state. Appendix A provides the list of HCUP Partners in the 16 states.

Synthetic person numbers provided by the HCUP Partners were verified against the patient's date of birth and gender to ensure that the person number identified unique patients. Unverified patient numbers included missing and invalid identifiers. Table B.1 (Appendix B) shows the percentage of discharges with verified patient identifiers by age group (0, 1-17, 18-64, and 65 and older). The percentage of discharges with verified patient identifiers was at least 90 percent for adults ages 18-64 in all states, except Kansas (71.4 percent) and CA (87.1 percent). Within a state, the percentage of verified patient identifiers was usually lower for ages 1 to 17, ranging from 43 to 100 percent, than for ages 18 to 64. For patients younger than 1 year (age 0), nearly half of the states (7 of 16 states) had less than 10 percent verified patient identifiers. In contrast, the percentage of verified patient identifiers for patients age 65 and over was at least 97 percent for all states except Kansas. Because the percentage of verified patient identifiers in Kansas was under 90 percent in each of the four age groups, Kansas was excluded from further consideration.

The 15 remaining states were included in the pilot NRD. They are geographically dispersed and account for 42 percent of the total U.S. resident population and 41 percent of the total U.S. hospitalizations in 2008 (Table 1).

Table 1. Percentage of Regional and Total U.S. Population and Hospitalizations

Region	States	Percentage of Regional or Total U.S. Resident Population in HCUP States, 2008	Percentage of Regional or Total U.S. Hospitalizations in HCUP States, 2008
Northeast	MA, NH, NY	49.6%	48.6%
Midwest	MO, NE	11.6%	12.6%
South	AR, FL, LA, SC, TN, VA	39.5%	40.4%
West	CA, HI, UT, WA	66.7%	65.9%
Total U.S.		41.6%	40.5%

Types of Hospitals in the SID

The SID contained inpatient discharges for all hospitals provided by the HCUP data sources (e.g., community, rehabilitation, specialty, and Federal). The other HCUP inpatient databases — the Nationwide Inpatient Sample (NIS) and the Kids' Inpatient Sample (KID) — were restricted to community, non-rehabilitation hospitals. *Community hospitals* were defined by the American Hospital Association (AHA) to be "all non-Federal, short-term, general, and other specialty hospitals, excluding hospital units of institutions." Specialty hospitals included in the AHA definition of community hospitals are: obstetrics-gynecology, ear-nose-throat, short-term rehabilitation, orthopedic, pediatric institutions, and long-term, acute care facilities. Also included are public hospitals and academic medical centers. To create a consistent collection of hospitals across states, we also limited the pilot NRD to U.S. community, non-rehabilitation hospitals.

Variation in the Reporting of Patient Identifiers

In this section we examine the availability of patient identifiers by age and the characteristics of discharges with missing, unverified, or suspect patient identifiers.

Availability of Patient Identifiers by Age

Ideally, the NRD would be used to study hospital readmissions for all ages, but the evaluation of the SID with synthetic patient identifiers showed variability in the reporting of identifiers by age groups. To examine this issue in more detail, we considered the percentage of discharges verified for each individual age and state (Table B.2 in Appendix B). This table illustrates that the patient identifiers for age 0 are not reliably coded in most of the NRD states, but become more reliable as age increases. The percentage of verified patient identifiers for age one starts below 50 percent in most states and increases to 80 or 90 percent by age 17. Table B.2 also emphasizes that fact that patient identifiers are exceptionally well reported for patients 65 years and older.

Table B.3 (Appendix B) shows the percentage of verified patient identifiers by cumulative age (age 0 and older, age 1 and older, etc.) in the NRD states. Because pediatric discharges ages 1-17 are a small percentage of the total discharges (about 5 percent), the percentage of verified patient identifiers appears better when the pediatric cases are averaged with adults.

We decided to exclude discharges for patients with age 0 from the pilot NRD because the small percentage of verified synthetic patient identifiers limits the ability to track readmissions for these patients. To assess the biases from excluding these discharges from the pilot NRD, we examined the proportions of discharges by patient characteristics, hospital characteristics, and diagnoses. To retain the small amount of discharges with missing values for age in years (0.01% of the 15.7 million records in the 15 SID), hot-deck methodology was used to impute the missing age. Hot-decking is a preferred method because it preserves the variance of the estimates. The first round of imputation for age used the stratifiers of hospital identifier and the Clinical Classifications Software (CCS) category for the principal diagnosis (DXCCS1). If records remained after the first round of imputation, the remaining missing values for age were imputed using DXCCS1 alone as the stratifier. This approach imputed all records with a missing age.

Table B.4 (Appendix B) shows the percentage of discharges across the NRD states in community, non-rehabilitation hospitals by age group (0, 1-17, and 18 and older) and by patient characteristics, hospital characteristics, and CCS for the principal diagnosis. Bias from exclusions occurs when the proportion of excluded records disproportionately impacts one type of discharge. Although patients age 0 years accounted for 12.6 percent of discharges overall, we first considered characteristics for which this age group accounted for a higher percentage of discharges; that is, they accounted for at least 15.1 percent of all discharges (a 20 percent increase from 12.6). Patients age 0 years accounted for all newborns and nearly all discharges with jaundice and perinatal conditions (over 99.5 percent). They also accounted for a disproportionately higher percentage of discharges for acute bronchitis (50.2 percent) and other upper respiratory infections (20.0 percent). Newborns accounted for a higher percentage of males (15.6 percent), Medicaid discharges (27.5 percent), privately-insured discharges (17.6 percent), and discharges from hospitals in the West (15.9 percent). In contrast, patients age 0 years accounted for a disproportionately lower percentage of hospitals in rural, non-core counties (8.5 percent). Patients age 0 years comprised a similar percentage of discharges (less than a 20 percent difference from 12.6 percent) across income quartiles of the patient's ZIP Code and hospital characteristics (e.g., bed size, control, and teaching status).

Discharges with Unverified, Missing, or Suspect Patient Identifiers

Discharges with unverified or missing patient identifiers cannot be used for a readmission analysis because they cannot be followed. Another concern was synthetic patient identifiers that were suspect because of extraordinary utilization in the year, defined as 20 or more admissions in a calendar year. In addition, a very small number of patient identifiers (about 0.1 percent) showed a patient discharged dead from one admission and then admitted at a later date.

We decided to exclude discharges for patients with unverified, missing, or suspect patient identifiers from the pilot NRD and assess the biases from this exclusion. Table B.5 (Appendix B) shows the verification status of patient identifiers for discharges at least one year old treated in community, non-rehabilitation hospitals by patient characteristics, hospital characteristics, and CCS for the principal diagnosis. Discharges at least one year old with unverified, missing, or suspect patient identifiers accounted for 6.1 percent of discharges across the NRD states. Therefore, we first considered characteristics for which this group accounted for a disproportionately higher percentage of discharges, meaning at least 7.4 percent of all discharges (a 20 percent increase from 6.1). Unverified, missing, or suspect patient identifiers accounted for a disproportionately higher percentage of pediatric cases (37.1 percent for ages 1-5, 28.6 percent for ages 6-10, and 23.5 percent for ages 11-17), young adults ages 18-44 (9.8 percent), Medicaid patients (15.0 percent), and uninsured patients (12.8 percent). The exclusion of discharges with unverified, missing, or suspect patient identifiers also affected hospitals differently because of a larger percentage of excluded discharges from government hospitals (8.7 percent), teaching hospitals (7.5 percent), hospitals in large-central metropolitan areas of at least one million (8.7 percent), and hospitals in the West (9.5 percent). The exclusion of unverified, missing, or suspect patient identifiers affected diagnostic groups differently because of a larger percentage of HIV discharges (34.1 percent), maternal patients (about 12-15 percent), substance- and alcohol-related disorders (about 12 percent), and conditions for pediatric patients such as perinatal conditions, congenital anomalies, appendicitis, and acute bronchitis.

Limitations of State-Specific Patient Identifiers

The SID captures all inpatient discharges for hospitals in the state. Synthetic patient identifiers track patients within and across hospitals in a state. While most patients seek treatment at hospitals in their state of residence, there are occasions when patients are treated at hospitals in another states. Hospitals that specialize in a certain type of care may attract patients from all over the U.S. In addition, hospitals near state borders may frequently treat patients that reside in other states. In this section, we discuss the impact of having synthetic patient identifiers that only track patients treated within a state.

We use the following three terms to describe the relationship of patient residence to hospital location:

- *Inflow* refers to non-resident patients coming into a state for treatment
- *Outflow* refers to residents of a state being treated at hospitals in other states
- *No flow* refers to patients being treated at hospitals in the state in which they reside.

Table B.6 (Appendix B) shows the extent of inflow for each NRD state for all discharges and for non-emergent discharges. *Non-emergent* was defined as patients not receiving ED services (identified by the HCUP data element HCUP_ED = 0).[5] The percentage of inflow discharges ranged from 0.9 percent in CA to 12.8 percent in NH. Only two of the NRD states (NH and TN) had at least 10 percent of their discharges coming from other states. For both of these states, the percentage of inflow discharges increased when considering non-emergent discharges. Given that inflow was higher for non-emergent care, it was reasonable to think that these inflow discharges generally reflect patients using nearby facilities in other states as their primary source of hospital care.

Table B.7 (Appendix B) shows the distribution of inflow discharges across community, non-rehabilitation hospitals in each NRD state. Six hospitals across the NRD states had an inflow of more than 50 percent of their total annual discharges. Another 60 hospitals had an inflow of 21 to 50 percent of total annual discharges. Of these 66 hospitals, 54 hospitals (82 percent) were within 15 miles of a state border; 10 hospitals (15 percent) were specialty, community hospitals; and two hospitals (3 percent) were neither near a state border nor a specialty hospital. The specialty, community hospitals included children's hospitals and those specializing in cancer, hospitals, and orthopedic surgery.[6]

Table B.8 (Appendix B) shows the outflow for patients residing in each NRD state. For this analysis, the SID from all HCUP states were used to capture all discharges for patients residing in the NRD state. This analysis was possible because the SID encompass more than 95% of all discharges in the U.S. The percentage of outflow discharges ranged from 0.9 percent in CA to 16.3 percent for NH. Only one of the NRD states (NH) had at least 10 percent of resident discharges occurring in other states. In NH, the percentage of outflow increased when considering only non-emergent care (from 16.3 percent of all discharges to 17.3 for non-emergent discharges).

Of all the NRD states, NH had the largest inflow and outflow of discharges. With respect to NH hospitals treating patients from other states, 61 percent of inflow discharges were from VT, 18

[5] More information on the data element HCUP_ED is available on the User Support Web site at https://www.hcup-us.ahrq.gov/db/vars/siddistnote.jsp?var=hcup_ed.
[6] These types of specialty hospitals are also considered community hospitals by the AHA.

percent were from ME, and 12 percent were from MA. With respect to NH residents being treated by hospitals in other states, 80 percent of resident discharges were treated in MA and another eight percent were treated in ME.

One other state was unusual in its pattern of inflow and outflow discharges. SC had a large differential in the percentage of outflow to inflow patients (Table B.6 and B.8 in Appendix B). The outflow of SC residents to hospitals in other states was 7.4 percent; the inflow of non-residents to SC hospitals was only 2.4 percent. Forty-four percent of SC outflow discharges were treated in GA and 43 percent were treated in NC. The difference increased when considering only non-emergent care (outflow of 8.1 percent and inflow of 1.9 percent).

In all other NRD states, the percentage of inflow and outflow was relatively similar (Tables B.6 and B.8 in Appendix B). The investigation of states with large inflow revealed that most of the hospitals involved were close to state borders and most of the patients resided in adjacent states. The exception was specialty hospitals that attracted a specific type of patient. The investigation of states with large outflow revealed that residents were seeking treatment from hospitals in neighboring states. If we excluded non-resident discharges from the pilot NRD, we would be excluding most of the discharges for hospitals near state borders. Instead, we made the assumption that border hospitals treated patients in their community and that community happened to cross states borders. Therefore, their readmissions rates should not be biased by the inflow and outflow of patients. Instead of excluding non-resident discharges from the pilot NRD states, we considered hospital-specific exclusions.

Specialty Hospitals

The NRD states included 81 community hospitals that were also designated by the AHA as specialty hospitals (AHA variable Z210). Table B.9 (Appendix B) provides information about certain characteristics of the 81 specialty hospitals. Almost half (40 hospitals) were acute long-term care hospitals treating an unusually high percentage of patients with respiratory disease or mental health disorders. These hospitals provide acute care services to patients who need long-term hospitalization (stays of more than 25 days). Other specialty hospitals included obstetrics-gynecology (n=8), cancer (n=7), cardiac (n=5), orthopedic (n=5), surgical (n=4), ear-nose-throat (n=3), other specialty hospitals (n=7), and children's other specialty hospitals (n=2).

For each of these specialty hospitals, we calculated the percentage of discharges by Major Diagnostic Category (MDC) and determined the predominant MDC. The percentage of discharges in the predominant MDC was compared to the percentage in the NIS. The NIS is a stratified sample of hospitals that produces national estimates of utilization in community, non-rehabilitation hospitals in the U.S. Each of these specialty hospitals had an extraordinarily high percentage of discharges in one MDC relative to the NIS.

Because these hospitals had such distinct patient populations, we assumed that their readmission rates were also unique. We also knew from the analysis of inflow that many of these hospitals treated a disproportionally large number of out-of-state patients. For these reasons, we decided to exclude specialty hospitals from the pilot NRD. This exclusion limited the pilot NRD to studies of readmission rates at community, non-rehabilitation hospitals that were also general medical/surgical hospitals.

Hospitals with a Large Percentage of Excluded Discharges

Discharge-specific exclusions such as the removal of discharges age 0 or with unverified, missing, or suspect patient identifiers impacted individual hospitals if they had a large percentage of excluded cases. Twenty-nine hospitals had more than 50 percent of their 2008 discharges excluded (average, 62 percent; range, 50 to 100 percent). These hospitals were not good candidates for a readmission analysis because too many of their discharges were not in the pilot NRD. We therefore decided to exclude the remaining discharges in these hospitals, and thereby removed the hospital from the pilot NRD. Unfortunately, more than half of these hospitals (16 hospitals) were children's general medical/surgical hospitals with a large percentage of discharges that were either age 0 or missing patient identifiers. The 16 excluded children's medical/surgical hospitals were two-thirds of all hospitals from this category in the NRD states (24 total children's medical/surgical hospitals). This left only 8 children's medical/surgical hospitals in the pilot NRD.

Summary of Exclusions for the Pilot NRD

The discharges contained in the pilot NRD were affected by decisions about excluding states, hospitals, and discharges. Exclusions were applied to the SID for the 15 NRD states in the following hierarchical order:

1. Non-community or rehabilitation hospitals
2. Specialty hospitals
3. Discharges younger than 1 year (age 0 years)
4. Discharges with unverified or missing patient identifiers
5. Discharges with suspect patient identifiers (e.g., 20 or more visits in the year)
6. Discharges with suspect patient identifiers (e.g., discharged dead with subsequent admission)
7. Discharges from hospitals with more than 50 percent of total discharges excluded for any cause.

Figure 1 shows the percentage of SID discharges for NRD states by type of exclusion. The largest percentage of excluded discharges was patients age 0 years (12.1 percent). Next were discharges with unverified or missing patient identifiers (5.1 percent), followed by discharges from non-community or rehabilitation hospitals (2.2 percent) and specialty hospitals (1.4 percent). The other exclusions (suspect patient identifiers and discharges from hospitals with more than 50 percent of total discharges excluded for any cause) account for less than one percent, combined. After exclusions, 78.4 percent of the SID discharges in the 15 states remained in the pilot NRD.

Figure 1. Percentage of SID Discharges in NRD States by Type of Exclusion

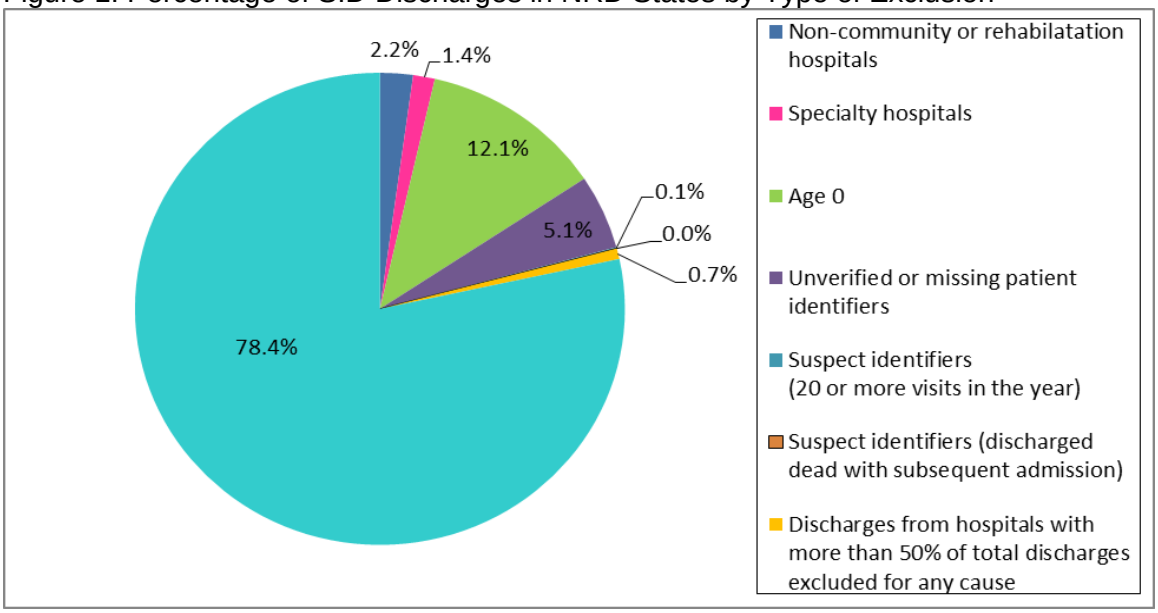
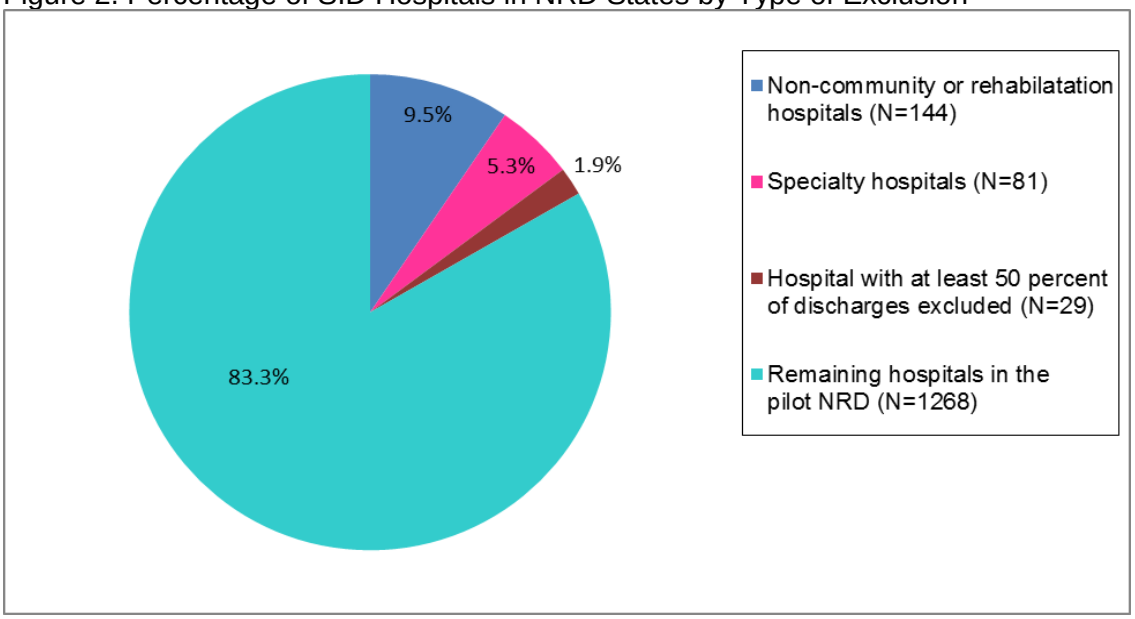


Table B.10 (Appendix B) shows the discharge counts for the NRD states by type of exclusion. Table B.11 (Appendix B) shows the proportion of discharges by patient characteristics, hospital characteristics, and CCS for the principal diagnosis for the 12.3 million discharges remaining in the pilot NRD. Three percent of the records are pediatric discharges; 97 percent of the records are adult discharges.

After exclusions, 83.3 percent of the hospitals remained in the study population. Figure 2 shows the percentage of hospitals for NRD states by type of exclusion. The largest percentage of excluded hospitals was for non-community or rehabilitation hospitals (9.5 percent). Next were specialty hospitals (5.3 percent). The exclusion of hospitals with more than 50 percent of their discharges excluded for age 0 or unverified/suspect patient identifiers was 1.9 percent.

Figure 2. Percentage of SID Hospitals in NRD States by Type of Exclusion



WEIGHTING AND STRATIFICATION

Although it would be ideal to have information from all payers for all inpatient stays in the U.S. to determine national estimates of readmissions, no such data source exists. Akin to the NIS, national estimates can be created using the information from the 15 NRD states in 2008 by applying weighting and stratification methods. This section describes weighting and sampling strategies for the pilot NRD.

Target Universe

The exclusion of records in the pilot NRD influenced the selection of the target universe for sampling and weighting. The universe was limited to 2008 inpatient discharges that are ages one and older treated at community, non-rehabilitation, non-specialty hospitals in the U.S. This differs from the target universe used for the other HCUP inpatient databases (the NIS and KID). The universe for the NIS and KID included all community, non-rehabilitation hospitals and discharges of all ages. Information on the target universe was available from the AHA Annual Survey of Hospitals. The AHA Survey includes information on the number of inpatient discharges and hospital characteristics such as control/ownership, bed size, and location. The 2008 AHA Survey reports almost 39.1 million inpatient discharges for community, non-rehabilitation, non-specialty hospitals.

Because of the pilot NRD needed to be limited to ages one and older, we also needed to adjust the AHA total discharge counts accordingly. We used the distribution by patient age of discharges for community, non-rehabilitation, non-specialty hospitals in the 2008 SID for all 42 states (accounting for 95% of all U.S. discharges) to inform the adjustment. We stratified the discharges by hospital characteristics (census region, urban-rural location, teaching capabilities, bed size, and ownership/control) to create relatively homogeneous groups with respect to the distribution of ages within a hospital. We knew from the HCUP NIS design that this combination of hospital characteristics explained significant differences in inpatient outcomes.[7] Within a stratum, we determined the proportion of discharges ages one and older. The total number of AHA discharges for the stratum was then multiplied by the SID proportion to obtain the estimated number of AHA discharges ages one and older. To improve reliability of the proportions, the strata were collapsed such that at least two SID hospitals and at least 100 discharges from the SID were included in each stratum.

Consider the example below using the stratum of West region, large metropolitan, private not-for-profit, teaching hospitals that were medium in bed size (Table 2).

Table 2. Adjustment to AHA Total Discharges Ages One and Older

Discharges in West Region, Large Metropolitan, Non-Teaching, Medium Size, Private Not-For-Profit Hospitals		
	Age 0	**Ages 1 and Older**
2008 SID proportion of discharges for strata	15.7%	84.3%
AHA universe (266,732 total discharges)	41,877	224,855

[7] *Changes in the NIS Sampling and Weighting Strategy for 1998.* ONLINE January 18, 2002. Available: https://www.hcup-us.ahrq.gov/db/nation/nis/reports/Changes_in_NIS_Design_1998.pdf. Accessed September 15, 2011.

Using the 2008 SID, the proportions of community, non-rehabilitation, non-specialty discharges in the stratum was 15.7 percent for discharges with age 0 and 84.3 percent for ages one and older. According to the 2008 AHA Survey, the stratum has 266,732 total inpatient discharges. Using the SID proportions, we estimated AHA discharges for ages one and older to be 224,855 (84.3 percent of 266,732).

After adjusting the AHA total discharges, the target universe of 2008 inpatient discharges that were ages one and older and treated at community, non-rehabilitation, non-specialty hospitals in the U.S. included 34.3 million discharges (87.7 percent of the total for all ages).

Sampling Frame

The sampling frame for the NRD was limited to discharges for patients who were ages one and older with verified patient identifiers and treated at community, non-rehabilitation, non-specialty hospitals in the 15 HCUP states. Although the NIS is a 20 percent sample of hospitals, that approach was not suitable for the NRD because a patient needed to be tracked across all hospitals in a state.

Because only the 15 NRD states had verified patient identifiers, and the states in three regions (Northeast, Midwest, and South) accounted for less than 50 percent of the population, all of the discharges in the sampling frame were included. In essence, the pilot NRD was a sample of convenience. Sampling discharges was not recommended at this time because the sample needed to balance the database's ability to estimate readmissions for common conditions such as chronic illnesses and injuries with the ability to estimate readmissions for rare diseases such as sickle cell anemia.

The 100 percent sample allowed for the study of both all-cause and condition-specific readmissions. A 100 percent sample means that conditions such as childbirth that generally do not get readmitted were included in the NRD. In addition, discharges that resulted in an in-hospital death were included because these were candidates for a readmission record.

The 100 percent sample also allowed the study of different time periods of the readmissions (e.g., 30 days, 60 days, and 90 days). That said, one year of data was probably not sufficient for examining readmissions more than 90 days apart.

The NRD states together included 12.3 million discharges in the sampling frame, which was larger than the NIS (about 8 million records a year) but smaller than the HCUP Nationwide Emergency Department Sample (about 28 million records a year). Given the relatively low cost of hard-disk storage and the speed of today's microprocessors, the size of the pilot NRD was reasonable.

Discharge Weights

This section explains the need for post-stratification for weighting the sampling frame to the target universe and the weighting strategy. We use the term *post-stratification* because the stratification was performed after sampling. Discharge weights for national estimates were developed using the target universe as the standard. Although discharge-level weights were calculated for the pilot NRD, hospital-level weights were not. The pilot NRD was a 100 percent sample of discharges, not hospitals; hospital weights were not applicable.

Post-Stratification for Weighting

Post-stratification of discharges for the purpose of weighting allowed us to compensate for any over- or under-represented types of hospitals in the sampling frame (the pilot NRD) with respect to the distribution of hospitals in the target universe (AHA data). In this section, we compare discharges in the sampling frame to the target universe by select hospital characteristics. We knew from the NIS design that these characteristics explained significant differences in inpatient outcomes: census region, urban/rural location, hospital teaching status, bed size and hospital control.[8]

U.S. Census Region

U.S. census region was an important stratification variable because practice patterns may vary substantially by region. The table below lists the census regions.

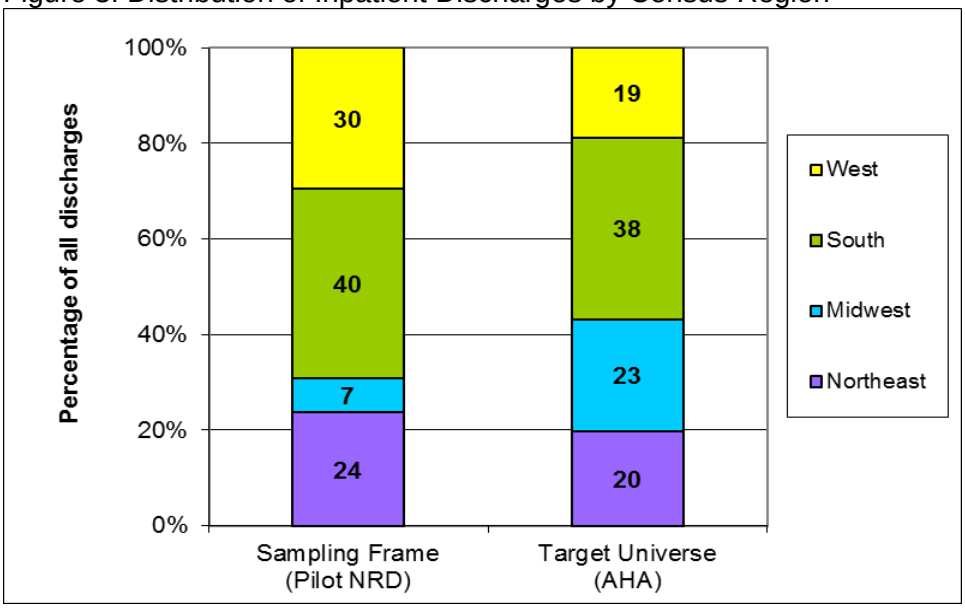
Table 3. States by Census Region

Region	States
Northeast	Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont
Midwest	Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, Wisconsin
South	Alabama, Arkansas, Delaware, District of Columbia, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia, West Virginia
West	Alaska, Arizona, California, Colorado, Hawaii, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, Wyoming

Figure 3 demonstrates that the distribution of inpatient discharges across census regions varied between the sampling frame and the target universe. About seven percent of inpatient discharges in the sampling frame were in the Midwest; in the target universe, the percentage for the Midwest was larger at 23 percent. In contrast, the percentage of inpatient discharges from the West was 30 percent in the NRD states and 19 percent in the target universe.

[8] *Changes in the NIS Sampling and Weighting Strategy for 1998.* ONLINE January 18, 2002. Available at https://www.hcup-us.ahrq.gov/db/nation/nis/reports/Changes_in_NIS_Design_1998.pdf. Accessed September 15, 2011.

Figure 3. Distribution of Inpatient Discharges by Census Region



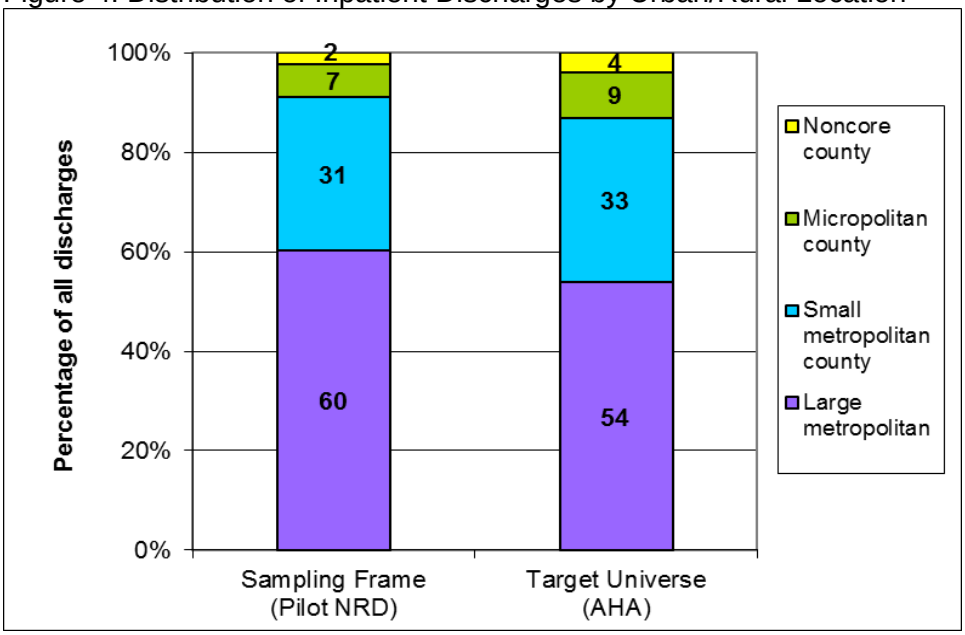
Urban-Rural Location

The urban-rural location of hospitals was assigned via the county of the hospital. The categorization was a simplified adaptation of the 2003 version of the Urban Influence Codes (UIC) (United States Department of Agriculture Economic Research Service 2007). The 12 categories of the UIC were combined into four broader categories that differentiated between large and small metropolitan, micropolitan, and noncore residual counties:

- Large metropolitan area – areas with at least one million residents
- Small metropolitan area – areas with less than one million residents
- Micropolitan area – non-metropolitan area with at least 10,000 people or more
- Noncore residual.

Figure 4 demonstrates that the distribution of inpatient discharges by urban-rural location varied between the sampling frame and the target universe. About 60 percent of the inpatient discharges in the sampling frame were in large metropolitan counties; in the target universe, the percentage was smaller at 54 percent.

Figure 4. Distribution of Inpatient Discharges by Urban/Rural Location

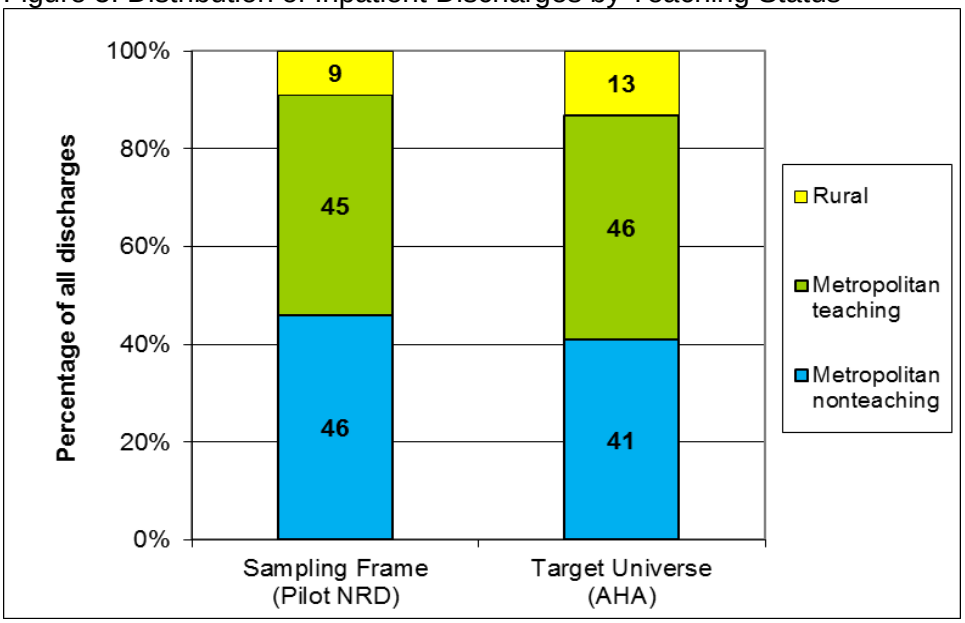


Teaching Status

Consistent with the NIS, a hospital was considered to be a teaching hospital it had an American Medical Association (AMA) approved residency program, was a member of the Council of Teaching Hospitals (COTH), or had a ratio of full-time equivalent interns and residents to beds of 0.25 or higher according to the AHA Annual Survey of Hospitals. Teaching status was only considered for metropolitan areas because only 2 percent of the discharges were treated at teaching hospitals in micropolitan and noncore residual areas.

Figure 5 demonstrates that the distribution of inpatient discharges by teaching status varied between the sampling frame and the target universe. About 46 percent of the inpatient discharges in sampling frame were in metropolitan nonteaching hospitals; in the target universe, the percentage was smaller at 41 percent.

Figure 5. Distribution of Inpatient Discharges by Teaching Status



Bed Size

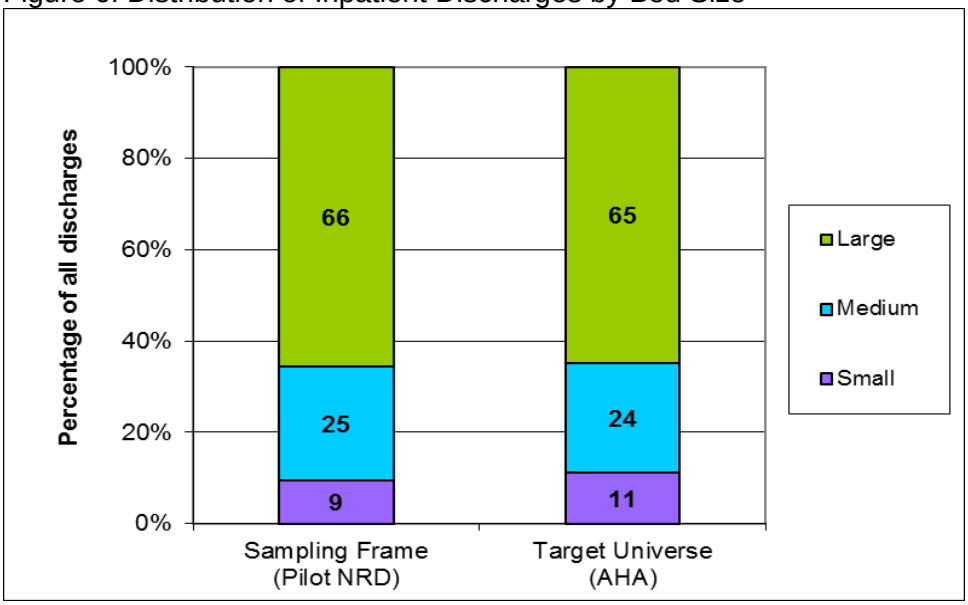
Table 4 shows the distribution of hospital bed size by region. The results were categorized according to the NIS bed size definition of small, medium, and large and further defined by hospital location and teaching status.

Table 4. Bed Size Categorization by Region

Location and Teaching Status	Hospital Bed Size		
	Small	Medium	Large
NORTHEAST			
Rural	1-49	50-99	100+
Urban, non-teaching	1-124	125-199	200+
Urban, teaching	1-249	250-424	425+
MIDWEST			
Rural	1-29	30-49	50+
Urban, non-teaching	1-74	75-174	175+
Urban, teaching	1-249	250-374	375+
SOUTH			
Rural	1-39	40-74	75+
Urban, non-teaching	1-99	100-199	200+
Urban, teaching	1-249	250-449	450+
WEST			
Rural	1-24	25-44	45+
Urban, non-teaching	1-99	100-174	175+
Urban, teaching	1-199	200-324	325+

Figure 6 demonstrates that the distribution of inpatient discharges by bed size varied between the sampling frame states and the target universe. About 9 percent of the inpatient discharges in sampling frame states were in small hospitals; in the target universe, the percentage was 11 percent.

Figure 6. Distribution of Inpatient Discharges by Bed Size



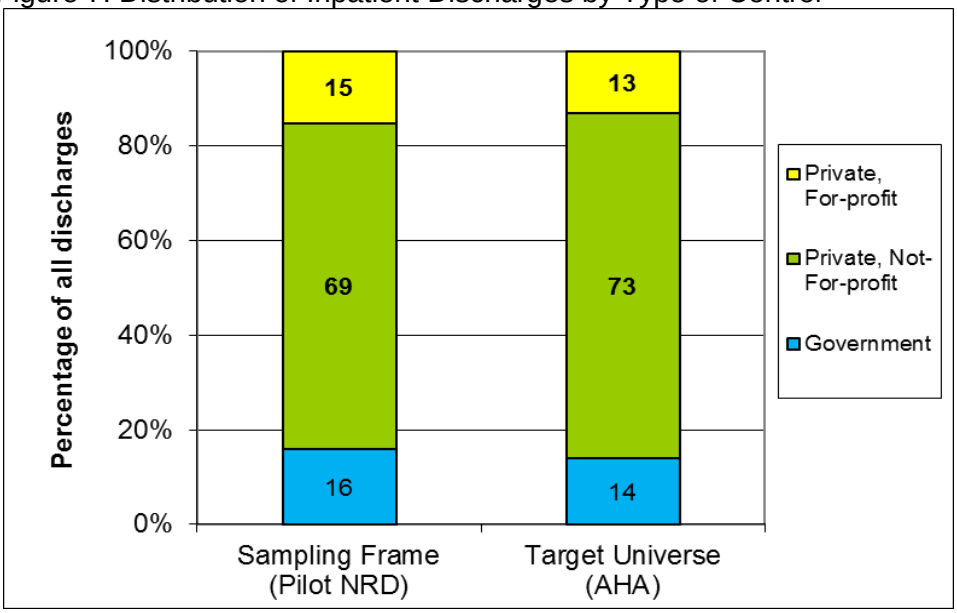
Hospital Control/Ownership

Depending on their control/ownership, hospitals tend to have different missions and different responses to government regulations and policies. Hospital control was categorized by the following three types:

- Public – government, non-Federal
- Voluntary – private, not-for-profit
- Proprietary – private, investor-owned/for-profit.

Figure 7 demonstrates that the distribution of inpatient discharges by control varied between the sampling frame and the target universe. About 69 percent of the inpatient discharges in the sampling frame states were treated at private, not-for-profit hospitals, while the percentage in the target universe was larger at 73 percent.

Figure 7. Distribution of Inpatient Discharges by Type of Control



Weighting

Because the distribution of discharges by hospital characteristics in the sampling frame was different from the target universe, weighting would benefit from post-stratification. The weighting scheme was designed to account for the known bias to the availability of patient identifiers; that is, there were more pediatric discharges (ages 1 to 17 years) with unverified patient identifiers and fewer elderly discharges (ages 65 and over) with unverified patient identifiers.

Although the AHA total discharge counts were adjusted to exclude age 0 in the target universe, we needed to further disaggregate the discharge counts into three age groups (1-17, 18-64, and 65 and older). Again, we used the distribution by patient age of discharges for community, non-rehabilitation, non-specialty hospitals in the 2008 SID for all 42 states (accounting for 95% of all U.S. discharges) to inform the adjustment. We stratified the discharges by hospital characteristics (census region, urban-rural location, teaching capabilities, bed size, and control/ownership). The total number of AHA discharges for the stratum was then multiplied by the SID proportion to obtain the estimated number of AHA discharges by age group.

Consider the example below using the stratum of West region, large metropolitan, teaching, medium size, private not-for-profit hospitals (Table 5).

Table 5. NRD Weighting Scheme

Discharge Level Weighting Scheme Using the Example of West Region, Large Metropolitan, Private Not-For-Profit, Non-Teaching, Medium Hospitals				
	Age 0	**Age 1-17**	**Age 18-64**	**Age 65+**
2008 SID proportion of discharges for strata	15.7%	2.0%	49.7%	32.6%
Discharge counts				
Target universe (266,732 total AHA discharges)	41,877	5,335	132,566	86,954
Sampling frame (Pilot NRD discharges)	0	1,227	35,793	28,695
Discharge weight = Target universe / sampling frame	--	4.348	3.704	3.030

Using the 2008 SID, the proportions of community, non-rehabilitation, non-specialty discharges in the stratum was 15.7 percent for discharges with age 0, 2.0 percent for pediatric discharges, 49.7 percent for adult discharges ages 18 to 64, and 32.6 percent for discharges ages 65 and over. According to the 2008 AHA, the stratum has 266,732 inpatient discharges. Using the SID proportions, the total of 266,732 discharges was divided into the four separate age categories. The discharges in the sampling frame from the same stratum were distributed into the age groups. Age 0 had no discharges because these records were previously excluded. Age-specific discharge weights were calculated by dividing discharges in the target universe count by discharges in the sampling frame. The above example shows that the discharge weight for ages 1 to 17 was larger than the discharge weight for ages 65 and older; pediatric discharges were not as well represented in the sampling frame because of unverified and missing patient identifiers.

Within each stratum, *s*, each NRD inpatient admission receives a weight:

$$DISCWT_i = Ns(universe)_i \div Ns(sample)_i$$

where $Ns(universe)_i$ represents the number of inpatient admissions at community, non-rehabilitation, non-specialty hospitals in the universe within stratum *s* for age group i; $Ns(sample)_i$ is the number of inpatient admissions in the sampling frame for age group i. Age group i is ages 1 to 17, ages 18 to 64, and ages 65 and older. Therefore, each discharge's weight ($DISCWT_i$) is equal to the number of inpatient admissions it represents in stratum *s* for age group *i* during that year.

To improve reliability of the age distribution of the SID discharges, the strata were collapsed prior to the weight calculations such that at least two SID hospitals and at least 100 discharges from the SID were included in each stratum. In addition, the strata were collapsed to include at least two sampling hospitals. This constraint was similar to the NIS. The stratum was first collapsed across control/ownership, combining either the two private designations or all three types of control (public, private not-for-profit, and private for-profit). Of the 1522 hospitals in the sampling frame, 470 were collapsed by control (30.9 percent). If the stratum combined across control still lacked a sufficient number of hospitals or discharges, then the bed-size category was collapsed. Large hospitals were combined with medium hospitals. If necessary, we did not separate the data by bed size (i.e., small, medium, and large hospitals were considered

together). Forty hospitals were collapsed by bed size (2.6 percent). We did not collapse across urban/rural location, teaching status, or region.

Final Sample Design

The pilot NRD was constructed using one calendar year of discharge data (2008). Included discharges were for patients ages one and older that were treated at community, non-rehabilitation, non-specialty hospitals, for which the majority of their discharges had synthetic patient identifiers that were verified and not suspect. Discharge weights were calculated separately for pediatric discharges (ages 1 to 17) and adult discharges (ages 18 to 64 and 65 and older) using post-stratification on census region, urban-rural location, teaching status, bed size, and hospital control. The universe of inpatient discharges for each stratum and age group was estimated using AHA total discharges and the proportion of discharges by type based on the SID for 42 states (accounting for more than 95% of all U.S. discharges).

NRD DATA ELEMENTS CRITICAL TO TRACKING A PATIENT AND DETERMINING THE TIME BETWEEN ADMISSIONS

For any readmission analysis of inpatient stays, three HCUP data elements are critical to tracking a patient and determining the time between admissions: VisitLink, DaysToEvent, and LOS.

Synthetic Patient Identifier (VisitLink)

VisitLink is the linkage variable for all inpatient stays associated with a unique patient. All discharges in the pilot NRD include a value for VisitLink. The value was assigned during construction of the HCUP SID and based on a unique combination of synthetic patient identifier provided by the HCUP Partner, date of birth, and gender. No verified person number was assigned if any one of the three pieces of information was missing. Because of exclusions, VisitLink was always coded on records in the NRD.

Although the term *verified person number* is used to describe the information in the HCUP data element VisitLink, the values are not recognizable as specific patient information. VisitLink does not include the values of the encrypted person's social security number, date of birth, or gender.

Time Between Admissions (DaysToEvent and LOS)

DaysToEvent is the number of days from a randomly chosen "start date" to the admission date for each patient's discharge. The actual admission and discharge dates could not be included on the NRD because they were considered highly sensitive information according to Health Insurance Portability and Accountability Act (HIPAA) guidelines. The coding scheme for DaysToEvent was designed to adhere to these strict privacy guidelines and protect patient confidentiality.

Each verified person number (VisitLink) was assigned a unique start date that was used to calculate DaysToEvent for all visits associated with that VisitLink value. The variable DaysToEvent was the difference between the visit's admission date and the start date associated with the VisitLink. DaysToEvent was reported as missing if the admission date was unavailable (N=17).

For readmission analyses, determining the number of days between the end of one admission and the start of the next admission is critical. No single data element specific to this timing difference was included in the pilot NRD because the calculation is dependent on which two discharges are of interest for the readmission study. For example, a study of readmissions for diabetes might only consider the number of days between two diabetes discharges, while a study of post-surgery infections might consider any discharge in 30 days.

Because DaysToEvent is based on the admission date, the calculation of days is the difference of DaysToEvent between two selected discharges for a unique verified person number (VisitLink), adjusted for the length of stay. Consider the following example:

- A patient with congestive heart failure has a 3-day hospital admission on 1/10/2008 and another admission on 1/25/2008.
- The DaysToEvent value is "9" for the 1/10/2008 admission, and the DaysToEvent value is "24" for the 1/25/2008 visit.
- The number of days between the *start of each admission* is 15 days (24 – 9 = 15) because DaysToEvent is based on the admission date.
- The number of days *between the admissions* (from discharge date of the first admission to the start of the second admission) is 12 days (24 – 9 + 3 = 12). because the patient had a 3-day length of stay.

If DaysToEvent or LOS was missing, then determining the number of days to a subsequent admission was not possible. We considered removing the discharges with missing DaysToEvent and LOS from the pilot NRD, but these data elements were rarely missing. Only 17 discharges were missing DaysToEvent (less than 0.0001 percent), and 1,038 discharges were missing LOS (0.008 percent). LOS was only critical if it was missing on the first admission in a series. If the admission was the second in the series, then LOS was not pertinent.

The lowest value of DaysToEvent will be on the earliest inpatient stay in the year for a patient. It is important to remember that if patient A has a value of 605 for DaysToEvent and patient B has a value of 300 for DaysToEvent, patient B's hospital stay did not necessarily take place prior to patient A's stay. In fact, Patient B's DaysToEvent value has no relation to Patient A's DaysToEvent value. Because of the use of a random start date in the calculation of DaysToEvent, the value of DaysToEvent cannot be compared across patients.

Additional information about the HCUP revisit variables is available on the HCUP User Support Web site (http://www.hcup-us.ahrq.gov/toolssoftware/revisit/revisit.jsp).

HANDLING TRANSFER RECORDS AND SAME-DAY STAYS

Hospital administrative databases like the NRD were "discharge-level" files, meaning that each record represents one discharge abstract from an inpatient stay. If a patient visits the hospital multiple times in a given year, the NRD included separate records for each inpatient stay. In addition, if a patient was transferred between hospitals within the state, the NRD would contain two discharge records – one record from the first hospital and a second record from the latter hospital.[9]

[9] If the patient is transferred to an out-of-state hospital, the subsequent discharge would not be included in the pilot NRD because the HCUP synthetic patient identifiers only can follow a patient within a state.

When studying readmissions, one might argue that these pairs of records represent one hospital event, even if that is not how they are represented in the administrative database. This section includes information on the identification of transfer records in the NRD and how the NRD was modified for greatest flexibility in the handling of these records for a readmission analysis.

Transfers and Other Same Day Stays

Inpatient transfers were defined as having all of the following characteristics:

- Discharge date of the first inpatient stay equaled the admission date of a subsequent inpatient stay.[10]
- The first record had a discharge disposition of transfer to an acute care hospital.
- The second record was from a different hospital and had an admission source indicating a transfer.

We also defined "same-day" stays in which the discharge date for one inpatient stay was the same as the admission date of a second stay for a patient (same as transfers), but there was no indication of a transfer. Same-day stays may or may not involve different hospitals. Same-day stays may indicate that a patient was discharged too soon and then needed to be readmitted on the same day. However, it was also possible that these were, in fact, transfer records with an incorrect or missing discharge disposition and admission source. To inform researchers using the NRD, we flagged records that were part of a transfer and same-day stay. This would allow an analyst to evaluate these related records.

A flag (HCUP variable SameDayEvent) was created to indicate the different types of transfers and same-day stays. The value of the flag was defined as follows:

- Transfer involving two discharges from <u>different</u> hospitals (value 1A and 1B): Discharge date of one admission equaled the admission date on another record for the same patient. There was a discharge disposition of transfer to an acute care hospital on the first record and an admission source of transfer (in) on the subsequent record; two different hospitals were involved. The value 1A was put on the first inpatient discharge (transferred out) and the value 1B was put on the subsequent stay (transferred in). A total of 1.4 percent of the records in the pilot NRD had a value 1A or 1B.
- Same-day stay involving two discharges at <u>different</u> hospitals (value 2A and 2B): The discharge date on the first inpatient stay equaled the admission date on a second inpatient stay; two different hospitals were involved, but the coding of either the discharge disposition or admission source did not indicate a transfer. The value 2A was put on the first inpatient discharge and the value 2B was put on the subsequent stay. A total of 1.4 percent of the records in the pilot NRD had a value 2A or 2B.
- Same-day stays involving two discharges at the <u>same</u> hospital (value 3A and 3B): The discharge date on the first inpatient stay equaled the admission date on a second inpatient stay; the hospital was the same on both records. The value 3A was put on the first inpatient discharge and the value 3B was put on the subsequent stay. A total of 2.7 percent of the records in the pilot NRD had a value 3A or 3B.

[10] Although the text refers to using the discharge and admission date, in reality, we used the HCUP data element DaysToEvent and LOS to identify the sequential order of inpatient records and whether they stopped and started on the same day.

- Same-day stay involving three or more discharges, same or different hospitals (value 4A, 4B, 4C, etc.): Multiple records indicating a combination of transfers and other same-day events seem odd, but they do rarely occur in administrative data. These sequential records were marked with the value 4A on the first record, 4B on the second record, 4C on the third record, and so on. A total of 1.1 percent of the records in the pilot NRD had a value 4A, 4B, etc.
- Not a transfer or other same-day stay (value 0). A total of 93.5 percent of the records in the pilot NRD did not involve transfers or same-day stays.

By keeping records for transfers and same-day stays separate, a study of readmissions would consider the second record a separate event. This would allow the analysis to consider the initial severity at the first stay as a predictor of future readmissions, including the transfer. In addition, the analysis could consider whether it was the care at the first or second hospital that might have contributed to later hospital stays.

Combined Transfer Records

Although studying the separate segments of a transfer or same-day stay would be interesting, many analyses of readmission consider this one continuous event. We decided to give analysts using the pilot NRD the option of including a "combined" record in their analyses, instead of the separate records for a transfer or same-day stay. For all records with SameDayEvent not equal to zero, we created a combined discharge record that summarized the information from the separate discharge records. This included transfers and same-day stays that involved the same and different hospitals (identified by SameDayStay values of 1A with 1B, 2A with 2B, 3A with 3B, and 4A with all subsequent records).

Combining information across multiple discharge records required specific rules for how to handle different types of information on the pairs of records. The pairs of transfer and same-day stay records were first ordered by earliest occurrence in the year. The different scenarios described below detail how different types of information were combined:

- Use first: For information that pertains to day of admission (e.g., admission month, admission source), the combined transfer record used the information from the first record in the pair.
- Use last: For information that pertains to the end of the time in the hospital (e.g., discharge disposition, expected payer), the combined transfer record used the information from the latter record in the pair.
- Summarize: For information that needed to reflect both stays, the combined transfer record summarized the information. For example, length of stay, total charge, and total hospital cost were summed across the pair of records. Discharge weights were also summed across the pairs and retained in an additional set of discharge weights.
- Diagnoses and related variables: Each record included arrays of ICD-9-CM diagnoses and related variables. On the assumption that the diagnoses on the latter record would reflect the final determination of diagnoses after complete treatment, the diagnoses reported on the latter record were retained at the beginning of the diagnosis array (including the principal diagnosis). The diagnoses from the first record were added to the end of the diagnosis array. The NRD is limited to a maximum of 25 diagnose codes, so no more than 25 total diagnoses were retained on a combined transfer record. The same scheme was used for all diagnosis-related variables also contained in arrays.

- Procedures and related variables: Each record included arrays of ICD-9-CM procedure codes and related variables. Although procedure codes were not necessarily reported in the order in which they were performed, we decided to retain the procedures reported on the first record at the beginning of the procedure array. The procedures from the latter record were added to the end of the procedure array. The NRD is limited to a maximum of 15 procedure codes, so no more than 15 total procedures were retained on a combined transfer record. The same scheme was used for all procedure-related variables that were also contained in arrays. The day of procedure on the latter record was adjusted for the length of stay on the first record, so the days reflected the time from the beginning of the first stay. Handling same-day stays that were comprised of more than two records was especially challenging. Procedure day could not be retained on these records.
- Hospital identifiers and characteristics: The hospital identifiers and characteristics from the latter stay were retained on the combined transfer record. This assumed that the latter hospital was primarily responsible for the care.
- Unique record identifier (HCUP variable KEY): KEY is a unique record identifier that can be used to find the same discharge record in the NRD and SID. For the combined record, we assigned a new unique KEY to distinguish it from the original records.
- Identification of the combined transfer record: Two variables identify combined transfer records: the HCUP variables SameDayEvent and NRD_Original.
    - The variable SameDayEvent was set to the integer value of SameDayEvent from the related records. For example, if the pair of records had SameDayEvent equal to 1A and 1B, then the combined transfer record would have SameDayEvent equal to 1.
    - The variable NRD_orginal was set to 1 on all “original” NRD records including the separate records representing a transfer or same-day stay. NRD_original was set to 0 on combined transfer records.

Appendix C contains the complete list of data elements in the pilot NRD. The list includes how each variable was handled for combined transfer records.

The combined transfer records were added to the pilot NRD. Of the original 12,319,916 NRD records, 6.5 percent of all NRD discharge records involved transfers or same-day stays. Combining transfers and same-day-stay records created 376,058 additional records. The final NRD included 12,695,974 records (12,319,916 + 376,058).

CALCULATING NATIONALLY WEIGHTED ESTIMATES

Having multiple discharge records representing patients transferred between facilities complicates using the NRD. In addition, the discharges need to be weighted for calculating national estimates. This section explains how to use the original NRD records with separate records for transfers in an analysis and how to substitute the combined transfer records for the originals in an analysis.

Unweighted Statistics

Because both the individual discharge records representing a transfer and a combined record summarizing the care across stays were included in the NRD, unweighted statistics needed to

exclude one group of records. There are 12,319,916 original NRD records. Combining transfers and same-day-stay records created 376,058 additional records. The final NRD included 12,695,974 records (12,319,916 original records and 376,058 combined transfer records).

The NRD data element NRD_original indicates the original NRD records (NED_original = 1). The combined transfer records have the value 0. The following combinations of NRD_original and SameDay event clearly identify the following types of NRD records:

- Discharges not involving transfers and same-day stays (NRD_original = 1 and SameDayEvent = "0")
- Separate discharges involving transfers and same-day stays (NRD_original = 1 and SameDayEvent not equal to "0")
- Combined transfer discharges (NRD_original = 0).

Unweighted statistics are probably best calculated by selecting original records with NRD_original equal to one. This can be done either by a SAS "where" statement or by using NRD_original as a weight. The zero values in NRD_original will force the combined transfer records to be excluded.

Weighting for National Estimates

An analyst using the NRD must use a discharge-level weight to produce national estimates. Weighted statistics estimate discharges that are ages one and older and treated at community, non-rehabilitation, non-specialty hospitals in the U.S. Similar to the NIS, proper statistical techniques must be used to calculate standard errors and confidence intervals when using the NRD. For detailed instructions, refer to the special report *Calculating Nationwide Inpatient Sample Variances* on the HCUP-US Web site.[11]

Because the NRD retained both the individual discharge records representing a transfer and a combined record summarizing the care across stays, two discharge-level weights were included on the file (DISCWT_TXseparate and DISCTWT_TXcombined). It is up to the analysts using the pilot NRD to decide which weight is appropriate for their analysis. The difference between the discharge-level weights and how they include different types of transfer records is explained below.

Weighted Statistics When Retaining the Separate Records for Transfers

The data element DISCWT_TXseparate includes the discharge-level weight to be used when an analysis includes the separate discharge records representing a transfer or same-day stay. The section of the report on Weighting describes how the weights are calculated. The combined transfer records have DISCWT_TXseparate set to zero, so they will be excluded from the weighted results.

[11] Houchens R, Elixhauser A, *Final Report on Calculating Nationwide Inpatient Sample (NIS) Variances, 2001.* HCUP Method Series Report # 2003-02. ONLINE June 2005 (revised June 6, 2005). U.S. Agency for Healthcare Research and Quality. Available at: http://www.hcup-us.ahrq.gov/reports/methods/CalculatingNISVariances200106092005.pdf

Weighted Statistics When Substituting in the Combined Transfer Records

The data element DISCWT_TXcombined includes the discharge-level weight to be used when an analysis includes the combined transfer records. The separate records representing a transfer or same-day stay have DISCWT_TXcombined set to 0, so they are excluded from the weighted results.

DATABASE DESIGN

This section on database design discusses the recommended file structure and data elements. It also discusses the HCUP standards in the coding of variables and the handling of missing and invalid data.

File Structure

We modeled the file structure of the pilot NRD after the NIS. The pilot NRD included discharge-level files and one hospital-level file. The discharge-level files allow the user access to numerous clinical and non-clinical data elements for use in selecting records of interest for an analysis. No attempt was made when creating the pilot NRD to determine whether sequential inpatient stays were related or unrelated. This evaluation was left to the analyst using the file; there are a variety of publicly-available tools for use by researchers to develop episodes and similar constructs.

Consistent with the other HCUP databases and because of the large number of useful data elements, the NRD variables were divided into the following discharge- and hospital-level file types:

- Discharge-level files
    - Core file with data elements critical to readmission analyses that were available from a large majority, if not all, states
    - Core 2 file with data elements that support readmission analyses and were available from at least half of the NRD states
    - Severity file with additional data elements to aid in identifying the severity of the condition for a specific discharge (e.g., Elixhauser comorbidity flags, All-Patient Refined DRG (APRDRG) value, risk of mortality, and severity)
    - Diagnosis and procedure groups file with additional information on the diagnoses and procedures
    - Data development file, which was intended for highly restricted use.
- Hospital-level file with hospital characteristics including occupancy rate and nurse staffing ratios.

Data development variables were only used to derive non-sensitive data elements for approved purposes. These variables are never released outside of AHRQ and may only be used by AHRQ researchers under special arrangement with the Project Officer.

Data Elements

Many of the data elements included in the pilot NRD are also included in the NIS. Differences in content were driven by differences in purpose. Because the pilot NRD is to be used for analyses of inpatient readmissions, additional data elements specific to that purpose were included. Data elements in the NIS that were not pertinent to the NRD were excluded (e.g. data elements specific to newborns).

Core data elements included clinical and non-clinical variables that support readmission analyses. Examples include the following:

- Variables that are essential to readmission analyses
    - Verified synthetic patient identifier (HCUP variable VisitLink) that identifies discharges belonging to the same patient
    - Timing between admissions for a patient (HCUP variable DaysToEvent)
    - Length of inpatient stay in days (HCUP variable LOS)
    - Identification of transfers, same-day stays, and combined transfer records (HCUP variable SameDayStay)
    - Identification of the patient as a resident of the state in which he or she received hospital care (HCUP variable RESIDENT)
- Admission month and discharge year[12]
- ICD-9-CM diagnoses with external cause of injury codes
- ICD-9-CM procedures
- Diagnosis and procedure classifications variables such as the Clinical Classifications Software (CCS) category, Chronic Condition Indicator (CCI), and procedure class.
- Patient demographics (e.g., gender, age, median household income quartile, and urban/rural location of the patient's residence)[13]
- Expected payment source (e.g., Medicare, Medicaid, private insurance, uninsured, and other insurance types)[14]
- Total charges and hospital cost
- Discharge weights for generating national estimates.

Specific data elements included in the pilot NRD were determined based on their usefulness for studying readmissions and the availability across the NRD states. For example, 12 of the 15 NRD states reported race/ethnicity of the patient in the SID, including information on Hispanic

[12] Admission and discharge dates were not available because of patient confidentiality restrictions. AMONTH serves as a proxy for the admission date.
[13] The median household income quartile was assigned during HCUP processing based on the patient's ZIP Code. If ZIP Code was not reported and there was indication that the patient was homeless, the income quartile was set to low income.
[14] *Uninsured* was defined by grouping discharges in which the expected primary payer is self-pay or charity/no charge.

ethnicity.[15] Patient race/ethnicity was not reported in the NE, LA, and WA SID. Overall, the percentage of records in the pilot NRD that were missing race/ethnicity was 6.1. In comparison, the percentage of records in the 2008 NIS that were missing race/ethnicity was more than three times higher (20.1 percent). Not having race for one of two states in the Midwest makes race-based estimates difficult for that region. We decided to include patient race/ethnicity on the pilot NRD because it is critical to studying disparities in readmission rates.

Appendix C contains the complete list of data elements in the pilot NRD. The list includes the number of states for which the data element was available and whether the data element was created specifically for the pilot NRD.

Data Standards and Values

The coding of the data elements in the NRD will be consistent with the other HCUP databases. The following objectives guided the definition of data elements included in all HCUP databases:

- Ensure usability without extensive editing by analysts.
- Retain the largest amount of information available from the original sources, while still maintaining consistency among sources.
- Structure the information for efficient storage, manipulation, and analysis.

More information on the coding of HCUP data elements is available on HCUP User Support (HCUP-US) Website (http://www.hcup-us.ahrq.gov/db/coding.jsp).

Missing Data and Variables

Some data elements were not available for all states or had missing values. The following special SAS values were used for HCUP data elements to indicate details of data availability and quality:

- Missing Data (.): When the information was not available from the HCUP Partner.
- Invalid Data (.A): When the source data contained undocumented, out-of-range, or invalid values (e.g., an invalid date or an alpha character in a numeric field).
- Inconsistent Data (.C): When related data elements within the same record were logically inconsistent (e.g., the female-specific procedure of hysterectomy was reported on a discharges with a gender of male).

More information on HCUP quality control procedures is available on the HCUP-US Website (http://www.hcup-us.ahrq.gov/db/quality.jsp).

DEFINING READMISSIONS

This section discusses common considerations when planning an analysis of readmissions and specifies how the NRD readmission rates presented in Appendix E were calculated. Common terminology is first defined:

[15] Hospital-specific evaluations of the reporting of patient race/ethnicity in the HCUP SID are done annually during the development of an analysis file used to support the National Healthcare Disparities Report.

- *Index event* – the starting point for analyzing repeat hospital visits
- *Readmission* – a subsequent inpatient admission within a specified time period; readmission may be for a specific cause or any cause.

The NRD was designed to support many different types of readmission analyses. Analysts can use the information contained in the pilot NRD to define the index event and readmission specific to their topic of interest. We discuss the following analytic considerations for defining index events and readmissions:

- Defining the index event
- Specifying the criteria for a readmission
- Selecting the appropriate time period to qualify the readmission
- Determining a clean period, if necessary, prior to the starting index event
- Reporting readmission rates.

Each topic is discussed in turn.

Defining the Index Event

The index event is typically defined by a combination of clinical criteria. Inclusion and exclusion criteria should be used to define an index event indicator (coded as 0 or 1) that identifies NRD discharges as an index event specific to the analysis of interest. The NRD did not include a variable for index events because they are specific to each analysis. The NRD included the information necessary to define different types of index events.

Criteria can include, but are not limited to, age of the patient and specific diagnoses and/or procedures. The NRD contained various data elements that can be used for inclusion criteria:

- International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) diagnosis and procedure codes
- Clinical Classifications Software (CCS) categories
- Diagnostic Related Group (DRG) and Major Diagnostic Category (MDC)
- All-Patient Refined DRG.

Possible exclusion criteria include the following:

- Index events in which the patient died in the hospital, because there is no risk of readmission.
- Patients with complicating comorbidities such as cancer or an immunocompromised state, because these conditions would greatly increase the risk of readmissions.
- Transfers and same-day stays that were retained separately or combined, because they represent a more complex type of care (NRD data element SameDayStay not equal to 0).[16]
- Admission month for when the index event occurred, because there is bias for which admissions were included in the NRD calendar-year file.

[16] It should be noted that these discharges should be included in a readmission analysis, but may not be appropriate for an index event.

The NRD included inpatient stays that were discharged in 2008. Admissions that began in 2007 and were discharged in 2008 were included. In contrast, admissions that began latter in 2008 and extended into 2009 were not included. The NRD contained 1.2 percent of admissions that started in 2007; therefore, we expected that we were missing about 1.2 percent of discharges that started in 2008 but finished in 2009.

Deciding which months should be excluded when qualifying an index event depends on the time that will be allowed for a readmission. For example, if studying 30-day readmissions, the index event might be limited to those occurring in the admission months of January to November. That allows the month of December for 30 days of follow-up. Readmissions for November index events may not be captured in the NRD because they extended into the next calendar year. Given that 91 percent of discharges in the NRD had a length of stay less than 11 days, it is mostly the admissions in the last week of November that continued into December.

Although it would be advantageous to be able to select a more specific date for a cut-off, patient confidentially concerns limited the available information on the admission date to the admission month (AMONTH). Information on admission day and year were not included on the NRD.

Definition of an Index Event for the NRD Readmission Rates

For the NRD readmission rates presented in the Appendix E, index events were defined as follows:

- Admission occurred between January 1 and November 30 of 2008 (1 <= AMONTH <= 11)
- Patient was discharged alive (DIED = 1)
- Four types of index events were defined by the following:
    - Principal diagnosis CCS (using the HCUP data element DXCCS1)
    - First-listed procedure CCS (using the HCUP data element PRCCS1)
    - MDC (using the HCUP data element MDC)
    - DRG (using the HCUP data element DRGnoPOA that does not consider the present on admission indicator for assignment)
- An individual patient could have multiple index events during the observation period, if they were more than 30 days apart.

Specifying the Criteria for a Readmission

Readmission analyses tend to consider one of the following: any subsequent admission regardless of cause, any subsequent admission that does not involve trauma, or any subsequent admission only if the event is “related” to the index event. In addition, a study may consider all readmissions within a time period or just the first readmission. The selection of criteria can dramatically change results. More information on how the results can change is available in an HCUP Method Series report on *Methodological Issues when Studying Readmissions and Revisits Using Hospital Administrative Data*.[17]

[17] Barrett M, Steiner C, Andrews R, Kassed C, Nagamine M. *Methodological Issues when Studying Readmissions and Revisits Using Hospital Administrative Data.* 2011. HCUP Methods Series Report #

The NRD included a number of different diagnosis and procedure-related variables that can be used to examine why a patient returned for hospital care. The NRD did not identify any discharge as a readmission; instead, the information necessary to select the appropriate readmission discharges were included on the NRD. Inclusion and exclusion criteria should be used to define a readmission indicator (coded as 0 or 1) that identifies NRD discharges as readmissions specific to the analysis of interest.

Definition of a Readmission for the NRD Readmission Rates

For the NRD readmission rates presented in the Appendix E, readmissions were defined as follows:

- Discharge occurred between January 1 and December 31 of 2008
- A discharge for patient was identified within 30 days of the index event.
- Various types of readmissions were considered:
    - If the index event was based on a principal diagnosis CCS
        - Any readmission with the same CCS as a principal diagnosis
        - Any readmission with the same CCS as a principal or secondary diagnosis
        - Readmission for any condition (all-cause readmission)
    - If the index event was based on the first-listed procedure CCS
        - Readmission for any condition (all-cause readmission)
    - If the index event was based on the MDC
        - Any readmission with the same MDC
        - Readmission for any condition (all-cause readmission)
    - If the index event was based on the DRG
        - Any readmission with the same DRG
        - Readmission for any condition (all-cause readmission).

Selecting the Time Period for Revisits

When determining an appropriate time period for the readmission, considerations include selecting a time that considers the same risk of exposure to all patients, seasonality of the disease, and possible external factors. Shorter time frames (7 or 14 days) are often used to make events attributable to hospital acute care; longer time frames may reflect differences in ambulatory care and/or coordination of care.

2011-01. ONLINE March 9, 2011.U.S. Agency for Healthcare Research and Quality. Available at: http://www.hcupus.ahrq.gov/reports/methods/methods.jsp.

Selected Time Period for the NRD Readmission Rates

For the NRD readmission rates presented in the Appendix E, we used a 30 day time period. We used DaysToEvent and length of stay (LOS) to compare subsequent discharges to an index event and determine if they were within 30 days:

- Readmissions: DaysToEvent (for any latter admission for the same VisitLink) – DaysToEvent (for the index event) + LOS (for the index event) <= 30
- Not a readmission: DaysToEvent (for any latter admission for the same VisitLink) – DaysToEvent (for the index event) + LOS (for the index event) > 30.

Defining a "Clean Period" Prior to the Index Event

In some readmission studies it may be appropriate to define a "clean" period of time at the beginning of the study period for which no hospitalization (either index or subsequent hospitalization) can be identified.

Consider two separate studies of 30-day readmissions for diabetes in a calendar year. In both studies, the index event is an adult admission with a principal diagnosis of diabetes in which the patient is discharged alive. The readmission criteria are subsequent admissions with a principal diagnosis of diabetes within a month (30 days). One option is to count patients from the beginning of the year. Programming code would look for the first index event for a person with an admission month from January to November. This allows an equal 30-day window from each index event to search for a readmission. Patients with an index event in November can be followed into December. The readmission rate would be the number of patients with at least one readmission for diabetes within 30 days, divided by the number of patients with an admission for diabetes in 11 months. This approach may count a true readmission in January as an index event, because data were not available in December of the previous year.

A second option is to define a "clean period" prior to selecting the index event that is the same length as the readmission time period. This would mean modifying the approach described above by excluding patients with an admission month of January. This guarantees that all index events had no prior admission for diabetes within 30 days. The readmission rate would then be the number of patients with a readmission for diabetes within 30 days divided by all patients with an admission for diabetes in 10 months.

Selected Clean Period for the NRD Readmission Rates

For the NRD readmission rates presented in the Appendix E, we did not define a clean period. We used discharges in January to November to identify index events; we used looked for readmissions in January through December.

Reporting Rates of Readmission

Although the definition of a readmission rates seems simple — number of readmissions divided by number of cases followed — our research into readmission rates showed no standard definition. In some cases, the unit of observation was a patient; in others, the unit of observation was discharges and individual patients were counted more than once. Some

studies focused on the first readmission following an index event, while others counted all readmissions. The definitions of the readmission rate were specific to the purpose of the analyses.

Severity or risk adjustment may also be beneficial when comparing readmission rates across geographical regions, hospital types, or different patient populations. A simple risk adjustment would include age and gender. A more complex adjustment might also include comorbidites, severity classified by the 3M All-Patient Refined DRG severity score, patient income quartile, or any other factor that could considerably increase or decrease the risk of subsequent hospital care. The NRD included variables to support these types of analyses in the Core, Severity, Diagnosis and Procedure Groups, and Hospital file.

Definition used for the NRD Readmission Rates

For the NRD readmission rates presented in the Appendix E, the readmission rates were defined as the percent of patients who were readmitted within 30 days of an index event.

- Numerator: Total number of index events that had at least one subsequent hospital admission within 30 days
- Denominator: Total number of index events between January and November 2008.

An individual patient could have multiple index events during the 11 months, if they were at least 30 days apart.

To test the different weighting strategies, readmission rates were calculated four different ways:

- Nationally weighted estimates
    - With transfers combined (weighted by DISCWT_TXcombined)
    - With transfer records separate (weighted by DISCWT_TXseparate)
- Unweighted estimates
    - With transfers combined (records with non-zero value of DISCWT_TXcombined)
    - With transfer records separate (records with non-zero value of DISCWT_TXseparate).

LIMITATIONS OF THE PILOT NATIONWIDE READMISSIONS DATABASE

The NRD was design to support national analyses of repeat hospital use. The study of variation in readmission rates is one way to look at quality of inpatient care. The limitations of the pilot NRD were caused by the limitations of the underlying data. We have used exclusions on certain types of hospitals and discharges and post-stratified weighting to minimize the issues.

Limitations on Studying Pediatric Readmissions

The NRD needed to exclude patients who were ages one and older because of unavailable patient identifiers in most of the NRD states. Although sick infants can have high readmission rates, their readmissions are often related to congenital anomalies and not necessarily the quality of hospital care.

Although pediatric discharges were included in the NRD and weighted differently than other ages, readmission rates for this age group should be viewed with caution. The exclusion criteria for unverified and missing patient identifiers disproportionally affected pediatric discharges, dropping more than a third of discharges for ages 1 to 5 (37.1 percent) and about a quarter of discharges for ages 6 to 10 and ages 11 to 17 (28.6 percent and 23.5 percent, respectively). In addition, two-thirds of the children's general medical/surgical hospitals were excluded because more than 50 percent of their discharges did not have verified patient identifiers.

Limitations from Using One Year of Discharge Data

The pilot NRD contained inpatient records for patients discharged in 2008. This included patients admitted in 2007 and discharged in 2008. The NRD did not include patients admitted to a hospital in 2008 but discharged in 2009. Therefore, 30- or 60-day readmissions for patients admitted in the latter part of the year may not be captured if the subsequent admission crossed into 2009. In addition, one year of discharge data is probably an insufficient length of time for examining readmissions that are more than 90 days apart.

Limitations from Using State-Specific Identifiers

Patients who were hospitalized in one state and readmitted or transferred to a hospital in another state cannot be tracked in the NRD, because each state SID uses a different unique patient identifier. The NRD included non-resident patients because we wanted to retain border hospitals that provided care for patients in their community, even though that community happened to cross states borders. The NRD excluded specialty hospitals, because they had unique distribution in the type of patients treated and a disproportionally large percentage of non-resident patients.

EXISTING FEDERAL AND NON-FEDERAL DATA SOURCES THAT CAN BE USED FOR ESTIMATES OF INPATIENT READMISSIONS

There are currently no data sources for estimating national, all-payer inpatient readmissions. We identified existing sources of estimates that did not charge a fee to access information on readmission rates. Sources were identified through the following:

- Our general knowledge of hospital quality measures and benchmarking data sources
- Federal entities and non-governmental organizations known to be focusing their efforts on hospital readmissions
- A PubMed search of the peer-reviewed literature on readmissions, generally, and pediatric readmissions, in particular.

Data sources and estimates for single states, other countries, or children under 18 months were not considered. Data sources using state data often overlapped with the inpatient data already provided to the HCUP partnership.

We explored the data sources and estimates of readmissions cited by current high-priority programs such as the DHHS Partnership for Patients and the Center for Medicare and Medicaid (CMS) Community Based Care Transitions demonstration. We examined Notices of Proposed Rulemaking regarding payment incentives for reducing hospital readmissions. We also looked for Medicare Payment Assessment Commission (MedPAC) Reports to Congress that studied and made recommendations about payment policy for inpatient readmissions. We visited Web

sites of private organizations with known work focusing on readmissions, such as the Commonwealth Fund and the Institute for Healthcare Improvement. We also investigated the status of readmission measures through repositories such as the National Quality Measures Clearinghouse and sources like the National Committee for Quality Assurance (NCQA).[18] Finally, although we were already familiar with the Jencks article on hospital readmissions, we used PubMed both to retrieve "related articles" that the Web site identified when viewing the abstract for the Jencks article and to conduct new searches.[19]

Briefly described below are several key sources of reliable estimates of readmissions. Appendix D provides additional details on each data source, population of interest, included hospitals, handling of transfers, and definitions of index events, readmissions, and readmission rates.

- Jencks et al. article in *New England Journal of Medicine* (2009) that reports 30-day (and longer) rates for Medicare FFS beneficiaries using Medicare Provider Analysis and Review (MedPAR) files for October 2003 through December 2004. Thirty-day rates are also provided for medical versus surgical discharges and for the top DRGs on index admission.
- MedPAC analysis of 2005 MedPAR file that reports 30-day rates by end-stage renal disease (ESRD) status, as well as 15-day rates for seven specific conditions that account for the largest share of spending on readmission.
- Hospital Compare dataset for 30-day readmissions for AMI, heart failure, and pneumonia among Medicare fee-for-service (FFS) beneficiaries ages 65 and older, as submitted to CMS for public reporting. These rates have also been summarized by the Commonwealth Fund for Q3 2006 through Q2 2009.
- Two articles intended to complement the Hospital Compare Web site by presenting 30-day rates for AMI and pneumonia by hospital referral region and hospital characteristics (as well as overall). Estimates are based on analysis of July 2005 to June 2008 or July 2006 to June 2009 Medicare claims.
- Three recently published articles reporting 365-day readmission rates from 2003 through 2008, 2004, and 2005 (respectively) using Pediatric Health Information System data from 37 tertiary care pediatric hospitals.

Other potential sources did not have publicly available information on readmissions:

- National Association of Children's Hospitals and Related Institutions has a Pediatric Quality Measurement System (PQMS), which allows participating children's hospitals to submit core and non-core measures to The Joint Commission. Noncore measures for pediatric readmission pertain to respiratory conditions (high versus low acuity), neonate, seizure, sickle cell anemia crisis, asthma, and bronchiolitis. Some rates are 15-day and some are 30-day.
- Thomson Reuters MarketScan® Research Databases can be used to study readmissions for patients with private insurance and Medicaid.

[18] No measures of pediatric readmissions were identified in the clearinghouse. Starting with commercial and Medicare plans in 2011, NCQA has a new measure to track all-cause readmissions.
[19] Jencks SF, Williams MV, Coleman EA. *Rehospitalizations among patients in the Medicare Fee-for-Service program*. *NEJM* 2009; 360:1418-1428.

- Department of Defense Tricare data capture active-duty and retired military and their dependents.
- HMO research networks and Kaiser can be used to study local readmission patterns for insured patients.

VALIDITY OF THE NATIONWIDE READMISSIONS DATABASE

To assess the validity of the NRD, readmission rates from the NRD were generated for most DRGs, MDCs, and major CCS categories for diagnoses and procedure. How the readmission rates were defined is specified in Appendix D with the other comparative data sources. Appendix E includes the data tables with weighted and unweighted readmission rates.

<Note: text comparing NRD to others to be determined after the 2008 NRD rates are calculated.>

FUTURE CONSIDERATIONS FOR THE NATIONWIDE READMISSIONS DATABASE

The pilot NRD has demonstrated its ability to produce valid estimates of national readmission rates, with some limitations. An annual update should be considered. One option is to create separate annual files each year (similar to the NIS). Another option is to use the new year of data to rebuild and augment the NRD into a rolling 24-month database. The benefit of a two-year file is the ability to examine readmissions that occur less frequently and better detect readmissions for rare conditions.

Creation of an Annual NRD

Each year, it takes approximately three months after the last SID and crosswalk are complete to create the NIS or the KID and their supporting documentation. The creation of the NRD requires that various types of information be available:

- HCUP SID from states with patient identifiers
- Identification of community, non-rehabilitation, non-specialty hospitals in the SID
- Cost-to-charge ratios to convert total charge to hospital cost.

The NRD would benefit from the NIS being created first because the NIS also needs to identify community, non-rehabilitation hospitals in the SID. The creation of the NRD requires the additional step of reviewing the impact of hospital- and discharge-level exclusions. Assuming that there is no change to the NRD database design, sampling, stratification, or weighting of the NRD, a similar three-month production period would be expected.

If many more than 15 states provide reliable patient identifiers in future data years, then a file with a 100 percent sample of the discharges may be too large and a different sampling strategy should be considered.

Publicly-Released NRD

Release of the NRD through the HCUP Central Distributor requires that the HCUP Partners sign participation agreements that often impose state-specific restrictions on the use of data elements. Because the NRD includes a 100 percent sample of discharges ages one and older

from all hospitals in participating states, HCUP Partners may be hesitant to agree to the release of the data. Precautions such as suppressing the hospital state and actual hospital identification can be taken. If any HCUP Partners opt out of participation, there is a risk for under-representation in certain regions. With all of the complications of creating a version of the NRD that can be publicly released, the process may initially take between six and 18 months. For example, it took 15 months for the HCUP Partners to agree to the release of the initial 1997 Kids' Inpatient Database and about 6 months for the HCUP Partners to agree to the initial release of the Nationwide Emergency Department Sample (NEDS). It should be noted that the NEDS did not include identifiers for the state, hospital, or patients.

SUMMARY AND RECOMMENDATIONS

<Note: final summary and recommendations to be determined after the 2008 NRD rates are calculated and compared to other data sources. >

APPENDICES

APPENDIX A. HCUP PARTNERS

Sponsored by the Agency for Healthcare Research and Quality (AHRQ), HCUP is a family of databases, software tools, and products developed through the collaboration of State data organizations, hospital associations, private data organizations, and the Federal government.

This HCUP feasibility study on a Nationwide Readmissions Database would not be possible without the contributions of the following data collection Partners:

Arkansas Department of Health

California Office of Statewide Health Planning and Development

Florida Agency for Health Care Administration

Hawaii Health Information Corporation

Kansas Hospital Association

Louisiana Department of Health and Hospitals

Massachusetts Division of Health Care Finance and Policy

Missouri Hospital Industry Data Institute

Nebraska Hospital Association

New Hampshire Department of Health & Human Services

New York State Department of Health

South Carolina State Budget & Control Board

Tennessee Hospital Association

Utah Department of Health

Virginia Health Information

Washington State Department of Health

APPENDIX B. DATA TABLES

Table B.1 Percentage of Discharges with Verified Patient Identifiers by State and Age Group (Table Intentionally Left Blank)

State	State Inpatient Databases (SID)											
	Age in Years											
	0			1-17			18-64			65 and older		
AR												
CA												
FL												
HI												
KS												
LA												
MA												
MO												
NE												
NH												
NY												
SC												
TN												
UT												
VA												
WA												

Source: Agency for Healthcare Research and Quality (AHRQ), Center for Delivery, Organization, and Markets, Healthcare Cost and Utilization Project, State Inpatient Databases, 2008, 16 states, all hospitals.
[1] Percentage is the number of SID records for that age group that have verified patient identifiers.
[2] Percentage is row percentage, the number of SID records for the age group divided by the number of records in the total SID.
Gray shading indicates percentage verified is less than 90%.

Table B.2 Percentage of Discharges with Verified Patient Identifiers by Age (Table Intentionally Left Blank)

Age in Years	South						West				Northeast			Midwest	
	AR	FL	LA	SC	TN	VA	CA	HI	UT	WA	MA	NH	NY	MO	NE
0															
1															
2															
3															
4															
5															
6															
7															
8															
9															
10															
11															
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23															
24															
25															
26															
27															
28															
29															

Age in Years	South						West				Northeast			Midwest	
	AR	FL	LA	SC	TN	VA	CA	HI	UT	WA	MA	NH	NY	MO	NE
30															
31															
32															
33															
34															
35															
36															
37															
38															
39															
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58															
59															
60															
61															

Age in Years	South						West				Northeast			Midwest	
	AR	FL	LA	SC	TN	VA	CA	HI	UT	WA	MA	NH	NY	MO	NE
62															
63															
64															
65															
66															
67															
68															
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70															
71															
72															
73															
74															
75															
76															
77															
78															
79															
80															
81															
82															
83															
84															
85															
86															
87															
88															
89															
90															
91															
92															
93															

Age in Years	South						West				Northeast			Midwest	
	AR	FL	LA	SC	TN	VA	CA	HI	UT	WA	MA	NH	NY	MO	NE
94															
95															
96															
97															
98															
99															
100															
101															
102															
103															
104															
105															

Source: Agency for Healthcare Research and Quality (AHRQ), Center for Delivery, Organization, and Markets, Healthcare Cost and Utilization Project, State Inpatient Databases, 2008, 15 states, all hospitals.

Gray shading indicates percentage verified is less than 90%.

Table B.3 Percentage of Discharges with Verified Patient Identifiers by Cumulative Age (Table Intentionally Left Blank)

Age Range	South						West				Northeast			Midwest	
	AR	FL	LA	SC	TN	VA	CA	HI	UT	WA	MA	NH	NY	MO	NE
Age 0+															
Age 1+															
Age 2+															
Age 3+															
Age 4+															
Age 5+															
Age 6+															
Age 7+															
Age 8+															
Age 9+															
Age 10+															
Age 11+															
Age 12+															
Age 13+															
Age 14+															
Age 15+															
Age 16+															
Age 17+															
Age 18+															

Source: Agency for Healthcare Research and Quality (AHRQ), Center for Delivery, Organization, and Markets, Healthcare Cost and Utilization Project, State Inpatient Databases, 2008, 15 states, all hospitals.

Gray shading indicates percentage verified is less than 90%.

Table B.4 Characteristics of Discharges by Age Group (Table Intentionally Left Blank)

	Age 0		Age 1-17		Age 18 and older	
	Number of records	Row Percentage	Number of records	Row Percentage	Number of records	Row Percentage
Total Discharges						
Patient Characteristics						
Gender						
Male						
Female						
Missing/Invalid						
Age						
0						
1 - 5						
6 - 10						
11-17						
18-44						
45-64						
65-84						
85+						
Primary Expected Payer						
Medicare						
Medicaid						
Private						
Uninsured						
Other						
Missing/Invalid						
National Income Quartile						
Quartile 1 (lowest)						
Quartile 2						
Quartile 3						
Quartile 4 (highest)						
Missing/Invalid						
Hospital Characteristics						

	Age 0		Age 1-17		Age 18 and older	
	Number of records	**Row Percentage**	**Number of records**	**Row Percentage**	**Number of records**	**Row Percentage**
Bed Size (Categories depend on location and teaching status)						
Small						
Medium						
Large						
Control						
Private, Not-for-Profit						
Private, For-Profit						
Government						
Teaching Status						
Teaching						
Non-Teaching						
Region						
Northeast						
Midwest						
South						
West						
Urban/Rural Location						
Large Central Metro (> 1M)						
Large Fringe Metro (> 1M)						
Medium Metro (250k-999k)						
Small Metro (50k - 249k)						
Micropolitan						
Noncore						
Diagnoses						
Principal Diagnoses (DXCCS1) with more than 1% of Discharges for Age 0						
218: Liveborn						
222: Hemolytic jaundice and perinatal jaundice						
224: Other perinatal conditions						
125: Acute bronchitis						

	Age 0		Age 1-17		Age 18 and older	
	Number of records	**Row Percentage**	**Number of records**	**Row Percentage**	**Number of records**	**Row Percentage**
217: Other congenital anomalies						
126: Other upper respiratory infections						
7: Viral infection						
159: Urinary tract infections						
154: Noninfectious gastroenteritis						
83: Epilepsy; convulsions						
55: Fluid and electrolyte disorders						
135: Intestinal infection						
122: Pneumonia (except that caused by tuberculosis or sexually transmitted disease)						
128: Asthma						
197: Skin and subcutaneous tissue infections						
233: Intracranial injury						
131: Respiratory failure; insufficiency; arrest (adult)						
45: Maintenance chemotherapy; radiotherapy						
Source: Agency for Healthcare Research and Quality (AHRQ), Center for Delivery, Organization, and Markets, Healthcare Cost and Utilization Project, State Inpatient Databases, 2008, 15 states, community/non-rehabilitation hospitals.						

Table B.5 Characteristics of Discharges Age One Year and Older by Patient Identifier Status (Table Intentionally Left Blank)

	Verified and not Suspect Patient Identifiers (Age 1+)		Unverified, Missing, or Suspect Patient Identifiers (Age 1+)	
	Number of records	Row Percentage	Number of records	Row Percentage
Total Discharges				
Patient Characteristics				
Gender				
Male				
Female				
Missing/Invalid				
Age				
1 - 5				
6 - 10				
11-17				
18-44				
45-64				
65-84				
85+				
Primary Expected Payer				
Medicare				
Medicaid				
Private				
Uninsured				
Other				
Missing/Invalid				
National Income Quartile				
Quartile 1 (lowest)				
Quartile 2				
Quartile 3				
Quartile 4 (highest)				
Missing/Invalid				
Hospital Characteristics				
Bed Size (Categories depend on location and teaching status)				

	Verified and not Suspect Patient Identifiers (Age 1+)		Unverified, Missing, or Suspect Patient Identifiers (Age 1+)	
	Number of records	**Row Percentage**	**Number of records**	**Row Percentage**
Small				
Medium				
Large				
Control				
Private, Not-for-Profit				
Private, For-Profit				
Government				
Teaching Status				
Teaching				
Non-Teaching				
Region				
Northeast				
Midwest				
South				
West				
Urban/Rural Location				
Large Central Metro (> 1M)				
Large Fringe Metro (> 1M)				
Medium Metro (250k-999k)				
Small Metro (50k - 249k)				
Micropolitan				
Noncore				
Diagnoses				
Principal Diagnoses (DXCCS1) with more than 1% of discharges for unverified or suspect patient identifiers				
5: HIV infection				
224: Other perinatal conditions				
217: Other congenital anomalies				
126: Other upper respiratory infections				
61: Sickle cell anemia				
142: Appendicitis and other appendiceal conditions				
125: Acute bronchitis				
196: Normal pregnancy and/or delivery				

	Verified and not Suspect Patient Identifiers (Age 1+)		Unverified, Missing, or Suspect Patient Identifiers (Age 1+)	
	Number of records	Row Percentage	Number of records	Row Percentage
233: Intracranial injury	67,663	86.8	10,302	13.2
652: Attention-deficit, conduct, and disruptive behavior disorders	6,173	87.1	913	12.9
185: Prolonged pregnancy	93,870	87.2	13,782	12.8
7: Viral infection	24,198	87.2	3,537	12.8
189: Previous C-section	187,459	87.4	27,120	12.6
193: OB-related trauma to perineum and vulva	271,829	87.5	38,874	12.5
660: Alcohol-related disorders	98,418	87.8	13,723	12.2
192: Umbilical cord complication	70,814	87.9	9,745	12.1
661: Substance-related disorders	87,980	88.0	11,946	12.0
244: Other injuries and conditions due to external causes	34,459	88.1	4,652	11.9
190: Fetal distress and abnormal forces of labor	78,735	88.1	10,593	11.9
128: Asthma	141,855	88.2	19,056	11.8
45: Maintenance chemotherapy; radiotherapy	62,834	88.2	8,404	11.8
229: Fracture of upper limb	57,056	88.6	7,345	11.4
187: Malposition; malpresentation	58,957	89.1	7,198	10.9
191: Polyhydramnios and other problems of amniotic cavity	67,677	89.3	8,117	10.7
83: Epilepsy; convulsions	98,992	89.4	11,795	10.6
195: Other complications of birth; puerperium affecting management of mother	256,744	89.4	30,392	10.6
184: Early or threatened labor	74,949	90.2	8,160	9.8
181: Other complications of pregnancy	184,920	90.8	18,743	9.2
230: Fracture of lower limb	94,780	91.7	8,573	8.3
657: Mood disorders	282,665	92.0	24,488	8.0
183: Hypertension complicating pregnancy; childbirth and the puerperium	79,983	92.3	6,684	7.7
154: Noninfectious gastroenteritis	51,386	92.5	4,181	7.5
659: Schizophrenia and other psychotic disorders	160,822	92.5	13,044	7.5
55: Fluid and electrolyte disorders	171,553	93.1	12,677	6.9
197: Skin and subcutaneous tissue infections	215,690	93.3	15,403	6.7
152: Pancreatic disorders (not diabetes)	107,280	93.8	7,048	6.2
122: Pneumonia (except that caused by tuberculosis or sexually transmitted disease)	380,338	93.9	24,665	6.1
50: Diabetes mellitus with complications	191,389	94.0	12,252	6.0
135: Intestinal infection	78,913	94.1	4,989	5.9

	Verified and not Suspect Patient Identifiers (Age 1+)		Unverified, Missing, or Suspect Patient Identifiers (Age 1+)	
	Number of records	**Row Percentage**	**Number of records**	**Row Percentage**
149: Biliary tract disease	174,480	94.3	10,643	5.7
102: Nonspecific chest pain	280,235	95.3	13,792	4.7
159: Urinary tract infections	198,832	96.0	8,385	4.0
109: Acute cerebrovascular disease	207,231	96.1	8,401	3.9
237: Complication of device; implant or graft	245,198	96.4	9,240	3.6
238: Complications of surgical procedures or medical care	180,984	96.4	6,800	3.6
131: Respiratory failure; insufficiency; arrest (adult)	146,636	96.4	5,431	3.6
100: Acute myocardial infarction	238,239	96.5	8,605	3.5
153: Gastrointestinal hemorrhage	136,244	96.8	4,561	3.2
145: Intestinal obstruction without hernia	124,672	96.8	4,097	3.2
205: Spondylosis; intervertebral disc disorders; other back problems	233,635	96.9	7,584	3.1
254: Rehabilitation care; fitting of prostheses; and adjustment of devices	141,131	96.9	4,513	3.1
2: Septicemia (except in labor)	297,190	97.0	9,041	3.0
101: Coronary atherosclerosis and other heart disease	336,807	97.4	8,975	2.6
157: Acute and unspecified renal failure	151,936	97.6	3,774	2.4
127: Chronic obstructive pulmonary disease and bronchiectasis	244,672	97.8	5,519	2.2
106: Cardiac dysrhythmias	294,250	97.9	6,442	2.1
108: Congestive heart failure; nonhypertensive	372,016	97.9	8,074	2.1
203: Osteoarthritis	309,056	98.9	3,457	1.1

Source: Agency for Healthcare Research and Quality (AHRQ), Center for Delivery, Organization, and Markets, Healthcare Cost and Utilization Project, State Inpatient Databases, 2008, 15 states, community/non-rehabilitation hospitals for discharges age one year and older.

Table B.6 Distribution of Discharges from Other States (Inflow) by State

State of Hospital Location	All SID Discharges[1]			Non-Emergent SID Discharges[2]		
	No Flow: Percentage of SID discharges that are residents	**Inflow:** Percentage of SID discharges that are from out of state	**Unknown Flow:** Patient residence missing in SID	**No Flow:** Percentage of SID discharges that are residents	**Inflow:** Percentage of SID discharges that are from out of state	**Unknown Flow:** Patient residence missing in SID
AR						
CA						
FL						
HI						
LA						
MA						
MO						
NE						
NH						
NY						
SC						
TN						
UT						
VA						
WA						

Source: Agency for Healthcare Research and Quality (AHRQ), Center for Delivery, Organization, and Markets, Healthcare Cost and Utilization Project, State Inpatient Databases, 2008, 15 states, all discharges.

[1] Denominator is SID discharges for the state.
[2] Denominator is non-emergent SID discharges (HCUP_ED = 0) for the state.

Table B.7 Distribution of Discharges from Other States (Inflow) for Community, Non-Rehabilitation Hospitals

State of Hospital Location	Inflow of more than 50%		Inflow of 21% to 50%		Inflow of 10% to 20%		Inflow of Less than 10%	
	Number of Hospitals	Percent of all Hospitals in the State	Number of Hospitals	Percent of all Hospitals in the State	Number of Hospitals	Percent of all Hospitals in the State	Number of Hospitals	Percent of all Hospitals in the State
AR								
CA								
FL								
HI								
LA								
MA								
MO								
NE								
NH								
NY								
SC								
TN								
UT								
VA								
WA								
NRD States								

Source: Agency for Healthcare Research and Quality (AHRQ), Center for Delivery, Organization, and Markets, Healthcare Cost and Utilization Project, State Inpatient Databases, 2008, 15 states, community/non-rehabilitation hospitals for discharges age one year and older.

Table B.8 Distribution of Resident Discharges to Other States (Outflow) by State

State of Patient Residence	All Resident Discharges[1]		Non-Emergent Resident Discharges[2]	
	No Flow: Percentage of resident discharges that are treated in state	**Outflow:** Percentage of resident discharges that are treated in other HCUP states	**No Flow:** Percentage of resident discharges that are treated in state	**Outflow:** Percentage of resident discharges that are treated in other HCUP states
AR				
CA				
FL				
HI				
LA				
MA				
MO				
NE				
NH				
NY				
SC				
TN				
UT				
VA				
WA				

Source: Agency for Healthcare Research and Quality (AHRQ), Center for Delivery, Organization, and Markets, Healthcare Cost and Utilization Project, State Inpatient Databases, 2008, 15 states, all hospitals.

[1] Denominator is resident discharges treated in any of the 44 HCUP states.
[2] Denominator is non-emergent resident discharges (HCUP_ED = 0) treated in any of the 44 HCUP states.

Table B.9 Characteristics of Specialty Hospitals in NRD States

AHA Specialty (Z210)	Predominant MDC	Discharges in Predominant MDC		Ratio of NRD percent to NIS percent
		Percentage in NRD hospital	Percentage in NIS hospitals[1]	
13: Surgical	MDC 8 Musculoskeletal system and connective tissue diseases and disorders	96.6	8.5	11.4
13: Surgical	MDC 8 Musculoskeletal system and connective tissue diseases and disorders	89.0	8.5	10.5
13: Surgical	MDC 8 Musculoskeletal system and connective tissue diseases and disorders	85.0	8.5	10.0
13: Surgical	MDC 13 Female reproductive system diseases and disorders	38.7	1.9	20.4
41: Cancer	MDC 6 Digestive System diseases and disorders	13.5	8.7	1.6
41: Cancer	MDC 13 Female reproductive system diseases and disorders	33.2	1.9	17.5
41: Cancer	MDC 17 Myeloproliferative diseases and disorders and poorly differentiated neoplasm	39.6	0.8	49.5
41: Cancer	MDC 17 Myeloproliferative diseases and disorders and poorly differentiated neoplasm	37.3	0.8	46.6
41: Cancer	MDC 17 Myeloproliferative diseases and disorders and poorly differentiated neoplasm	22.2	0.8	27.8
41: Cancer	MDC 17 Myeloproliferative diseases and disorders and poorly differentiated neoplasm	21.5	0.8	26.9
41: Cancer	MDC 17 Myeloproliferative diseases and disorders and poorly differentiated neoplasm	28.2	0.8	35.3
42: Heart	MDC 5 Circulatory system diseases and disorders	87.2	14.7	5.9
42: Heart	MDC 5 Circulatory system diseases and disorders	82.8	14.7	5.6
42: Heart	MDC 5 Circulatory system diseases and disorders	64.2	14.7	4.4
42: Heart	MDC 5 Circulatory system diseases and disorders	56.5	14.7	3.8
42: Heart	MDC 5 Circulatory system diseases and disorders	52.5	14.7	3.6
44: Obstetrics and gynecology	MDC 14 Pregnancy/Childbirth and MDC 15 Newborns	95.5	22.5	4.2
44: Obstetrics and gynecology	MDC 14 Pregnancy/Childbirth and MDC 15 Newborns	89.7	22.5	4.0
44: Obstetrics and gynecology	MDC 14 Pregnancy/Childbirth and MDC 15 Newborns	86.6	22.5	3.8
44: Obstetrics and gynecology	MDC 14 Pregnancy/Childbirth and MDC 15 Newborns	89.1	22.5	4.0
44: Obstetrics and gynecology	MDC 14 Pregnancy/Childbirth and MDC 15 Newborns	86.6	22.5	3.8
44: Obstetrics and gynecology	MDC 14 Pregnancy/Childbirth and MDC 15 Newborns	75.4	22.5	3.4

AHA Specialty (Z210)	Predominant MDC	Discharges in Predominant MDC		Ratio of NRD percent to NIS percent
		Percentage in NRD hospital	Percentage in NIS hospitals[1]	
44: Obstetrics and gynecology	MDC 14 Pregnancy/Childbirth and MDC 15 Newborns	78.0	22.5	3.5
44: Obstetrics and gynecology	MDC 14 Pregnancy/Childbirth and MDC 15 Newborns	68.8	22.5	3.1
45: Eye, ear, nose and throat	MDC 2 Eye diseases and disorders	78.8	0.1	788.0
45: Eye, ear, nose and throat	MDC 3 Ear, nose, mouth, and throat diseases and disorders	37.8	1.1	34.4
45: Eye, ear, nose and throat	MDC 9 Skin, subcutaneous tissue, and breast diseases and disorders	51.3	2.5	20.5
47: Orthopedic	MDC 8 Musculoskeletal system and connective tissue diseases and disorders	98.5	8.5	11.6
47: Orthopedic	MDC 8 Musculoskeletal system and connective tissue diseases and disorders	98.1	8.5	11.5
47: Orthopedic	MDC 8 Musculoskeletal system and connective tissue diseases and disorders	96.8	8.5	11.4
47: Orthopedic	MDC 8 Musculoskeletal system and connective tissue diseases and disorders	86.2	8.5	10.1
47: Orthopedic	MDC 8 Musculoskeletal system and connective tissue diseases and disorders	68.7	8.5	8.1
49: Other specialty	MDC 4 Respiratory diseases and disorders	32.9	10.1	3.3
49: Other specialty	MDC 4 Respiratory diseases and disorders	20.4	10.1	2.0
49: Other specialty	MDC 8 Musculoskeletal system and connective tissue diseases and disorders	17.4	8.5	2.0
49: Other specialty	MDC 10 Endocrine, nutritional, and metabolic diseases and disorders	44.2	3.2	13.8
49: Other specialty	MDC 10 Endocrine, nutritional, and metabolic diseases and disorders	35.7	3.2	11.2
49: Other specialty	MDC 19: Mental diseases and disorders	99.5	3.8	26.2
49: Other specialty	MDC 14 Pregnancy/Childbirth and MDC 15 Newborns	50.8	22.5	2.3
59: Children's other specialty	MDC 8 Musculoskeletal system and connective tissue diseases and disorders	63.4	8.5	7.5
59: Children's other specialty	MDC 17 Myeloproliferative diseases and disorders and poorly differentiated neoplasm	46.4	0.8	58.0
80: Acute long-term care	MDC 4 Respiratory diseases and disorders	75.7	10.1	7.5
80: Acute long-term care	MDC 4 Respiratory diseases and disorders	74.6	10.1	7.4
80: Acute long-term care	MDC 4 Respiratory diseases and disorders	71.6	10.1	7.1

AHA Specialty (Z210)	Predominant MDC	Discharges in Predominant MDC		Ratio of NRD percent to NIS percent
		Percentage in NRD hospital	Percentage in NIS hospitals[1]	
80: Acute long-term care	MDC 4 Respiratory diseases and disorders	58.6	10.1	5.8
80: Acute long-term care	MDC 4 Respiratory diseases and disorders	57.8	10.1	5.7
80: Acute long-term care	MDC 4 Respiratory diseases and disorders	56.1	10.1	5.6
80: Acute long-term care	MDC 4 Respiratory diseases and disorders	55.7	10.1	5.5
80: Acute long-term care	MDC 4 Respiratory diseases and disorders	55.0	10.1	5.4
80: Acute long-term care	MDC 4 Respiratory diseases and disorders	53.8	10.1	5.3
80: Acute long-term care	MDC 4 Respiratory diseases and disorders	52.0	10.1	5.1
80: Acute long-term care	MDC 4 Respiratory diseases and disorders	49.0	10.1	4.9
80: Acute long-term care	MDC 4 Respiratory diseases and disorders	48.2	10.1	4.8
80: Acute long-term care	MDC 4 Respiratory diseases and disorders	46.6	10.1	4.6
80: Acute long-term care	MDC 4 Respiratory diseases and disorders	46.2	10.1	4.6
80: Acute long-term care	MDC 4 Respiratory diseases and disorders	43.8	10.1	4.3
80: Acute long-term care	MDC 4 Respiratory diseases and disorders	40.2	10.1	4.0
80: Acute long-term care	MDC 4 Respiratory diseases and disorders	40.0	10.1	4.0
80: Acute long-term care	MDC 4 Respiratory diseases and disorders	39.7	10.1	3.9
80: Acute long-term care	MDC 4 Respiratory diseases and disorders	39.7	10.1	3.9
80: Acute long-term care	MDC 4 Respiratory diseases and disorders	38.8	10.1	3.8
80: Acute long-term care	MDC 4 Respiratory diseases and disorders	36.1	10.1	3.6
80: Acute long-term care	MDC 4 Respiratory diseases and disorders	34.4	10.1	3.4
80: Acute long-term care	MDC 4 Respiratory diseases and disorders	32.2	10.1	3.2
80: Acute long-term care	MDC 4 Respiratory diseases and disorders	31.5	10.1	3.1
80: Acute long-term care	MDC 4 Respiratory diseases and disorders	31.1	10.1	3.1
80: Acute long-term care	MDC 4 Respiratory diseases and disorders	28.3	10.1	2.8
80: Acute long-term care	MDC 4 Respiratory diseases and disorders	28.2	10.1	2.8
80: Acute long-term care	MDC 4 Respiratory diseases and disorders	26.4	10.1	2.6
80: Acute long-term care	MDC 4 Respiratory diseases and disorders	26.2	10.1	2.6
80: Acute long-term care	MDC 4 Respiratory diseases and disorders	25.7	10.1	2.5
80: Acute long-term care	MDC 4 Respiratory diseases and disorders	24.9	10.1	2.5
80: Acute long-term care	MDC 4 Respiratory diseases and disorders	22.8	10.1	2.3
80: Acute long-term care	MDC 4 Respiratory diseases and disorders	22.4	10.1	2.2

AHA Specialty (Z210)	Predominant MDC	Discharges in Predominant MDC		Ratio of NRD percent to NIS percent
		Percentage in NRD hospital	Percentage in NIS hospitals[1]	
80: Acute long-term care	MDC 4 Respiratory diseases and disorders	22.2	10.1	2.2
80: Acute long-term care	MDC 4 Respiratory diseases and disorders	20.1	10.1	2.0
80: Acute long-term care	MDC 4 Respiratory diseases and disorders	17.9	10.1	1.8
80: Acute long-term care	MDC 5 Circulatory system diseases and disorders	20.0	14.7	1.4
80: Acute long-term care	MDC 19: Mental diseases and disorders	52.2	3.8	13.7
80: Acute long-term care	MDC 19: Mental diseases and disorders	30.7	3.8	8.1
80: Acute long-term care	MDC 14 Pregnancy/Childbirth and MDC 15 Newborns	41.5	22.5	1.8

Source: Agency for Healthcare Research and Quality (AHRQ), Center for Delivery, Organization, and Markets, Healthcare Cost and Utilization Project, State Inpatient Databases and Nationwide Inpatient Sample (NIS), 2008, 15 states, community/non-rehabilitation specialty hospitals.

[1] 2008 NIS estimates by MDC were generated using HCUPnet at http://hcupnet.ahrq.gov/. Accessed August 26, 2011.

Table B.10 Discharge Counts by Type of Exclusions for NRD

State	Total discharges in the SID	Exclusions in Hierarchical Order							Pilot NRD	
		(1) Discharges from non-community or rehab hospitals	(2) Discharges from community, non-rehab hospitals that are specialty hospitals	(3) Age of 0 years	(4) Unverified patient identifiers	(5) Suspect patient identifiers (20 or more visits in the year)	(6) Suspect patient identifiers (Discharged dead with subsequent admission)	(7) Discharges from hospitals with more than 50% of total discharges excluded for any cause	Total Discharges	Percent of SID total
All States	15,716,023	341,185	225,579	1,901,244	799,643	13,058	1,738	113,660	12,319,916	78.4
AR	425,140	19,998	18,003	42,634	5,854	367	195	0	338,089	79.5
CA	4,017,998	124,205	19,656	609,865	362,789	3,120	401	79,043	2,818,919	70.2
FL	2,571,753	36,831	16,505	259,128	98,063	2,846	367	0	2,158,013	83.9
HI	135,693	15,242	18,020	10,473	3,258	0	4	0	88,696	65.4
LA	606,354	10,546	40,975	58,827	33,987	349	110	3,084	458,476	75.6
MA	845,101	6,447	8,076	88,408	43,704	471	35	6,500	691,460	81.8
MO	902,240	15,417	2,419	94,550	57,722	536	103	15,802	715,691	79.3
NE	215,493	1,388	1,301	28,100	173	22	16	0	184,493	85.6
NH	128,845	0	0	14,698	4,996	0	41	0	109,110	84.7
NY	2,629,383	48,515	68,151	276,026	118,730	3,226	130	0	2,114,605	80.4
SC	560,234	152	1,560	67,519	8,894	368	71	0	481,670	86.0
TN	869,627	27,006	28,070	85,896	13,267	472	99	0	714,817	82.2
UT	279,504	10,583	2,114	62,004	17,718	0	9	6,332	180,744	64.7
VA	876,314	17,046	161	108,541	30,471	741	66	2,899	716,389	81.8
WA	652,344	7,809	568	94,575	17	540	91	0	548,744	84.1

Source: Agency for Healthcare Research and Quality (AHRQ), Center for Delivery, Organization, and Markets, Healthcare Cost and Utilization Project, State Inpatient Databases, 2008, 15 states, all hospitals.

Table B.11 Characteristics of Discharges in the Pilot NRD

	Age 1+		Age 1-17		Age 18+	
	Number of records	Column percentage	Number of records	Row percentage	Number of records	Row percentage
Total Discharges	**12,319,916**	**100.0**	**422,248**	**3.4**	**11,897,668**	**96.6**
Patient Characteristics						
Gender						
Male	4,990,596	40.5	202,345	4.1	4,788,251	95.9
Female	7,329,320	59.5	219,903	3.0	7,109,417	97.0
Missing/Invalid	0	0.0	0	0.0	0	0.0
Age						
1 - 5	133,341	1.1	133,341	100.0	0	0.0
6 - 10	74,079	0.6	74,079	100.0	0	0.0
11-17	214,828	1.7	214,828	100.0	0	0.0
18-44	3,462,452	28.1	0	0.0	3,462,452	100.0
45-64	3,386,109	27.5	0	0.0	3,386,109	100.0
65-84	3,862,653	31.4	0	0.0	3,862,653	100.0
85+	1,186,454	9.6	0	0.0	1,186,454	100.0
Primary Expected Payer						
Medicare	5,465,646	44.4	1,471	0.0	5,464,175	100.0
Medicaid	1,961,936	15.9	216,619	11.0	1,745,317	89.0
Private	3,839,548	31.2	169,300	4.4	3,670,248	95.6
Uninsured	604,683	4.9	17,931	3.0	586,752	97.0
Other	428,587	3.5	16,141	3.8	412,446	96.2
Missing/Invalid	19,516	0.2	786	4.0	18,730	96.0
National Income Quartile						
Quartile 1 (lowest)	3,310,422	26.9	139,315	4.2	3,171,107	95.8
Quartile 2	3,075,482	25.0	109,582	3.6	2,965,900	96.4
Quartile 3	2,786,701	22.6	85,204	3.1	2,701,497	96.9
Quartile 4 (highest)	2,803,905	22.8	73,378	2.6	2,730,527	97.4
Missing/Invalid	343,406	2.8	14,769	4.3	328,637	95.7
Hospital Characteristics						
Bed Size (Categories depend on location and teaching status)						
Small	1,167,722	9.5	30,210	2.6	1,137,512	97.4

	Age 1+		Age 1-17		Age 18+	
	Number of records	**Column percentage**	**Number of records**	**Row percentage**	**Number of records**	**Row percentage**
Medium	3,078,992	25.0	100,499	3.3	2,978,493	96.7
Large	8,073,202	65.5	291,539	3.6	7,781,663	96.4
Control						
Private, Not-for-Profit	8,488,314	68.9	292,820	3.4	8,195,494	96.6
Private, For-Profit	1,869,432	15.2	41,067	2.2	1,828,365	97.8
Government	1,962,170	15.9	88,361	4.5	1,873,809	95.5
Teaching Status						
Teaching	5,668,377	46.0	283,759	5.0	5,384,618	95.0
Non-Teaching	6,651,539	54.0	138,489	2.1	6,513,050	97.9
Region						
Northeast	2,915,175	23.7	114,734	3.9	2,800,441	96.1
Midwest	900,184	7.3	25,101	2.8	875,083	97.2
South	4,867,454	39.5	183,326	3.8	4,684,128	96.2
West	3,637,103	29.5	99,087	2.7	3,538,016	97.3
Urban/Rural Location						
Large Central Metro (> 1M)	4,908,556	39.8	180,069	3.7	4,728,487	96.3
Large Fringe Metro (> 1M)	2,596,309	21.1	73,468	2.8	2,522,841	97.2
Medium Metro (250k-999k)	2,604,672	21.1	96,522	3.7	2,508,150	96.3
Small Metro (50k - 249k)	1,105,106	9.0	35,954	3.3	1,069,152	96.7
Micropolitan	825,572	6.7	26,966	3.3	798,606	96.7
Noncore	279,701	2.3	9,269	3.3	270,432	96.7
Diagnoses						
Principal Diagnoses (DXCCS1) with more than 1% of discharges						
122: Pneumonia (except that caused by tuberculosis or sexually transmitted disease)	373,669	3.0	25,240	6.8	348,429	93.2
108: Congestive heart failure; nonhypertensive	368,243	3.0	203	0.1	368,040	99.9
101: Coronary atherosclerosis and other heart disease	327,871	2.7	23	0.0	327,848	100.0
203: Osteoarthritis	293,538	2.4	33	0.0	293,505	100.0
2: Septicemia (except in labor)	292,892	2.4	2,298	0.8	290,594	99.2
106: Cardiac dysrhythmias	289,721	2.4	980	0.3	288,741	99.7
657: Mood disorders	279,300	2.3	24,278	8.7	255,022	91.3
102: Nonspecific chest pain	277,861	2.3	275	0.1	277,586	99.9

	Age 1+		Age 1-17		Age 18+	
	Number of records	Column percentage	Number of records	Row percentage	Number of records	Row percentage
193: OB-related trauma to perineum and vulva	261,512	2.1	8,434	3.2	253,078	96.8
195: Other complications of birth; puerperium affecting management of mother	247,249	2.0	8,855	3.6	238,394	96.4
127: Chronic obstructive pulmonary disease and bronchiectasis	242,806	2.0	755	0.3	242,051	99.7
237: Complication of device; implant or graft	236,250	1.9	5,859	2.5	230,391	97.5
100: Acute myocardial infarction	235,139	1.9	18	0.0	235,121	100.0
205: Spondylosis; intervertebral disc disorders; other back problems	227,097	1.8	530	0.2	226,567	99.8
197: Skin and subcutaneous tissue infections	212,290	1.7	14,829	7.0	197,461	93.0
109: Acute cerebrovascular disease	206,178	1.7	418	0.2	205,760	99.8
159: Urinary tract infections	196,515	1.6	6,674	3.4	189,841	96.6
50: Diabetes mellitus with complications	188,854	1.5	5,979	3.2	182,875	96.8
189: Previous C-section	180,140	1.5	535	0.3	179,605	99.7
181: Other complications of pregnancy	178,973	1.5	6,353	3.5	172,620	96.5
238: Complications of surgical procedures or medical care	175,437	1.4	4,942	2.8	170,495	97.2
149: Biliary tract disease	172,488	1.4	2,366	1.4	170,122	98.6
55: Fluid and electrolyte disorders	168,892	1.4	13,816	8.2	155,076	91.8
659: Schizophrenia and other psychotic disorders	158,416	1.3	2,415	1.5	156,001	98.5
157: Acute and unspecified renal failure	150,509	1.2	424	0.3	150,085	99.7
131: Respiratory failure; insufficiency; arrest (adult)	141,791	1.2	1,506	1.1	140,285	98.9
254: Rehabilitation care; fitting of prostheses; and adjustment of devices	138,619	1.1	814	0.6	137,805	99.4

	Age 1+		Age 1-17		Age 18+	
	Number of records	**Column percentage**	**Number of records**	**Row percentage**	**Number of records**	**Row percentage**
128: Asthma	137,723	1.1	27,805	20.2	109,918	79.8
153: Gastrointestinal hemorrhage	135,159	1.1	840	0.6	134,319	99.4
145: Intestinal obstruction without hernia	123,043	1.0	2,562	2.1	120,481	97.9
Procedures						
First Procedure (PRCCS1) with more than 1% of discharges						
137: Other procedures to assist delivery	544,435	4.4	18,240	3.4	526,195	96.6
134: Cesarean section	479,869	3.9	8,935	1.9	470,934	98.1
222: Blood transfusion	282,475	2.3	4,998	1.8	277,477	98.2
216: Respiratory intubation and mechanical ventilation	252,432	2.0	5,145	2.0	247,287	98.0
70: Upper gastrointestinal endoscopy; biopsy	250,961	2.0	3,295	1.3	247,666	98.7
45: Percutaneous transluminal coronary angioplasty (PTCA)	238,146	1.9	39	0.0	238,107	100.0
152: Arthroplasty knee	215,312	1.7	337	0.2	214,975	99.8
140: Repair of current obstetric laceration	209,784	1.7	6,634	3.2	203,150	96.8
54: Other vascular catheterization; not heart	204,413	1.7	4,063	2.0	200,350	98.0
47: Diagnostic cardiac catheterization; coronary arteriography	202,085	1.6	358	0.2	201,727	99.8
231: Other therapeutic procedures	184,250	1.5	10,895	5.9	173,355	94.1
124: Hysterectomy; abdominal and vaginal	175,149	1.4	17	0.0	175,132	100.0
153: Hip replacement; total and partial	149,153	1.2	87	0.1	149,066	99.9
84: Cholecystectomy and common duct exploration	143,594	1.2	2,062	1.4	141,532	98.6
158: Spinal fusion	137,445	1.1	2,484	1.8	134,961	98.2
219: Alcohol and drug rehabilitation/detoxification	128,121	1.0	343	0.3	127,778	99.7
48: Insertion; revision;	123,827	1.0	298	0.2	123,529	99.8

	Age 1+		Age 1-17		Age 18+	
	Number of records	**Column percentage**	**Number of records**	**Row percentage**	**Number of records**	**Row percentage**
replacement; removal of cardiac pacemaker or cardioverter/defibrillator						
58: Hemodialysis	120,370	1.0	278	0.2	120,092	99.8
80: Appendectomy	101,337	0.8	19,326	19.1	82,011	80.9
4: Diagnostic spinal tap	59,060	0.5	5,516	9.3	53,544	90.7
168: Incision and drainage; skin and subcutaneous tissue	56,684	0.5	5,895	10.4	50,789	89.6
224: Cancer chemotherapy	56,410	0.5	6,239	11.1	50,171	88.9
227: Other diagnostic procedures (interview; evaluation; consultation)	43,995	0.4	5,265	12.0	38,730	88.0
217: Other respiratory therapy	37,902	0.3	7,439	19.6	30,463	80.4
228: Prophylactic vaccinations and inoculations	29,589	0.2	257	0.9	29,332	99.1
115: Circumcision	241	0.0	54	22.4	187	77.6
220: Ophthalmologic and otologic diagnosis and treatment	234	0.0	38	16.2	196	83.8
Source: Agency for Healthcare Research and Quality (AHRQ), Center for Delivery, Organization, and Markets, Healthcare Cost and Utilization Project, State Inpatient Databases, 2008, 15 states, community/non-rehabilitation/non-specialty hospitals for discharges age one year and older.						

APPENDIX C. DATA ELEMENTS IN THE NATIONWIDE READMISSIONS DATABASE

HCUP Variable Name	Description	NRD only	File	No. of States	Action for Combined Record
Variables in Multiple Files					
DISCWT_TXseparate	Discharge weight to target universe, includes transfer records separately	*	All, but Hosp	15	Sum across records.
DISCWT_TXcombined	Discharge weight to target universe, includes transfer records combined	*	All, but Hosp	15	Sum across records.
HOSPID	HCUP hospital number Assigned value		All	15	Assigned value from latter record in pair.
HOSPST	State postal code for the hospital (e.g., AZ for Arizona)		Core Hosp	15	Assigned value from latter record in pair.
IDNUMBER	AHA hospital identifier without the leading 6 (not available for all states)		Core Hosp	15	Assigned value from latter record in pair.
KEY	Unique record number for file beginning in 1998		All, but Hosp	15	Assigned new unique value.
NRD_ORIGINAL	Indicates original NRD record: (0) combined transfer record derived from multiple SID records, (1) original SID record	*	All, But Hosp	15	Assigned to 0 if record is original NRD record. Assigned to 1 if it is a combined transfer record.
NRD_STRATUM	Stratum for post-stratification based on geographic region, urban/rural location, teaching status, bed size, and control.	*	All	15	Assigned value from latter record in pair.
YEAR	Discharge year		Core Hosp	15	Assigned from latter record. Vlaue should be the same as first record.
Variable in the Core File					
AGE	Age in years at admission coded 0-124 years		Core	15	Assigned value from first in pair.
AGE_I	Age in years at admission coded 0-124 years, imputed	*	Core	15	Assigned value from first in pair.
AMONTH	Admission month coded from (1) January to (12) December		Core	15	Assigned value from first in pair.
ATYPE	Admission type, uniform coding: (1) emergency, (2) urgent, (3) elective, (4) newborn, (5) Delivery (coded in 1988-1997 data only), (5) trauma center beginning in 2003 data, (6) other		Core	14	Assigned value from first in pair.
AWEEKEND	Admission on weekend: (0) admission on Monday-Friday, (1) admission on Saturday-Sunday		Core	15	Assigned value from first in pair.
DAYSTOEVENT	Days from "start date" to admission		Core	15	Assigned value from first in pair.
DIED	Indicates in-hospital death: (0) did not die during hospitalization, (1) died during hospitalization		Core	15	Assigned value from latter record in pair.

HCUP Variable Name	Description	NRD only	File	No. of States	Action for Combined Record
DISPUNIFORM	Disposition of patient, uniform coding used beginning in 1998: (1) routine, (2) transfer to short term hospital, (5) other transfers, including skilled nursing facility, intermediate care, and another type of facility, (6) home health care, (7) against medical advice, (20) died in hospital, (99) discharged alive, destination unknown		Core	15	Assigned value from latter record in pair.
DQTR	Coded: (1) Jan - Mar, (2) Apr - Jun, (3) Jul - Sep, (4) Oct – Dec		Core	15	Assigned value from latter record in pair.
DRG	DRG in use on discharge date		Core	15	Assigned value from latter record in pair.
DRG_NoPOA	DRG in use on discharge date, assigned without POA		Core	15	Assigned value from latter record in pair.
DRG24	DRG Version 24 (effective October 2006 - September 2007)		Core	15	Assigned value from latter record in pair.
DRGVER	Grouper version in use on discharge date		Core	15	Assigned value from latter record in pair.
DX1-DX25	Diagnoses, principal and secondary (ICD-9-CM)		Core	15	Retained information in the array from the latter record as is. Added information from the first record to the end of the array. Maximum retained is 25 total.
DXCCS1-DXCCS25	CCS category for all diagnoses		Core	15	Retained information in the array from the latter record as is. Added information from the first record to the end of the array. Maximum retained is 25 total.
E_CCS1-E_CCS4	CCS category for all E codes		Core	15	Retained information in the array from the latter record as is. Added information from the first record to the end of the array. Maximum retained is 25 total.
ECODE1-ECODE4	External causes of injury codes (ICD-9-CM)		Core	15	Retained information in the array from the latter record as is. Added information from the first record to the end of the array. Maximum retained is 25 total.
ELECTIVE	Indicates elective admission: (1) elective, (0) non-elective admission		Core	15	Assigned value from first in pair.
FEMALE	Indicates gender: (0) male, (1) female		Core	15	Assigned value from latter record in pair.

HCUP Variable Name	Description	NRD only	File	No. of States	Action for Combined Record
HCUP_ED	Indicator that discharge record includes evidence of emergency department (ED) services: (0) Record does not meet any HCUP Emergency Department criteria, (1) Emergency Department revenue code on record, (2) Positive Emergency Department charge (when revenue center codes are not available), (3) Emergency Department CPT procedure code on record, (4) Admission source of ED, (5) State-defined ED record; no ED charges available		Core	15	Assigned to 0 if both records had value of 0; otherwise set to lowest non-zero value.
LOS	Length of stay, edited		Core	15	Sum across records. If either record missing information, set to missing.
MDC	MDC in use on discharge date		Core	15	Assigned value from latter record in pair.
MDC24	MDC Version 24 (effective October 2006 - September 2007)		Core	15	Assigned value from latter record in pair.
NCHRONIC	Number of chronic conditions on original record		Core	15	Sum across records.
NDX	Number of diagnoses coded on the original record		Core	15	Sum across records.
NECODE	Number of E codes coded on the original record beginning in 2003		Core	15	Sum across records.
NPR	Number of procedures coded on the original record		Core	15	Sum across records.
ORPROC	Major operating room procedure indicator		Core	15	Assigned to 1 if either record has value of 1; otherwise set to 0.
PAY1	Expected primary payer, uniform: (1) Medicare, (2) Medicaid, (3) private insurance, (4) self-pay, (5) no charge, (6) other		Core	15	Assigned value from latter record in pair.
PAY2	Expected secondary payer, uniform: (1) Medicare, (2) Medicaid, (3) private insurance, (4) self-pay, (5) no charge, (6) other		Core	10	Assigned value from latter record in pair.
PAYCAT	Payer category based hierarchical assignment using primary and secondary expected payer: (1) Medicare, (2) Medicaid, (3) private insurance, (4) uninsured, (9) other	*	Core	15	Assigned value from latter record in pair.
PL_NCHS2006	Patient Location: NCHS Urban-Rural Code (V2006). This is a six-category urban-rural classification scheme for U.S. counties: (1) "Central" counties of metro areas of >=1 million population,(2) "Fringe" counties of metro areas of >=1 million population,(3) Counties in metro areas of 250,000-999,999 population,(4) Counties in metro areas of 50,000-249,999 population,(5) Micropolitan counties,(6) Not metropolitan or micropolitan counties		Core	15	Assigned value from latter record in pair.
PL_UR_CAT4	Patient location: Urban-Rural 4 categories		Core	15	Assigned value from latter record in pair.

HCUP Variable Name	Description	NRD only	File	No. of States	Action for Combined Record
PR1-PR15	Procedures, principal and secondary (ICD-9-CM)		Core	15	Retained information in the array from the first record as is. Added information from the latter record to the end of the array. Maximum retained is 15 total.
PRCCS1-PRCCS15	CCS category for all procedures		Core	15	Retained information in the array from the first record as is. Added information from the latter record to the end of the array. Maximum retained is 15 total.
RACE	Race, uniform coding: (1) white, (2) black, (3) Hispanic, (4) Asian or Pacific Islander, (5) Native American, (6) other		Core	15	Assigned value from latter record in pair.
RESIDENT	Identifies patient as a resident of the state in which he or she received hospital care	*	Core	15	Assigned to 1 if either record has value of 1; otherwise set to 0.
SAMEDAYEVENT	Identifies transfer and same-day stay pairs records	*	Core	15	Set to interger value of character code for related records.
TOTCHG	Total charges, edited		Core	15	Sum across records. If either record missing information, set to missing.
TOTCOST	Total costs, derived from total charges and the HCUP cost-to-charge ratio		Core	15	Sum across records. If either record missing information, set to missing.
TRAN_IN	Identifies records transferred into the hospital		Core	15	Assigned value from first in pair.
VISITLINK	Visit linkage variable		Core	15	Assigned from latter record. Vlaue should be the same as first record.
ZIPINC_QRTL	Median household income national quartiles for patient's ZIP Code		Core	15	Assigned value from latter record in pair.
Variables in Core2 Files					
ASOURCE	Admission source, uniform coding: (1) ER, (2) another hospital, (3) another facility including long-term care, (4) court/law enforcement, (5) routine/birth/other		Core2	9	Assigned value from first in pair.
ASOURCE_X	Admission source, as received from data source using State-specific coding		Core2	9	Assigned value from first in pair.
ASOURCEUB92	Admission source (UB-92 standard coding)		Core2	8	Assigned value from first in pair.
DISP_X	Disposition of patient, as received from source		Core2	15	Assigned value from latter record in pair.
DISPUB04	Disposition of patient (UB-04 standard coding)		Core2	14	Assigned value from latter record in pair.
DSHOSPID	Hospital number as received from the data source		Core2	15	Assigned value from latter record in pair.

HCUP Variable Name	Description	NRD only	File	No. of States	Action for Combined Record
DXPOA1-DXPOA25	Indicator of diagnosis present on admission		Core2	10	Retained information in the array from the latter record as is. Added information from the first record to the end of the array. Maximum retained is 25 total.
E_POA1-E_POA4	Indicator of external cause of injury code present on admission		Core2	10	Retained information in the array from the latter record as is. Added information from the first record to the end of the array. Maximum retained is 25 total.
HCUP_OS	Indicator that discharge record includes evidence of observation services		Core2	15	Assigned to 0 if both records had value of 0; otherwise set to lowest non-zero value.
HISPANIC_X	Hispanis indicator, as received from source		Core2	9	Assigned value from latter record in pair.
LOS_X	Length of stay, as received from data source		Core2	15	Sum across records. If either record missing information, set to missing.
PAY1_X	Expected primary payer, as received from the data source		Core2	15	Assigned value from latter record in pair.
PAY2_X	Expected secondary payer, as received from the data source		Core2	10	Assigned value from latter record in pair.
PAY3_X	Expected tertiary payer, as received from the data source		Core2	9	Assigned value from latter record in pair.
POINTOFORIGIN_UB04	Point of origin for admission or visit, UB-04 standard coding.		Core2	13	Assigned value from first in pair.
POINTOFORIGIN_X	Point of origin for admission or visit, as received from source		Core2	13	Assigned value from first in pair.
PRDAY1-PRDAY15	Number of days from admission to procedures.		Core2	14	Retained information in the array from the first record as is. Added information from the latter record to the end of the array and adjust PRDAY value by LOS. For same-day stays involving more than two records, set to missing because off-set to PRDAY is too difficult. Maximum retained is 15 total.
PSTCO2	Patient state-county code		Core2	15	Assigned value from latter record in pair.
RACE_X	Race, as received from source		Core2	15	Assigned value from latter record in pair.
Variables in Data Development File					

HCUP Variable Name	Description	NRD only	File	No. of States	Action for Combined Record
ADATE	Admission date		Ddev	15	Assigned value from first in pair.
DDATE	Discharge date		Ddev	15	Assigned value from latter record in pair.
DOB	Date of birth		Ddev	14	Assigned value from latter record in pair.
MEDINC	Median household income of patient's ZIP Code		Ddev	15	Assigned value from latter record in pair.
PRDATE1-PRDATE15	Procedure dates		Ddev	13	Retained information in the array from the first record as is. Added information from the latter record to the end of the array. Maximum retained is 15 total.
ZIP	ZIP Code of the patient		Ddev	15	Assigned value from latter record in pair.
Variable in Diagnosis and Procedure Groups File					
CHRON1-CHRON25	Chronic Condition Indicators for all diagnoses		DX_PR_Grp	15	Retained information in the array from the latter record as is. Added information from the first record to the end of the array. Maximum retained is 25 total.
CHRONB1-CHRONB25	Chronic Condition Indicators – body system for all diagnoses		DX_PR_Grp	15	Retained information in the array from the latter record as is. Added information from the first record to the end of the array. Maximum retained is 25 total.
DXMCCS1-DXMCCS25	Multi-level CCS category for all diagnoses		DX_PR_Grp	15	Retained information in the array from the latter record as is. Added information from the first record to the end of the array. Maximum retained is 25 total.
E_MCCS1-E_MCCS4	Multi-level CCS category for all E codes		DX_PR_Grp	15	Retained information in the array from the latter record as is. Added information from the first record to the end of the array. Maximum retained is 25 total.
PCLASS1-PCLASS15	Procedure class for all procedures		DX_PR_Grp	15	Assigned value from latter record in pair.

HCUP Variable Name	Description	NRD only	File	No. of States	Action for Combined Record
PRMCCS1-PRMCCS15	Multi-level CCS category for all procedures		DX_PR_Grp	15	Retained information in the array from the first record as is. Added information from the latter record to the end of the array. Maximum retained is 15 total.
U_BLOOD	Utilization flag: Blood		DX_PR_Grp	10	Assigned to 1 if either record has value of 1; otherwise set to 0.
U_CATH	Utilization flag: Cardiac catheterization lab		DX_PR_Grp	10	Assigned to 1 if either record has value of 1; otherwise set to 0.
U_CCU	Utilization flag: Coronary care unit		DX_PR_Grp	10	Assigned to 1 if either record has value of 1; otherwise set to 0.
U_CHESTXRAY	Utilization flag: Chest x-ray		DX_PR_Grp	10	Assigned to 1 if either record has value of 1; otherwise set to 0.
U_CTSCAN	Utilization flag: Computed tomography scan		DX_PR_Grp	10	Assigned to 1 if either record has value of 1; otherwise set to 0.
U_DIALYSIS	Utilization flag: Dialysis		DX_PR_Grp	10	Assigned to 1 if either record has value of 1; otherwise set to 0.
U_ECHO	Utilization flag: Echocardiogram		DX_PR_Grp	10	Assigned to 1 if either record has value of 1; otherwise set to 0.
U_EEG	Utilization flag: Electroencephalogram		DX_PR_Grp	10	Assigned to 1 if either record has value of 1; otherwise set to 0.
U_EKG	Utilization flag: Electrocardiogram		DX_PR_Grp	10	Assigned to 1 if either record has value of 1; otherwise set to 0.
U_EPO	Utilization flag: Erythropoietin		DX_PR_Grp	10	Assigned to 1 if either record has value of 1; otherwise set to 0.
U_ICU	Utilization flag: Intensive care unit		DX_PR_Grp	10	Assigned to 1 if either record has value of 1; otherwise set to 0.
U_LITHOTRIPSY	Utilization flag: Lithotripsy		DX_PR_Grp	10	Assigned to 1 if either record has value of 1; otherwise set to 0.
U_MHSA	Utilization flag: Mental health and substance use		DX_PR_Grp	10	Assigned to 1 if either record has value of 1; otherwise set to 0.
U_MRT	Utilization flag: Magnetic resonance technology		DX_PR_Grp	10	Assigned to 1 if either record has value of 1; otherwise set to 0.
U_NUCMED	Utilization flag: Nuclear medicine		DX_PR_Grp	10	Assigned to 1 if either record has value of 1; otherwise set to 0.
U_OCCTHERAPY	Utilization flag: Occupational therapy		DX_PR_Grp	10	Assigned to 1 if either record has value of 1; otherwise set to 0.
U_ORGANACQ	Utilization flag: Organ acquisition		DX_PR_Grp	10	Assigned to 1 if either record has value of 1; otherwise set to 0.
U_OTHIMPLANTS	Utilization flag: Other implants		DX_PR_Grp	10	Assigned to 1 if either record has value of 1; otherwise set to 0.

HCUP Variable Name	Description	NRD only	File	No. of States	Action for Combined Record
U_PACEMAKER	Utilization flag: Pacemaker		DX_PR_Grp	10	Assigned to 1 if either record has value of 1; otherwise set to 0.
U_PHYTHERAPY	Utilization flag: Physical therapy		DX_PR_Grp	10	Assigned to 1 if either record has value of 1; otherwise set to 0.
U_RADTHERAPY	Utilization flag: Radiology		DX_PR_Grp	10	Assigned to 1 if either record has value of 1; otherwise set to 0.
U_RESPTHERAPY	Utilization flag: Respiratory therapy		DX_PR_Grp	10	Assigned to 1 if either record has value of 1; otherwise set to 0.
U_SPEECHTHERAPY	Utilization flag: Speech therapy		DX_PR_Grp	10	Assigned to 1 if either record has value of 1; otherwise set to 0.
U_STRESS	Utilization flag: Cardiac stress test		DX_PR_Grp	10	Assigned to 1 if either record has value of 1; otherwise set to 0.
U_ULTRASOUND	Utilization flag: Ultrasound		DX_PR_Grp	10	Assigned to 1 if either record has value of 1; otherwise set to 0.
Variables in Hospital File[20]					
DISCWT1_17	Discharge weight for ages 1 to 17, includes transfer records separately	*	Hosp	15	
DISCWT18_64	Discharge weight for ages 18 to 64, includes transfer records separately	*	Hosp	15	
DISCWT65_	Discharge weight for ages 65 and older, includes transfer records separately	*	Hosp	15	
HFIPSSTCO	Hospital FIPS state/county code		Hosp	15	
HL_UR_CAT4	Hospital urban/rural location		Hosp	15	
HOSP_BEDSIZE	Bed size of hospital (STRATA)		Hosp	15	
HOSP_BEDSIZE_ORIG	Bed size of hospital (original category)		Hosp	15	
HOSP_CONTROL	Control/ownership of hospital (STRATA)		Hosp	15	
HOSP_LPNFTEAPD	LPN FTEs per 1000 adjusted inpatient days		Hosp	15	
HOSP_MHSCLUSTER	Multi-hospital system cluster code: (1) centralized health system, (2) centralized physician/insurance health system, (3) moderately centralized health system, (4) decentralized health system, (5) independent hospital system, (6) unassigned		Hosp	15	
HOSP_MHSMEMBER	Multi-hospital system membership : (0) non-member, (1) member		Hosp	15	

[20] Because the unit of observation is the hospital and not a discharge in the Hospital file, data elements did not need to be combined for transfer records.

HCUP Variable Name	Description	NRD only	File	No. of States	Action for Combined Record
HOSP_NAFTEAPD	Nurse aides per 1000 adjusted inpatient days		Hosp	15	
HOSP_OPIPRatio	Ratio of outpatient revenues to inpatient revenues		Hosp	15	
HOSP_OPSURGPCT	Percentage of all surgeries performed in outpatient setting		Hosp	15	
HOSP_OccRate	Hospital occupancy rate		Hosp	15	
HOSP_REGION	Region of hospital: (1) Northeast, (2) Midwest, (3) South, (4) West		Hosp	15	
HOSP_RNFTEAPD	RN FTEs per 1000 adjusted inpatient days		Hosp	15	
HOSP_RNPCT	Percentage of RNs among all nurses (RNs and LPNs)		Hosp	15	
HOSP_TEACH	Teaching status of hospital: (0) non-teaching, (1) teaching		Hosp	15	
HOSP_UR_TEACH	Teaching status of hospital by location: (0) non-teaching metropolitan, (1) teaching metropolitan, (2) rural		Hosp	15	
H_CONTRL	Hospital ownership/control		Hosp	15	
HOSPADDR	Hospital address from AHA Annual Survey Database		Hosp	15	
HOSPCITY	Hospital city from AHA Annual Survey Database		Hosp	15	
HOSPNAME	Hospital name from AHA Annual Survey Database		Hosp	15	
HOSPSERV	AHA service code for hospital: (10) adult medical/surgical, (50) children's medicale/surgical		Hosp	15	
HOSPSTCO	Modified Federal Information Processing Standards (FIPS) State/county code for the hospital		Hosp	15	
HOSPZIP	Hospital ZIP Code from AHA Annual Survey Database		Hosp	15	
N_DISC_U	Number of AHA universe discharges in the NRD stratum, ages 1+		Hosp	15	
N_DISC1_17	Number of AHA universe discharges in the NRD stratum, ages 1-17		Hosp	15	
N_DISC18_64	Number of AHA universe discharges in the NRD stratum, ages 18-64		Hosp	15	
N_DISC65_	Number of AHA universe discharges in the NRD stratum, ages 65+		Hosp	15	
N_HOSP_U	Number of AHA Universe Hospitals in NRD_STRATUM		Hosp	15	
S_DISC_U	Number of NRD discharges in the NRD stratum, ages 1+		Hosp	15	
S_DISC1_17	Number of NRD discharges in the NRD stratum, ages 1-17		Hosp	15	
S_DISC18_64	Number of NRD discharges in the NRD stratum, ages 18-64		Hosp	15	
S_DISC65_	Number of NRD discharges in the NRD stratum, ages 65+		Hosp	15	

HCUP Variable Name	Description	NRD only	File	No. of States	Action for Combined Record
S_HOSP_U	Number of Sample Hospitals in NRD_STRATUM		Hosp	15	
TOTAL_DISC	Total discharges in the year		Hosp	15	
APRDRG	All Patient Refined DRG		Severity	15	Assigned value from latter record in pair.
APRDRG_Risk_Mortality	All Patient Refined DRG: Risk of Mortality Subclass: (0) No class specified,(1) Minor likelihood of dying,(2) Moderate likelihood of dying,(3) Major likelihood of dying,(4) Extreme likelihood of dying		Severity	15	Assigned value from latter record in pair.
APRDRG_Severity	All Patient Refined DRG: Severity of Illness Subclass : (0) No class specified,(1) Minor loss of function (includes cases with no comorbidity or complications),(2) Moderate loss of function,(3) Major loss of function,(4)Extreme loss of function		Severity	15	Assigned value from latter record in pair.
APSDRG	All-Payer Severity-adjusted DRG		Severity	15	Assigned value from latter record in pair.
APSDRG_Charge_Weight	All-Payer Severity-adjusted DRG: Charge Weight		Severity	15	Assigned value from latter record in pair.
APSDRG_LOS_Weight	All-Payer Severity-adjusted DRG: Length of Stay Weight		Severity	15	Assigned value from latter record in pair.
APSDRG_Mortality_ Weight	All-Payer Severity-adjusted DRG: Mortality Weight		Severity	15	Assigned value from latter record in pair.
CM_AIDS	AHRQ comorbidity measure: Acquired immune deficiency syndrome		Severity	15	Assigned to 1 if either record has value of 1; otherwise set to 0.
CM_ALCOHOL	AHRQ comorbidity measure: Alcohol abuse		Severity	15	Assigned to 1 if either record has value of 1; otherwise set to 0.
CM_ANEMDEF	AHRQ comorbidity measure: Deficiency anemias		Severity	15	Assigned to 1 if either record has value of 1; otherwise set to 0.
CM_ARTH	AHRQ comorbidity measure: Rheumatoid arthritis/collagen vascular diseases		Severity	15	Assigned to 1 if either record has value of 1; otherwise set to 0.
CM_BLDLOSS	AHRQ comorbidity measure: Chronic blood loss anemia		Severity	15	Assigned to 1 if either record has value of 1; otherwise set to 0.
CM_CHF	AHRQ comorbidity measure: Congestive heart failure		Severity	15	Assigned to 1 if either record has value of 1; otherwise set to 0.
CM_CHRNLUNG	AHRQ comorbidity measure: Chronic pulmonary disease		Severity	15	Assigned to 1 if either record has value of 1; otherwise set to 0.
CM_COAG	AHRQ comorbidity measure: Coagulopathy		Severity	15	Assigned to 1 if either record has value of 1; otherwise set to 0.

HCUP Variable Name	Description	NRD only	File	No. of States	Action for Combined Record
CM_DEPRESS	AHRQ comorbidity measure: Depression		Severity	15	Assigned to 1 if either record has value of 1; otherwise set to 0.
CM_DM	AHRQ comorbidity measure: Diabetes, uncomplicated		Severity	15	Assigned to 1 if either record has value of 1; otherwise set to 0.
CM_DMCX	AHRQ comorbidity measure: Diabetes with chronic complications		Severity	15	Assigned to 1 if either record has value of 1; otherwise set to 0.
CM_DRUG	AHRQ comorbidity measure: Drug abuse		Severity	15	Assigned to 1 if either record has value of 1; otherwise set to 0.
CM_HTN_C	AHRQ comorbidity measure: Hypertension, uncomplicated and complicated		Severity	15	Assigned to 1 if either record has value of 1; otherwise set to 0.
CM_HYPOTHY	AHRQ comorbidity measure: Hypothyroidism		Severity	15	Assigned to 1 if either record has value of 1; otherwise set to 0.
CM_LIVER	AHRQ comorbidity measure: Liver disease		Severity	15	Assigned to 1 if either record has value of 1; otherwise set to 0.
CM_LYMPH	AHRQ comorbidity measure: Lymphoma		Severity	15	Assigned to 1 if either record has value of 1; otherwise set to 0.
CM_LYTES	AHRQ comorbidity measure: Fluid and electrolyte disorders		Severity	15	Assigned to 1 if either record has value of 1; otherwise set to 0.
CM_METS	AHRQ comorbidity measure: Metastatic cancer		Severity	15	Assigned to 1 if either record has value of 1; otherwise set to 0.
CM_NEURO	AHRQ comorbidity measure: Other neurological disorders		Severity	15	Assigned to 1 if either record has value of 1; otherwise set to 0.
CM_OBESE	AHRQ comorbidity measure: Obesity		Severity	15	Assigned to 1 if either record has value of 1; otherwise set to 0.
CM_PARA	AHRQ comorbidity measure: Paralysis		Severity	15	Assigned to 1 if either record has value of 1; otherwise set to 0.
CM_PERIVASC	AHRQ comorbidity measure: Peripheral vascular disorders		Severity	15	Assigned to 1 if either record has value of 1; otherwise set to 0.
CM_PSYCH	AHRQ comorbidity measure: Psychoses		Severity	15	Assigned to 1 if either record has value of 1; otherwise set to 0.
CM_PULMCIRC	AHRQ comorbidity measure: Pulmonary circulation disorders		Severity	15	Assigned to 1 if either record has value of 1; otherwise set to 0.
CM_RENLFAIL	AHRQ comorbidity measure: Renal failure		Severity	15	Assigned to 1 if either record has value of 1; otherwise set to 0.
CM_TUMOR	AHRQ comorbidity measure: Solid tumor without metastasis		Severity	15	Assigned to 1 if either record has value of 1; otherwise set to 0.
CM_ULCER	AHRQ comorbidity measure: Peptic ulcer disease excluding bleeding		Severity	15	Assigned to 1 if either record has value of 1; otherwise set to 0.
CM_VALVE	AHRQ comorbidity measure: Valvular disease		Severity	15	Assigned to 1 if either record has value of 1; otherwise set to 0.

HCUP Variable Name	Description	NRD only	File	No. of States	Action for Combined Record
CM_WGHTLOSS	AHRQ comorbidity measure: Weight loss		Severity	15	Assigned to 1 if either record has value of 1; otherwise set to 0.
DS_DX_Category1	Disease Staging: Principal Disease Category		Severity	15	Set to missing.
DS_LOS_Level	Disease Staging: Length of Stay Level : (1) Very low (less than 5% of patients),(2) Low (5 - 25% of patients),(3) Medium (25 - 75% of patients),(4) High (75 - 95% of patients),(5) Very high (greater than 95% of patients)		Severity	15	Set to missing.
DS_LOS_Scale	Disease Staging: Length of Stay Scale		Severity	15	Set to missing.
DS_Mrt_Level	Disease Staging: Mortality Level: (0) Extremely low - excluded from percentile calculation (mortality probability less than .0001), (1) Very low (less than 5% of patients), (2) Low (5 - 25% of patients), (3) Medium (25 - 75% of patients), (4) High (75 - 95% of patients), (5) Very high (greater than 95% of patients)		Severity	15	Set to missing.
DS_Mrt_Scale	Disease Staging: Mortality Scale		Severity	15	Set to missing.
DS_RD_Level	Disease Staging: Resource Demand Level :(1) Very low (less than 5% of patients),(2) Low (5 - 25% of patients),(3) Medium (25 - 75% of patients),(4) High (75 - 95% of patients),(5) Very high (greater than 95% of patients)		Severity	15	Set to missing.
DS_RD_Scale	Disease Staging: Resource Demand Scale		Severity	15	Set to missing.
DS_Stage1	Disease Staging: Stage of Principal Disease Category		Severity	15	Set to missing.

APPENDIX D. COMPARATIVE DATA SOURCES

The tables below detail the identified sources of reliable estimates of readmissions. Information is provided on the data source, population of interest, included hospitals, handling of transfers, and definitions of index events, readmissions, and readmission rates.

Data Source	**HCUP Nationwide Readmissions Database (NRD)**
Population	Patients ages one and older, regardless of insurance coverage. Includes Medicare, Medicaid, privately insured, uninsured and other payers.
Hospitals	Community, non-rehabilitation, non-specialty hospitals.
Transfers	Rates calculated two ways: (1) If a patient was transferred to a different hospital on the same day or was transferred within the same hospital, the two events were combined as a single stay and the second event was not counted as a readmission. (DISCWT_TXcombined was used.) (2) Transfer and same-day-event records were kept separate. The second event can be counted as a readmsission. (DISCWT_TXseperate was used.)
Index Events	(1) Admission occurred between January 1 and November 30 of 2008 (1 <= AMONTH < 11). (2) Discharged alive (DIED=0). (3) Patient may be a non-resident of the state (Any value of RESIDENT). (4) An individual patient could have multiple index events during the 11 months, if they were at least 30 days apart. (5) No "clean" period was required (i.e., we did not require a certain time frame prior to an index event that had no hospital stays).
Readmissions	Readmissions were discharged between January 1 and December 31 of 2008. The following types of readmissions were identified within 30 days following an index event. No more than one readmission was counted. For CCS diagnoses, we examined three types of readmissions: readmissions with the same CCS as principal diagnosis, with the same CCS in any diagnosis field, and for any condition (all-cause readmission). For CCS procedures, we examined readmission for any condition (all-cause readmission). For DRGs, we examined two types of readmissions: readmission with the same DRG and with any DRG (all-cause readmission). For MDCs, we examined two types of readmissions: readmission with the same MDC and with any MDC (all-cause readmission).
Readmission rates	A 30-day readmission rate was defined as the *"percent of patients who were readmitted"* within 30 days of an index event. Numerator: Total number of index events that had at least one subsequent hospital admission within 30 days. Denominator: Total number of index events between January and November 2008. Rates are not risk adjusted. See Appendix E for rates.

Benchmark	**Jencks (NEJM 2009)**[21]
Data Source	MEDPAR file for October 1, 2003 through December 31, 2004.
Population	Medicare FFS beneficiaries.
Hospitals	Acute care hospitals. Excludes critical access hospitals (N=855).
Transfers	See below.
Index Events	(1) Admitted between October 2003 and December 2003. (2) Discharged alive. (3) Excludes same-day transfers to other acute care hospitals, e.g., specialty units, rehab facilities, long-term care hospitals.
Readmissions	For readmission rate, count only on rehospitalization within 30 days per discharge. Readmission can occur at any acute care hospital. Includes same-day rehospitalizations except same-day transfers to other acute care hospitals, e.g., specialty units, rehab facilities, long-term care hospitals. Excludes patients rehospitalized for rehab (DRG 462) within 30 days.
Readmission rates	Rate = Number of patients readmitted within 30/60/90/180/365 days, divided by number of people discharged (per definitions above). Readmission rates are retrospectively calculated for top 5 medical and top 5 surgical DRGs on index discharge, based on number of readmissions. No direct risk adjustment. Supplementary appendix describes for method of estimating fraction of rehospitalizations that might have been planned. 30 day rate: 19.6% overall, 21% all medical, 15.6 all surgical, see article for rates by top DRG

[21] Jencks SF, Williams MV, Coleman EA. *Rehospitalizations among patients in the Medicare Fee-for-Service program*. NEJM 2009; 360:1418-1428.

Benchmark	**MedPAC (Report to Congress, June 2008)[22]**
Data Source	2005 Medicare Provider Analysis and Review file.
Population	Medicare beneficiaries.
Hospitals	Not specified.
Transfers	People transferred from one hospital to another are not considered readmissions.
Index Events	(1) Acute care stay. (2) Discharged alive. (3) People transferred to another acute care hospital.
Readmissions	Readmission to an acute care hospital, either the same or a different hospital than index within specified time period. Readmissions included those that may have been unrelated to the initial diagnosis.
Readmission rates	30-day rate: 17.6% (31.6% for ESRD and 16.9% for non-ESRD) 15 day rates also provided for each of 7 conditions comprising 30 percent of spending on readmissions.

[22] *Medicare Payment Advisory Commission's June 2008 Report to the Congress: Reforming the Delivery System.* ONLINE June 2008. Available: http://www.medpac.gov/documents/Jun08_EntireReport.pdf. Accessed September 9, 2011.

Benchmark	The Commonwealth Fund[23]
Data Source	Hospital Compare, reporting period Q3 2006 through Q2 2009. Data for other time periods may be accessible directly through Hospital Compare.
Population	Medicare FFS beneficiaries age 65 or older.
Hospitals	Not specified.
Transfers	See below.
Index Events	(1) Principal diagnosis of heart attack, except if discharged alive on same day as admitted. Principal diagnosis of heart failure. Principal diagnosis of pneumonia. (2) Discharged alive. (3) Discharged only to non-acute care setting. (4) Excludes transfer to another acute care facility. (5) Excludes patients discharged against medical advice and those without at least 30 days post-discharge enrollment in FFS Medicare. Also requires a complete claims history for 12 months prior to admission. (6) No admissions within 30 days of discharge from index are considered additional index admissions.
Readmissions	Readmission can be for any cause. Readmissions to hospital-owned rehabilitation and psychiatric facilities are not counted as readmissions to acute care hospitals. For AMI, some planned procedures (e.g., nonemergent hospitalizations for PTCA and CABG) and other admissions not counted as readmissions. For HF and pneumonia: Additional HF and pneumonia admissions within 30 days of discharge from an index admission are considered potential readmissions, not index admissions. That is, any admission for condition of interest is either an index admission or a potential readmission, but not both. For AMI: only one additional AMI admission within 30 days of discharge from index is counted as readmission.
Readmission rates	Risk-standardized readmission rates (RSRRs) are estimated for each hospital. This is calculated as the ratio of predicted to expected readmissions, multiplied by the national unadjusted rate. The numerator of the ratio is the predicted number of readmissions for each hospital within 30 days given the hospital's performance with its observed case mix. 30 day rate for AMI: 19.97% 30 day rate for HF: 24.73% 30 day rate for pneumonia: 18.34% Range for various distributions (e.g., by state, by decile) may be available directly from WhyNotTheBest.org

[23] *Why Not The Best. A Health Care Quality Improvement Resource*. ONLINE. Available: http://whynotthebest.org/. Accessed December 14, 2010.

Benchmark	**Lindenauer (J Hosp Med 2010)[24]**
Data Source	Acute care hospital inpatient claims.
Population	Medicare FFS beneficiaries age 65 and older.
Hospitals	Nonfederal acute care hospitals in US and organized territories.
Transfers	For transfers to or from another acute care facility, responsibility for readmission is assigned to the hospital that ultimately discharges patient to non-acute setting (e.g., home or SNF).
Index Events	(1) Between July 2006 and June 2009. (2) Principal diagnosis of pneumonia (ICD-9-CM codes 480.X, 481, 482.XX, 483.X, 485, 486, and 487.0). (3) Excludes patients where pneumonia is a secondary DX, those discharged against medical advice, or if administrative records (for 1 year before and 30 days after discharge) are not available or are incomplete. (4) Admissions counted as readmissions (i.e., those that occur within 30 days of discharge for pneumonia) are not also treated as index hospitalizations.
Readmissions	Readmission for any cause within 30 days of discharge.
Readmission rates	Hospital-specific readmission rates are calculated as the ratio of predicted-to-expected events, multiplied by the national unadjusted rate, a form of indirect standardization. Comorbidities from index admission are not included in the model unless documented in 12 months prior to admission. 30 day rate: 18.3% overall, ranging from 13.6 to 26.7% at hospital level Rate variation across hospital referral regions also provided

[24] Lindenauer PK, Bernheim SM, Grady JN, Lin Z, Wang Y, Wang Y, Merrill AR, Han LF, Rapp MT, Drye EE, Normand SL, Krumholz HM. *The performance of US hospitals as reflected in risk-standardized 30-day mortality and readmission rates for Medicare beneficiaries with pneumonia.* J Hosp Med. 2010 Jul-Aug;5(6):E12-8.

Benchmark	**Krumholz (Circulation 2009)[25]**
Data Source	Medicare administrative claims and enrollment data.
Population	Medicare FFS beneficiaries age 65 and older.
Hospitals	Short-term acute and critical access non-federal hospitals.
Transfers	For transfers to or from another facility, responsibility for readmission is assigned to the hospital that ultimately discharges patient to non-acute setting (e.g., home or SNF).
Index Events	(1) Between July 2005 and June 2008. (2) Primary diagnosis of AMI, primary diagnosis of heart failure. (3) Discharged alive. (4) Excluded patients not in FFS for 1 year before admission or who were discharged against medical advice. (5) An admission counted as an outcome was not defined as another index hospitalization.
Readmissions	Readmission for any cause within 30 days of discharge. Some planned procedures (e.g., nonemergent hospitalizations for PTCA and CABG) and other admissions not counted for AMI; see more detailed supplements. Readmission can occur to any acute care hospital caring for Medicare patients.
Readmission rates	Risk-standardized readmission rates (RSRRs) are estimated for each hospital. Median 30 day rate for AMI: 19.9% (ranging from 15.3 to 29.4% at hospital level) Median 30 day rate for HF: 24.4% (ranging from 15.9 to 34.4% at hospital level) Rate variation by hospital characteristics and by hospital referral regions also provided.

[25] Krumholz HM, Merrill AR, Schone EM, Schreiner GC, Chen J, Bradley EH, Wang Y, Wang Y, Lin Z, Straube BM, Rapp MT, Normand SL, Drye EE. *Patterns of hospital performance in acute myocardial infarction and heart failure 30-day mortality and readmission*. Circ Cardiovasc Qual Outcomes. 2009 Sep;2(5):407-13. Epub 2009 Jul 9.

Benchmark	**Berry (JAMA 2011)[26]**
Data Source	Pediatric Health Information System, an administrative database containing combined hospitalization data from 37 tertiary care pediatric hospitals in US. Data maintained through CHCA and Thomson Reuters.
Population	317,643 patients of all ages admitted in 2003.
Hospitals	37 free-standing children's hospitals (as designated by NACHRI) that are members of Child Health Corporate of America (a business alliance of noncompeting children's hospitals).
Transfers	Not specified.
Index Events	(1) Calendar years 2003 through 2008. (2) Patients with at least one admission. (3) Excludes admissions associated with use of primary inpatient rehab, psychiatry or psychological service, normal newborn and obstetric care, and chemotherapy hospitalizations. (4) Excludes patient if all of their admissions are these types.
Readmissions	Rehospitalization within any 365 day interval within follow up period through 2008 (main outcome measure is max number of readmissions). Readmission to the same hospital as index.
Readmission rates	365 day rate: 21.8% experienced at least one readmission

[26] Berry JG, Hall DE, Kuo DZ, Cohen E, Agrawal R, Feudtner C, Hall M, Kueser J, Kaplan W, Neff J. *Hospital utilization and characteristics of patients experiencing recurrent readmissions within children's hospitals*. JAMA. 2011 Feb 16;305(7):682-90.

Benchmark	**Feudtner (Pediatrics 2009)[27]**
Data Source	Hospital administrative data collected for 2003 through 2005 via Pediatric Health Information System.
Population	186,856 patients age 2 to 18 years.
Hospitals	38 not-for-profit free-standing children's hospitals in the U.S.
Transfers	Not specified.
Index Events	(1) Calendar year 2004. (2) Discharged alive.
Readmissions	Readmission to the hospital within 365 days from index. Readmission to the same hospital as index.
Readmission rates	365 day rate: 16.7%

[27] Feudtner C, Levin JE, Srivastava R, Goodman DM, Slonim AD, Sharma V, Shah SS, Pati S, Fargason C Jr, Hall M. *How well can hospital readmission be predicted in a cohort of hospitalized children? A retrospective, multicenter study*. Pediatrics. 2009 Jan;123(1):286-93.

Benchmark	Feudtner (J Pediatrics 2010)[28] -- based on abstract only
Data Source	Not identified.
Population	197,744 patients age 2 to 18 years.
Hospitals	39 children's hospitals located in 24 states in the U.S.
Transfers	Calendar year 2005.
Index Events	Not specified.
Readmissions	Readmission within 365 days from index discharge. Readmission to the same hospital as index.
Readmission rates	365 day rate: 16.3% State-level variation in rates may be available in full article

[28] Feudtner C, Carroll KW, Hexem KR, Silberman J, Kang TI, Kazak AE. Parental hopeful patterns of thinking, emotions, and pediatric palliative care decision making: a prospective cohort study. Arch Pediatr Adolesc Med. 2010 Sep;164(9):831-9.

APPENDIX E. NRD WEIGHTED AND UNWEIGHTED READMISSION RATES

<Table shells in Excel.>