SPARCS Documentation File

July 25, 2014

I. Contents

I. SPARCS Data Files and Documentation

Data Format & Documentation

To date, SPARCS has provided inpatient data for the years 1982 to 2011.

Original Documentation
Note that the years received after July 2012 (all files except for 1995-2009) are formatted differently than earlier years. Links to both formats can be found at www.health.ny.gov/statistics/sparcs/data_distribution.htm:

OLD FORMAT
Inpatient: www.health.state.ny.us/statistics/sparcs/inpat.htm
NEW FORMAT
Inpatient: www.health.ny.gov/statistics/sparcs/sysdoc/inpatientoutputdd.pdf

General Information

Unique Individual Identifier
Beginning in 1995, SPARCS contains a variable that uniquely identifies individuals in the data, "Encrypted Enhanced Unique Personal Identifier" (ENC_ENH_UPID). According to the SPARCS data dictionaries, Enhanced UPID is "a composite field composed of portions of the patient's last name, first name, social security number, the patient's date of birth, and the sex of the patient, as recorded on the date of the admission or start of care. This field is designed to enhance matching

criteria for individual patient records for longitudinal analysis without compromising the confidentiality of the record." The encrypted version of this variable, to which we have access, allows for similar longitudinal identification. See page 48 of the SPARCS inpatient data dictionary for further details about the construction of the Enhanced UPID variable.

Pre-1995 Files

While we have access to inpatient files from 1982 through 2011, only the 1995-2011 files are useable as part of our working dataset. This is because there is no longitudinal individual identifier in the data prior to 1995. This identifier, ENC_ENHANCED_UPID, only appears beginning in 1995. As John Piddock explains, "Because of the limited number of identifiers in the 1982-1994 group, you'll need to use the PFI, Medical Record Number and the calculated 'difference between discharge year and age'[to longitudinally link individuals]. Keep in mind that this will only link those seen at the same hospital."

Continuation Records

As described in Appendix ZZ of the SPARCS Data Dictionary (http://www.health.ny.gov/statistics/sparcs/sysdoc/appz2.htm), continuation records are the secondary records of multiple record discharges: "Extensive services provided during a hospitalization may result in multiple discharge records being created for a single patient stay. The extra records, referred to as "continuation records", are needed when there is more accommodation, ancillary or non-acute care information for the patient than will fit on a single discharge record."

The continuation records in the "new format" files (those received after July 2012) are structured differently than the continuation records for "old format" files. The "new format" continuation records repeat only the variables used to identify the hospital visit (discharge number, record sequence number, record sequence count). Due to this different formatting, they are read in using SAS, and stored in a separate .dta file (**inpatientcontCCYY.dta** contains the continuation records for **inpatientCCYY.dta**). In contrast, the "old format" continuation records contain all of the same variables as the primary record, uniquely populating only the ancillary and acute care fields. In both cases, it is necessary to deal carefully with continuation records. As we do not make use of the extra ancillary and acute care information contained within these records, they are excluded from the **inpatientsmallCCYY.dta** files, and all subsequent files.

Small Inpatient Data Files

Smaller versions of the original files were also created. These files contain only the most crucial variables, and exclude observations with AIDS and abortion flags. They also exclude continuation records. The small files also include charges as a dollar amount, rather than an integer (the raw data does not include decimal points, and thus must be divided by 100 to yield dollar values). All years of the small files use the variable names from the "old format" years (1995-99), and "new format" variable names have been modified accordingly.

The resulting files for all years are stored in the same directory as the full data files:

Year	File Name	Observations	**Unique Patient IDs** (ENC_ENHANCED_UPID in this Original File)
1995	inpatientsmall1995	2,429,442	1,846,700
1996	inpatientsmall1996	2,417,691	1,812,861
1997	inpatientsmall1997	2,376,853	1,768,733
1998	inpatientsmall1998	2,382,061	1,761,642
1999	inpatientsmall1999	2,397,847	1,764,438
2000	inpatientsmall2000	2,458,197	1,795,120
2001	inpatientsmall2001	2,469,717	1,798,177
2002	inpatientsmall2002	2,502,112	1,806,988
2003	inpatientsmall2003	2,564,025	1,835,240
2004	inpatientsmall2004	2,594,186	1,842,277
2005	inpatientsmall2005	2,579,337	1,829,693
2006	inpatientsmall2006	2,594,156	1,838,574
2007	inpatientsmall2007	2,574,554	1,821,967
2008	inpatientsmall2008	2,592,001	1,825,732
2009	inpatientsmall2009	2,602,535	1,836,591
2010	inpatientsmall2010	2,568,800	1,815,022
2011	inpatientsmall2011	2,531,382	1,791,456

All of the tables above are created using the log file generated by **inpatientdescribe.do**, **outpatientdescribe.do** and **inoutdescribe.do**.

II. Applying Cost-Charge Ratios

Hospital charge variables are deflated by the cost-charge ratio (costs/charges) for a given hospital. This process is implemented at the individual-visit-year level, before the data is collapsed, because each hospital uses a different ratio.

Following CMS advice, the raw cost-to-charge ratio was trimmed by replacing the top and bottom 5 percent of the raw cost-to-charge ratio with the median cost to charge ratio for that year.

Cost Charge Ratio Data

We use two sources of HCRIS cost-charge ratio (CCR) data. The primary source is the HCRIS files available at the NBER indicated in the do file **ccr_jroth.do**. We rely on Jean's code to compile the files and calculate raw CCR, and a modified version of Joe Doyle's code to calculate adjusted ratios from this data. The resulting dataset is **hcrisfy1995_2011.dta**. This dataset links CCRs to Medicare Provider Numbers.

hcrisfy1995_2011.dta					
Variable	**Obs**	**Mean**	**Std. Dev**	**Min**	**Max**
provider	0				
fybegin	110,332	15915.75	1670.134	13057	18900
fyend	110,332	15612.53	5279.353	-21548	19266
year	116,554	2002.958	4.829767	1995	2011
ccr	116,554	0.466802	0.1296366	0.1835379	0.9277433
mdccr	116,554	0.4593308	0.0858099	0.3297621	0.6268804
ccr_raw	56,413	1.318416	17.50843	1.46E-08	2759.782

The secondary source is a dataset also created by Joe Doyle, **ccr_aha_id2.dta**, which links CCR to American Hospital Association ID (AHA ID) for the years 2002-2008.

Accordingly, we currently have access to CCR values for the years 1995-2011. Both sources of CCR data take the raw information from HCRIS, and both calculate CCR in the same way, per the CMS recommendation: the raw CCR value from the HCRIS data is calculated. Then, the top 5% and bottom 5% of CCR values are replaced with the median CCR for the year. Both sources contain CCRs for hospitals across the country.

Linking CCR Data to SPARCS Data

As noted above, the cost-charge ratio datasets identify hospitals in two ways: CMS Provider Number[1] and AHA ID. The provider numbers are 6 digit numeric codes beginning with "33" for hospitals in the state of New York. AHA IDs are 7 digit numeric codes beginning with "621" for New York hospitals. The two different sources of CCR data must be linked to SPARCS using these two different ID types.

CMS Provider Number
The SPARCS data contains a variable called PROVIDER_ID_NUM, which is missing 12% of the time on average (ranging 0%-17% for any given year). The variable takes the form of a viable New York CMS provider number about 32% of the time. We make the initial assumption that when observations successfully merge with the HCRIS CCR data using PROVIDER_ID_NUM as the provider number *and* the PROVIDER_ID_NUM begins with "33", the number can be trusted as the correct CMS provider number. The latter criterion is necessary because occasionally the PROVIDER_ID_NUM takes the form of an Aetna or other insurance provider ID that is six digits long, but does not begin with "33". In these cases, the merge will be successful because the using dataset contains hospitals provider numbers from across the country, resulting in false positives.

AHA Identifier
Sam Kleiner provided a PFI to AHA ID crosswalk for the years 2000 to 2006 in the form of an excel file, /inpatientdata/**aha_to_pfi.csv**. We merge this file onto the data file containing CCR by AHA ID, /inpatientdata/**ccr_aha_id2**.dta. We assume that where the merge is successful, the AHA ID number is correct, even in the case of the years 2007 and 2008. We retain only successfully merged observations. This yields the file /inpatientdata/**ccraha2002_2008.dta.** This file may be used to directly link SPARCS data for the years 2002-2008 to CCRs.

It is important to note that only the Provider ID data source includes fiscal year beginning and end dates for the hospitals. The lack of these dates may undermine the AHA ID file as a useful source of CCRs. In some years, the AHA ID file appears somewhat unnecessary, as it only provides CCRs to an average of about 200,000 observations between 2002 and 2007. However, in 2008 the quality of the provider IDs in SPARCS diminishes significantly, and the AHA ID file provides over 1 million matches.

The two files often offer different CCRs for the same provider. We currently prioritize the Provider ID match, as this ID is present in the SPARCS data itself. However, there is no method of verifying that the ID in the SPARCS data is correct, only that it is in the correct format. Conversely, the AHA ID – PFI crosswalk provided by Sam Kleiner appeals because it prescribes exactly one match per PFI, an element that we know to be correct in the data, but it is impossible to review Sam's methodology for assembling the crosswalk.

Linking CCR Data to SPARCS with Both CMS Provider Number and AHA ID
Bearing in mind the steps and assumptions made above, our approach to linking cost charge ratios to the SPARCS data takes the following form:

[1] The OSCAR CMS Provider Number/ID was renamed the CMS Certification Number in 2007. These terms are all used interchangeably in this document.

First, we merge SPARCS to the two CCR files, giving preference to the provider number-HCRIS data:

1. We merge the CCR file **hcrisfy1995_2011.dta** to the SPARCS data based on year and provider number (*PROVIDER_ID_NUM*).
2. We ignore matches where the provider number does not begin with "33" and is not six digits long.
3. For only the years 2002 to 2008, we merge the SPARCS data to **ccraha2002_2008.dta** based on year and provider number. It is important to note that the CCR value offered by this file sometimes differs from the value provided by **hcrisfy1995_2011.dta.** Currently, the AHA value is ignored if it diverges.

Next, we apply the CCR values identified by the successful merges to all other observations in a given year that share the same PFI:

4. We check for instances where there is more than one CCR for a given PFI and year. In these cases, we consider the list of viable provider numbers associated with the PFI-year. We select the most frequently appearing one, and assign that provider number to all PFIs in that year.
5. We generate a variable, *ccrpfi* that is equal to the maximum CCR for a given year and PFI, effectively applying the CCR value associated with a given PFI and year to all other observations with the same PFI-year.

We then identify PFIs that have not yet been assigned a CCR. In these cases, we search for the provider number associated with the PFI. We use both the original HCRIS files and other years of SPARCS data to identify these PFI-provider number matches.

6. We build county names on to the SPARCS data using the crosswalk in "Appendix F" (http://www.health.ny.gov/statistics/sparcs/sysdoc/appf.htm). This allows for easy confirmation that hospitals in SPARCS correspond to the same counties as hospitals in HCRIS.
7. We then search for provider IDs for the PFIs with no CCR match, using the file **hcrisproviderlist.dta**, a compilation of HCRIS files for the years 1995-2011. We search by keyword and county using the do file **findproviderids.do.** The results are then converted into a PFI-provider crosswalk using **foundproviderids.do.** Because the same PFI never yields different provider IDs in this dataset, even across years, this crosswalk is general, rather than year-specific. We merge the crosswalk onto the SPARCS files, creating a new provider ID variable.
8. The years 2008-2011 yield significantly fewer natural matches between SPARCS and the CCR datasets. Accordingly, for these years we create an additional PFI to Provider ID crosswalk, based on natural matches occurring in the SPARCS data for the years 2005-2007. The crosswalk excludes all PFI-provider matches that do not agree across years. It is merged onto the SPARCS data for the relevant years. This crosswalk is secondary to the crosswalk created in step 7.
9. After these crosswalks are added, the SPARCS data is then merged again with **hcrisfy1995_2011.dta**, and missing CCRs are updated.
10. The variable *ccrpfi*, created in step 5, is then updated, taking into account the newly merged CCR values.

In some instances, it is not possible to determine a Provider ID match for a hospital in a given year. In these cases, we apply an average CCR and assume calendar year dates.

11. Because county is never missing in the SPARCS data, in cases where a CCR match cannot be found, the average annual CCR for the county is used. The county average was calculated using the New York state observations in the file **hcrisfy1995_2011.dta**, merged with the county information in the HCRIS files (which are condensed in the file **hcrisproviderlist.dta** using the eponymous do file). The HCRIS file with county identifiers is not available

for 1995, so the 1996 file is used to make provider-county matches. Observations in **hcrisfy1995_2011.dta** for which a county match cannot be found are ignored. This occurs with varying frequency in different years, as follows:

year	Freq.	Percent	Cum.
1995	43	21.29	21.29
1996	30	14.85	36.14
1997	32	15.84	51.98
1998	21	10.40	62.38
1999	11	5.45	67.82
2000	7	3.47	71.29
2001	11	5.45	76.73
2002	12	5.94	82.67
2003	11	5.45	88.12
2004	4	1.98	90.10
2005	7	3.47	93.56
2006	1	0.50	94.06
2007	1	0.50	94.55
2008	1	0.50	95.05
2009	2	0.99	96.04
2010	3	1.49	97.52
2011	5	2.48	100.00
Total	202	100.00	

Though the fiscal years of each hospital do not precisely align with calendar years (86% of records indicate a fiscal year start date of January 1), we equate fiscal year with calendar year for the purpose of calculating this average.

12. In several years, some counties are lacking any observations, meaning that a county average cannot be calculated for these county-years. In these cases, the annual New York State average CCR is used. There are 15 instances of missing counties for the 17 years of data.

SUMMARY OF CCR MATCHES GENERATED

Year	**Total Obs.**	**CCRs Generated by CMS (#)**	**CCRs Generated by AHA (#)**	**CCRs Generated by CMS Using SPARCS/HCRIS Crosswalks (#)**	**CCRs Generated Using County/State Avg. (#)**
1995	2,429,442	2,115,936	0	55,476	258,030
1996	2,417,691	2,092,333	0	55,566	269,792
1997	2,376,853	2,164,921	0	55,149	156,783
1998	2,382,061	2,303,068	0	77,376	1,617
1999	2,397,847	2,317,715	0	75,826	4,306
2000	2,458,197	2,349,690	0	85,118	23,389
2001	2,469,717	2,370,919	0	85,419	13,379
2002	2,502,112	2,394,544	62,289	43,958	1,321
2003	2,564,025	2,473,677	46,729	41,778	1,841
2004	2,594,186	2,466,940	81,177	44,077	1,992
2005	2,579,337	2,385,950	141,806	45,590	5,991
2006	2,594,156	2,423,368	120,666	45,473	4,649
2007	2,574,554	2,057,671	413,511	91,392	11,980
2008	2,592,001	794,831	1,433,616	355,687	7,867
2009	2,602,535	784,515	0	1,725,028	92,992
2010	2,568,800	764,752	0	1,704,005	100,043
2011	2,531,382	729,407	0	1,701,483	100,492

13. After a CCR has been identified for every observation based on calendar year, it is then necessary to create an effective CCR for each observation, which takes into account the discharge date of the observation, as well as the fiscal year for which the CCR is applicable. If the discharge date falls

within the range of the hospital's fiscal year, the CCR for that year is retained. If not, the CCR for the correct fiscal year (the prior or subsequent fiscal year) is applied. This results in a complete CCR variable **effccrpfi**, which is the "effective CCR, assigned based on PFI". This effective CCR is further adjusted to reflect 2012 dollars, using the Urban Consumer Price Index (CPI-U). The inflation-adjusted effective CCR is applied to all charge variables, generating associated cost variables. There are a small number of observations (192 in 1995 and 25 in 1996) for which TOTAL_CHARGES is equal to zero. We replace these with the minimum non-zero charge ($0.01) so that the charge variable can be used to count number of visits. It is important to note that TOTAL_NC_CHARGES is a subset of TOTAL_CHARGES. DO NOT ADD THEM TOGETHER:

New Cost Variable	Definition
costs	TOTAL_CHARGES* inflationadjccr
totalnotcovcosts	TOTAL_NC_CHARGES* inflationadjccr

Lastly, all discharges for individuals residing outside of New York are dropped, and a set of key variables (costs, visits, length of stay, and "age in 1995") are created. Note that calculated length of stay differs from the LOS variable, as it ignores leave of absence days. Also, "age in 1995" is bounded at 100, a cap that affects 3537 discharges. The construction of the "age in 1995" variable is a bit complex, and is discussed in more depth on page 12 in Section IV. This entirety of this process is completed using the do file **inpatientapplyccr.do.** It results in a file data file **inpatientsmallfyccr1995_2011.dta.**

III. Merging SPARCS with NVS Mortality Data

Sources of Mortality Data

We identify deaths within the SPARCS inpatient files using two sources of information. First, we make use of the PATIENT_DISPOSITION variable within the SPARCS files, which indicates a patient's condition upon discharge. Deaths in the hospital are indicated using this variable. We also make use of vital statistics data to identify deaths outside of the hospital. This vital statistics information is available in a separate file for the years 1995-2009, and as an additional set of variables (DOD_DT indicates date of death and D32A indicates cause) within the SPARCS data for the years 2010-2011. We allow the death indicators contained in the PATIENT_DISPOSITION variable to supersede the vital statistics data. We selected this hierarchy because we consider the NVS death information to be potentially fallible, as the "fuzzy" matching algorithm used to link SPARCS and death data allows for incorrect matches between individuals to be generated by the process.

SPARCS "Patient Disposition" Death Indicators
For all years of SPARCS data, the variable Patient Disposition or Patient Status indicates the state of the patient at time of discharge. If a patient dies during a visit, the disposition/status code indicates the death, and the date of discharge is understood to be the date of death. The following codes indicate a death. They are all taken to mean a death in the hospital:

Code	Definition	Frequency (1995-2011)
20	Expired (or did not recover - Christian Science patient)	1,064,131
40	Expired at Home	1
41	Expired in a Medical Facility (e.g. hospital, SNF, ICF, or free standing hospice)	60

	USAGE NOTE: Codes 40 and 41 are for use only on Medicare and TRICARE claims for hospice care.	
42	Expired - Place Unknown USAGE NOTE: For use only on Medicare and TRICARE claims for hospice care.	0

In the years 1995-2011, a total of 1,064,192 individual deaths codes are observed.

New York Vital Statistics Data
Through data obtained from the Vital Statistics Department of the State of New York (referred to in this document and related code as Vital Statistics or NVS), we are able to match the unique identifier from the SPARCS data and observe the date when an individual who has appeared in SPARCS dies. A probabilistic matching method was used in order to match the unique identifier in SPARCS to the Vital Statistics records.

The matching process was undertaken by Larry D. Schoen at the Department of Health, and in some older documentation the records from this source are identified as "Larry's" mortality data.

The mortality matching for the years 1995-2009 was done in two steps. First, we created a dataset containing the last discharge record for every individual observed in the 1995-2009 SPARCS files, who was not shown to have died in the hospital. The NY Department of Health then matched mortality data to this reduced dataset, and created a set of mortality files for these years, located at /disk/agedisk3/sparcs.kowalski/data/ORIG/20121108/extracted/stata/finalinYYn.dta.

The mortality data for the years 2010-2011 was included in the SPARCS files by the NY Department of Health. The date and cause of death for records from these years is stored in the variables DOD_DT (date of death) and D32A (cause of death).

Inaccurate Death Dates

We have observed several instances where either the PATIENT_DISPOSITION variable or the Vital Statistics data indicate that a patient has died on a given date, but the same ENC_ENHANCED_UPID (patient identifier) appears again at later discharge dates, often multiple times. It is unclear whether the death data or the patient identifiers are in error. However, these inconsistencies are quite rare in terms of total discharge records, and even rarer in terms of unique individuals.

SPARCS
There are 605 individuals in SPARCS for which there are multiple death dates indicated by the PATIENT_DISPOSITON variable. For 249 of these individuals, the range of death dates is only 1 day, and for 510 individuals the range is no more than 365 days, leaving 95 individuals with ranges of more than one year, and up to 5939 days (~16.25 years). The following table indicates the number of different dates of death reported for individuals with any date of death indicated by the PATIENT_DISPOSITION variable:

# of Different Dates of Death	Freq.	Percent	Cum.
1	1,061,370	99.94	99.94
2	596	0.06	100.00
3	9	0.00	100.00

Total | 1,061,975 100.00

In addition, after adjusting the duplicate death-date observations to retain only the latest recorded death date indicated by the PATIENT_DISPOSITION variable, there are 3991 discharges, for 965 individuals[2], where the date of discharge is later than the latest date of death indicated by a PATIENT_DISPOSITION code.

NY Vital Statistics
Within the compiled 1995-2009 Vital Statistics data file, **/disk/agedisk3/sparcs.kowalski/katearch/deathdata/linkeddeaths1995_2009.dta**, there are already some apparent discrepancies between discharge dates and death dates. This file is meant to contain the latest recorded discharge for each patient seen in the SPARCS files, probabilistically matched to mortality data. However, of the 899,113 observations with a precise (MDY) date of discharge and death, and no AIDS or ABORT flag, **241 observations** indicate a date of death after the latest date of discharge. In these cases, the date of death ranges from 1 to 325 days after the latest date of discharge indicated in the files. As these differences are all less than a year, these discrepancies may not be problematic.

When the **linkeddeaths1995_2009.dta** file (which retains all observations, including those with an AIDS/ABORT flag in case the individual identifiers correspond with other, non-flagged observations) is merged with the SPARCS data, **282 discharges of 247 individuals** reflect a date of discharge after the date of death indicated by the Vital Statistics records. This indicates that several of records contained in the linked deaths file are not actually the last discharges for an individual observed in SPARCS.

Applying Mortality Data to SPARCS Inpatient Sample

First, we identify the in-hospital deaths indicated by the PATIENT_DISPOSITION variable in SPARCS.

1. Where PATIENT_DISPOSITION is equal to 20, 40, 41 or 42, we give the dummy variable *deathhosp* a value of 1. We record the date of discharge as the date of death. We then apply this *deathhosp* indicator and the latest observed date of death to all records with the same ENC_ENHANCED_UPID, so that date of death is indicated for all observations of individuals who ever die in the sample period. By applying the maximum date of death to all observations, we eliminate instances of multiple death dates for the same individual. This process is completed by the first half of the file **inpatientdeaths.do.**

We next apply the NVS mortality data for the years 1995-2009.

2. We first create a file appending all of the matched death data provided by the NY Department of Health, using the file **getlinkeddeaths.do.** We eliminate any observations for which an ENC_ENHANCED_UPID is not recorded. For most records, date of death is available to the date. For five records only month-year or year is available. In these cases, we re-code the date as the first of the month or first of the year. At this stage, we do not eliminate records for which the discharge date is later than the date of death. We will deal

[2] These counts are based on the 41,459,973 records contained in **inpatientsmallfyccr1995_2011.dta**, which excludes AIDS, ABORTION, and non-NY records.

with these in a later step. The completed file is saved as /disk/agedisk3/sparcs.kowalski/katearch/deathdata/**linkeddeaths1995_2009.dta**.

3. We next merge linkeddeaths1995_2009.dta on to the SPARCS inpatient sample. We subordinate matches to any deaths already indicated in step 1. There are 7,707 records for which the NVS data corresponds to a death date already indicated within SPARCS. These are counted as deaths indicated by SPARCS. There are also 715 observations for which the SPARCS death dates disagree with the date indicated by the NVS data. These records retain the SPARCS death date as well. The death matches that we retain are indicated using the dummy variable *deathnvs.* This step is completed in the next segment of **inpatientdeaths.do.**

We then account for deaths matched by the Department of Health and provided as part of the 2010 and 2011 SPARCS files.

4. It is important to note that while the mortality data from the file linkeddeaths1995_2009 only includes deaths through December 31, 2009, the death dates linked to the 2010-11 SPARCS data continue through December 31, 2012. Date of death for these years is stored in the variable DOD_DT. There are 1097 records where the date of death indicated by the variable DOD_DT occurs prior to the date of discharge. In all of these cases the difference is one day. We apply these death dates to all observations of the dead individuals. As in step 3, we subordinate these mortality data to the deaths indicated by the SPARCS variable PATIENT_DISPOSITION. We also identify these matches using the variable *deathnvs* = 1.

Lastly, we deal with individuals for whom the date of death falls after the final discharge date observed in SPARCS.

5. We use the simple rule of ignoring any deaths that violate the condition that date of death cannot be sooner than last date of discharge. We do so to avoid inclusion of any erroneous deaths. We recode all records of individuals with death dates that violate the "date of death ≥ latest discharge" rule as non-deaths, at the end of the file inpatientdeaths.do. The reported deaths of 1,305 individuals, in 9521 observations are ignored. The file dataset is saved as /inpatientdata/**inpatientsmalldeaths.dta.**

After making all adjustments, death date is known for a total of 2,111,793 individuals in the sample -- 1,061,010 of these deaths are from the PATIENT_DISPOSITION variable, and 1,050,783 are from the NVS mortality data. The following details the distribution of death years in the sample:

Total Deaths Reported

Year of Death	Freq.	Percent	Cum.
1995	99,479	4.71	4.71
1996	111,296	5.27	9.98
1997	114,702	5.43	15.41
1998	119,095	5.64	21.05
1999	124,903	5.91	26.97
2000	127,058	6.02	32.98
2001	128,571	6.09	39.07
2002	131,013	6.20	45.28
2003	131,230	6.21	51.49

2004	126,511	5.99	57.48
2005	129,275	6.12	63.60
2006	126,463	5.99	69.59
2007	126,610	6.00	75.59
2008	128,208	6.07	81.66
2009	126,510	5.99	87.65
2010	99,483	4.71	92.36
2011	117,207	5.55	97.91
2012	44,179	2.09	100.00
Total	2,111,793	100.00	

Deaths Reported by SPARCS

Year of Death	Freq.	Percent	Cum.
1995	72,160	6.80	6.80
1996	68,768	6.48	13.28
1997	65,428	6.17	19.45
1998	64,670	6.10	25.54
1999	66,488	6.27	31.81
2000	66,666	6.28	38.09
2001	65,336	6.16	44.25
2002	66,003	6.22	50.47
2003	65,736	6.20	56.67
2004	63,156	5.95	62.62
2005	61,037	5.75	68.37
2006	58,570	5.52	73.89
2007	56,969	5.37	79.26
2008	57,369	5.41	84.67
2009	55,219	5.20	89.87
2010	53,605	5.05	94.93
2011	53,830	5.07	100.00
2012	0	0.00	100.00
Total	1,061,010	100.00	

Deaths Reported by NVS

Year of Death	Freq.	Percent	Cum.
1995	27,319	2.60	2.60
1996	42,528	4.05	6.65
1997	49,274	4.69	11.34
1998	54,425	5.18	16.52
1999	58,415	5.56	22.08
2000	60,392	5.75	27.82
2001	63,235	6.02	33.84
2002	65,010	6.19	40.03
2003	65,494	6.23	46.26
2004	63,355	6.03	52.29
2005	68,238	6.49	58.78
2006	67,893	6.46	65.24
2007	69,641	6.63	71.87
2008	70,839	6.74	78.61
2009	71,291	6.78	85.40
2010*	45,878	4.37	89.76
2011*	63,377	6.03	95.80
2012*	44,179	4.20	100.00
Total	1,050,783	100.00	

*Deaths in these years are only reported for individuals with inpatient visits in 2010-11

IV. Final Data Cleaning

After adding death data to the SPARCS inpatient sample, we undertake a few small data cleaning tasks. In this section we will also briefly describe the construction of the "age in 1995" variable, which was actually created at the same time that the CCR codes were applied.

Create agein1995 Variable

Procedure
The variable agein1995 indicates the age of a given individual as of 6/30/1995. It is calculated using the PATIENT_DOB variable. We calculate age in 1995 at midyear for the sake of consistency with the population and mortality age calculations discussed in the next section. Because date of birth is typically provided as a year and month, and occasionally only as a year, calculating age as of midyear 1995 is somewhat complex:

1. First, we must convert the PATIENT_DOB variable, which is stored as a string in the form "CCYYMM" or "CCYY" into an elapsed date. While no individuals in the dataset have two different birthdates, some individuals appear with a "CCYYMM" birthdate in some records an only a "CCYY" birthdate in others. Thus, we first apply the more precise birthdate to all observations of an

individual. We identify the birth month for 156,831 additional records using this approach. For the remaining 268,460 observations, we simply apply the birth year. Stata will assume that the missing date components (day or day-month) are equal to 1 (thus all birth dates are either of the form MM01CCYY or 0101CCYY). Note that this means that we assume that all individuals without a birth month were born in the first half of the year. It also means that all individuals born in July are assumed to have a birthday on July 1. Thus, we assign the midyear to be June 31 (so that all July birthdays fall after midyear, and all June birthdays fall before).

2. Having correctly generated a date of birth variable (dob), we create the agein1995 variable, which is equal to the time between the month of birth and June 1995. We calculate this period in months, rather than days, so as to avoid the issue of leap years when converting to years. We round down to the closest year (so an individual who was 25 years and 8 months in 1995 is considered age 25). The formula for calculating agein1995 is as follows: **agein1995 = floor([ym(1995, 6) - ym(year(dob), month(dob))] / 12)**

Remove Duplicate Records

Procedure
As mentioned earlier in this document, it appears that the inpatient files contain a number of "adjustment records". It is crucial to ensure that we do not overestimate inpatient visits – given the focus of this project, it is better to ignore real visits than to incorrectly create high-intensity outlier patients. Accordingly, we liberally eliminate all observations that *may* be duplicate records. We consider records to be the same if they share the same PFI, ADMIT_DATE, DISCHARGE_DATE, ENC_ENHANCED_UPID, and costs.

Typically, discharge numbers differ between original and adjustment records. While it is not possible to distinguish between the original record and the subsequent adjustment records with certainty, we attempt to retain the latest version of the record by keeping the record with the highest discharge number.

Identify Individuals with Significant Pre-1995 Inpatient Visits

Ideally, our dataset documents the medical expenditure evolution of a cohort without an intensive medical history. While it is not possible to eliminate with certainty all of the individuals who have significant medical histories, we can identify some individuals that we *know* have had prior inpatient visits using the 1982-1994 SPARCS files. Though initially we had planned to eliminate individuals who appeared in the pre-1995 data, we ultimately decided not to select our sample based on this information.

Longitudinal Linking
As John Piddock explains, the pre-1995 data do not contain a longitudinal patient identifier variable. It is possible though, to link individuals across time, as long as they continue to visit the same hospital. This can be done using the combination of "PFI, Medical Record Number and the calculated 'difference between discharge year and age.'" Because ostensibly, each hospital maintains the same medical record number for a given individual for every visit that they make, the combination of PFI and medical record number should be a unique identifier. We only have access to encrypted medical record number ("MRN"), which should be an adequate substitute. We believe that John recommended using date of birth as well in order to be as certain as possible that our linkages are correct. However, in order to

identify as many individuals as possible with potential pre-1995 visits, we elect not to use date of birth as an additional constraint when initially identifying linkages.

The MRN-PFI method of identifying individuals is imperfect – in some cases, we find that the same MRN-PFI combination corresponds to multiple UPIDs. This is true throughout the 1995-2011 data sample, but becomes problematic when trying to link the pre-1995 files to this working sample. After performing the initial link, therefore, we implement a multi-step process to ensure that each MRN-PFI combination is attributed to only one UPID, in order to avoid double-counting pre-1995 visits or incorrectly identifying individuals as having pre-1995 visits.

Below is a detailed description of the linking process:

1. First, we compile a dataset of all pre-1995 inpatient visits. We drop all duplicate records – records that share a PFI, discharge date, and encrypted medical record number.
2. Next, we collapse the data by PFI and MRN. We create variables detailing the number of visits associated with each combination, as well as variables identifying the first appearance, last appearance, and number of visits in each pre-1995 year. We are left with a dataset containing 27,149,206 unique MRN-PFI combinations.
3. We then merge this set of pre-1995 data onto the clean 1995-2011 dataset, by PFI and MRN. At this point, the same ENC_ENH_UPID may be associated with multiple PFI-MRN combinations that appear in the pre-1995 data.
    a. The simple merge successfully finds matches for 3,430,284 observations out of the 41,409,316 records in the cleaned dataset (about 8%).
4. Next, we identify instances where the merge resulted in the same MRN-PFI being attributed to more than one UPID. We "undo" these merges.
    a. This results in the elimination of 397,001 matches, corresponding to 74,292 MRN-PFI combinations.
5. The next step will be to try to use gender and DOB to identify the correct MRN-PFI to UPID match. As in step two, we collapse the compiled dataset of all pre-1995 inpatient visits, this time by PFI, MRN, DOB, and sex. This yields a dataset containing 27,828,509 unique MRN-PFI-DOB-sex combinations. We then merge this set of pre-1995 data onto the 1995-2011 dataset, by MRN, PFI, DOB, and sex.
    a. This merge finds matches for 347,070 additional observations.
6. At this point, we still see 58,963 MRN-PFI combinations out of our merged combinations that correspond to more than one UPID, even with the added DOB and sex matching requirements. To eliminate these, we follow the following rule: if an MRN-PFI combination corresponds to more than one UPID, we keep the match with the UPID that it corresponds to most frequently. Using this rule, we eliminate matches to 102,353 observations. This still leaves a few MRN-PFI combinations corresponding to multiple UPIDs (if there are multiple "mode" UPID matches). We disregard all of these matches. This results in eliminating an additional 16,037 observation matches. At this stage, each MRN-PFI combination linked to pre-1995 observations corresponds with only on UPID.
7. We then use these merges to identify the total number of hospital visits in each pre-1995 year associated with each UPID in the dataset. We are careful

to count the visits associated with each MRN-PFI combination once per UPID. Likewise, we identify the earliest pre-1995 visit and latest pre-1995 visit associated with a given UPID, across all MRN-PFI matches.

a. The 1,297,832 UPIDs associated with the successful MRN-PFI matches identified during the initial merge correspond to a total of 6,679,335 records (that is 7% of all individuals in the dataset and 16% of the total records in the dataset).

Summary of Pre-1995 Visitors Identified in Sample

We identify 1,297,832 individuals (out of a total of 17,884,777) in the 1995-2011 working data sample with pre-1995 inpatient hospital visits. The following table summarizes the year of the first observed pre-1995 visit for each individual (ENC_ENH_UPID):

First Pre-1995 Visit	Freq.	Percent
1982	59,649	4.60
1983	51,995	4.01
1984	54,304	4.18
1985	59,287	4.57
1986	70,822	5.46
1987	85,664	6.60
1988	22,362	1.72
1989	80,264	6.18
1990	71,042	5.47
1991	136,249	10.50
1992	137,043	10.56
1993	156,554	12.06
1994	312,597	24.09
Total	1,297,832	100.00

The following table summarizes the portion of the population that we know to have had an inpatient visit in each year of the pre-1995 period:

Year	# of Visitors
1982	59,649
1983	59,970
1984	68,262
1985	78,547
1986	96,629
1987	119,097
1988	36,971
1989	118,083
1990	114,355
1991	209,510
1992	236,601
1993	284,459
1994	460,240

As the table below shows, approximately 7% of all individuals in the 1995-2011 dataset have at least one pre-1995 inpatient visit:

# of Years in Pre-1995 Sample	**# of Individuals**	**% of Individuals**
0	16,586,945	92.74%
1	919,576	5.14%
2	231,252	1.29%
3	83,780	0.47%

4	34,313	0.19%
5	15,086	0.08%
6	6,987	0.04%
7	3,399	0.02%
8	1,716	0.01%
9	902	0.01%
10	470	0.00%
11	229	0.00%
12	95	0.00%
13	27	0.00%
Full Sample	17,884,777	100.00%

Clean Diagnosis and Demographic Variables

Procedure
Many variables, including those for payment type, diagnosis, and various demographic indicators, take multiple values for the same individual. Because we will ultimately collapse our data to the patient-year level, we must select one value per year. In the case of variables such age gender or race, we will select one value for the entire period.

Collapse to Patient-Year Level

Procedure
After eliminating superfluous records, cleaning remaining variables, and converting charges to inflation adjusted costs using hospital-specific CCR values, we collapse the data from the record-year level to the patient-year level. This step allows us to next balance the data at the patient level.

V. Balancing the Data to Reflect Full NY State Population

Background

Our working dataset must reflect the population and mortality trends in New York State as a whole. We are particularly interested in expenditure evolution of the non-elderly adult population. The goal of the working dataset is to account for the whereabouts of every individual who was age 25 – 64 (the age cohort that we will be following) in the state of New York in 1995 (the year our SPARCS data begins) during each year of our sample period (1995-2011). To create our working dataset, we undertake a two-part "balancing" process.

Definition of Age in the Dataset
We will describe the ages of individuals in our working dataset using the variable "age in 1995". It is important to keep in mind that this is an objective, rather than relative, description of age; much like a birthday. For instance, the "age 25" cohort means the group of people born in 1970, who were 25 in 1995, *NOT* the group of people who ARE 25 years old in whatever year we are discussing.

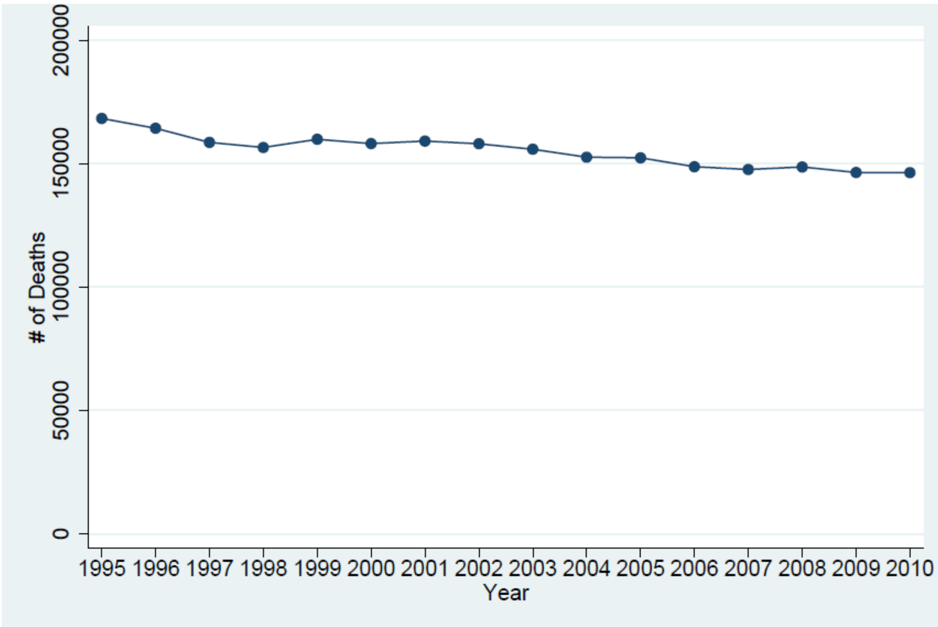
Population and Mortality Data

Mortality Data
We use the Center for Disease Control and Prevention/National Center for Health Statistics Multiple Cause of Death data. The detailed public use data files, which are available on the NBER server for the years 1995-2011, do not identify deaths by state after 2004. Accordingly, we used the copies of these data made available

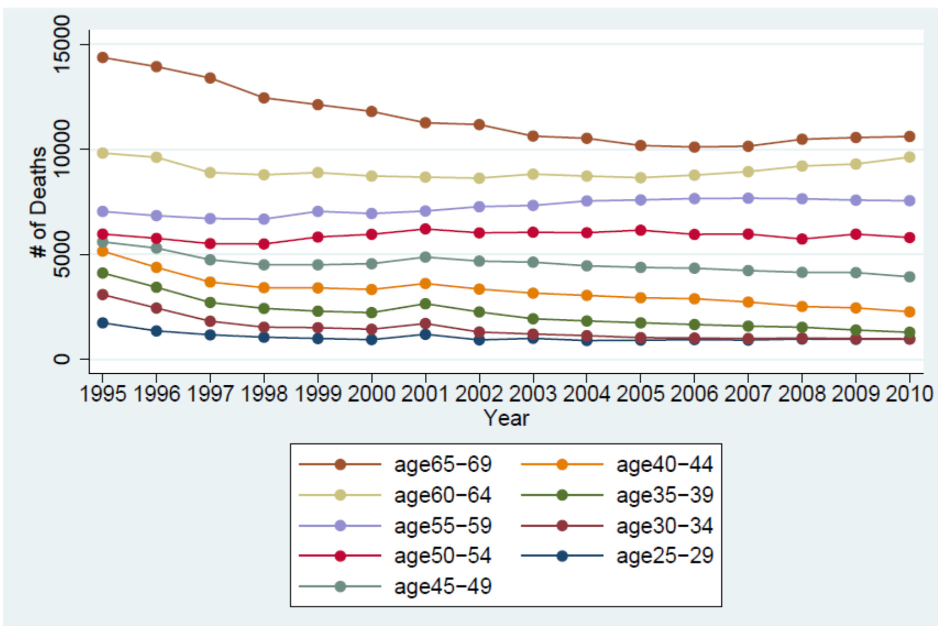
online by the CDC for the years 1999 to 2010. These online files, however, only provide death totals by age, rather than the full detailed data. This left some ambiguity regarding the way in which the CDC files arrived at death totals, and how to replicate this counting method using the NBER files. Fortunately, the years 1999-2004 are contained in both data sets. Using these years, we determined that the CDC files take the death totals directly from the variable *staters*, state of residence, without taking note of state of occurrence. Thus, we use this method for the years 1995-1998 as well. Using this method, we retain continuity in our method of counting deaths. The totals include deaths of New York residents that occur outside of New York, and do not include deaths of non-residents that occur inside the state.

The following graphs show the deaths of NY residents in each year, first, in total, and second, by age (NOT age cohort). As these graphs show, there is no discontinuity between the years 1998 and 1999, where we change data sources.

NY Deaths per Year



NY Deaths per Year - Ages 25 to 69



The NBER Multiple Cause of Death Files can be found at /disk/data2/mortality/CCYY/mortCCYY.dta.

The CDC Wonder Multiple Cause of Death data for years 1999-2010 can be found at /disk/homes2b/nber/katearch/SPARCS/Multiple Cause of Death, 1999-2010.txt. A copy is also saved ad /disk/agedisk3/sparcs.kowalski/katearch/deathdata. This text data file was created at http://wonder.cdc.gov/ucd-icd10.html.

A complete death dataset was created using the do file /disk/agedisk3/sparcs.kowalski/katearch/deathdata/**getnvssdeaths.do** (note that the file must be run on the NBER servers, not the NBER age servers). The resulting file is /disk/agedisk3/sparcs.kowalski/katearch/deathdata/nydeaths1995_2011.dta.

Unfortunately, mortality data for NY state with 1 year age categories is not available for the year 2011 from the CDC at this time. Currently we use the 2010 data again for 2011. 2011 data should become available in fall 2013, per discussion with CDC Wonder staff (spoke with Sigrid cwus@cdc.gov 888-496-8347 on 8/8/13).

Population Data
We use the US Census intercensal population estimate data file for 1995 to construct our NY population cohort. These data identify the NY population for each year of age from 0 to 84 (ages 85 and older are consolidated into a single category). The 1995 population estimates are contained within the file /disk/oldadmin/homes/web/html/data/census-intercensal-population/pop90s.dta on the NBER public server.

A complete population dataset for the years 1995 – 2010 is available for reference. It was created using /disk/agedisk3/sparcs.kowalski/katearch/popdata/**getpopulation.do** and is saved as /popdata/**nypopulation1995_2010**.

Part I: Within-Sample Balancing

First, we create an observation for every individual age 25-64 (in 1995) who ever appears in SPARCS in every year of our sample period. In years where an individual did not visit the hospital, we simply create an observation where all fields are missing, except for agein1995 and deathyear. At this stage, the dataset contains an annual observation for each ENC_ENHANCED_UPID that ever appears in the SPARCS inpatient data. If an individual dies, they remain in the dataset, but their deathyear indicates that they are dead (and as they do not visit the hospital in years following their year of death, those fields are coded as "missing" in later years).

Part II: State Population Balancing

Balancing the Dataset to Match NY State Population & Death Totals
We complete the process of balancing the working dataset to match the 1995 NY state totals in two steps. Again, we include only individuals who are ages 25-64 in 1995 in the balanced sample.

1. First, we build observations to match the mortality totals in NY state for the years 1995-2011. That is, we add observations for individuals who die during our sample period according to the mortality records, and are not recorded as dying in SPARCS. We allocate ages and death years to these individuals such that the combination of these individuals plus the dying individuals observed in SPARCS match the age and year of death distribution observed in the state mortality totals.
    a. We count the number of deaths of individuals who appear in SPARCS between 1995 and 2011, and group these dying people by "age in 1995" and year of death.
    b. We also calculate the total deaths by "age in 1995" and year of death in the state of New York for the years 1995-2010. We use the 2010 data again to simulate deaths in 2011 by "age in 1995".
    c. We then find the difference between the NY population and SPARCS population totals for each age-deathyear category. These differences are equal to the number of people in each age-deathyear cohort of the 1995 NY population who die between 1995 and 2011, but do not visit the

hospital. We create an observation for each individual in this set. We give each individual a unique id, reshape to create an observation for each individual in each year, and apply the year of death to each observation, by unique id. The result is a dataset of the following form:

id	**year**	**deathyear**	**agein1995**
deadny+_n	1995-2011	1995-2011	25-64 yrs

We can then append this dataset to the SPARCS balanced dataset. Together, the SPARCS and non-SPARCS deaths account for all of the 895,425 total deaths in NY from 1995-2011 among individuals who were age 25-64 in 1995:

	Deaths in SPARCS Population				
Death Year	**Death in Hospital**	**Death from NVS Data**	**Total SPARCS Deaths**	**Non-SPARCS Deaths**	**Total Deaths**
1995	14,146	5,496	19,642	22,936	42,578
1996	14,552	9,044	23,596	17,804	41,400
1997	14,788	10,595	25,383	14,142	39,525
1998	15,803	11,972	27,775	12,541	40,316
1999	17,102	13,564	30,666	12,299	42,965
2000	18,652	14,655	33,307	11,725	45,032
2001	19,376	16,431	35,807	12,717	48,524
2002	20,833	17,820	38,653	11,280	49,933
2003	22,031	18,812	40,843	10,640	51,483
2004	22,319	19,643	41,962	11,218	53,180
2005	22,935	21,980	44,915	10,611	55,526
2006	23,556	23,169	46,725	10,515	57,240
2007	24,404	25,019	49,423	10,352	59,775
2008	26,027	26,542	52,569	10,257	62,826
2009	26,612	28,620	55,232	10,360	65,592
2010	27,133	19,963	47,096	20,956	68,052
2011	28,415	28,584	56,999	14,479	71,478
Total	358,684	311,909	670,593	224,832	895,425
*While 2,111,793 deaths were observed in SPARCS, only 670,593 individuals aged 25-64 in 1995 died by 2011.					

Deaths in the SPARCS population comprise 75% of the Deaths observed in New York from 1995 to 2011 in this cohort. 40% of all deaths are deaths observed in the hospital and indicated by the SPARCS dataset, and 35% are deaths provided by the New York Department of Vital Statistics.

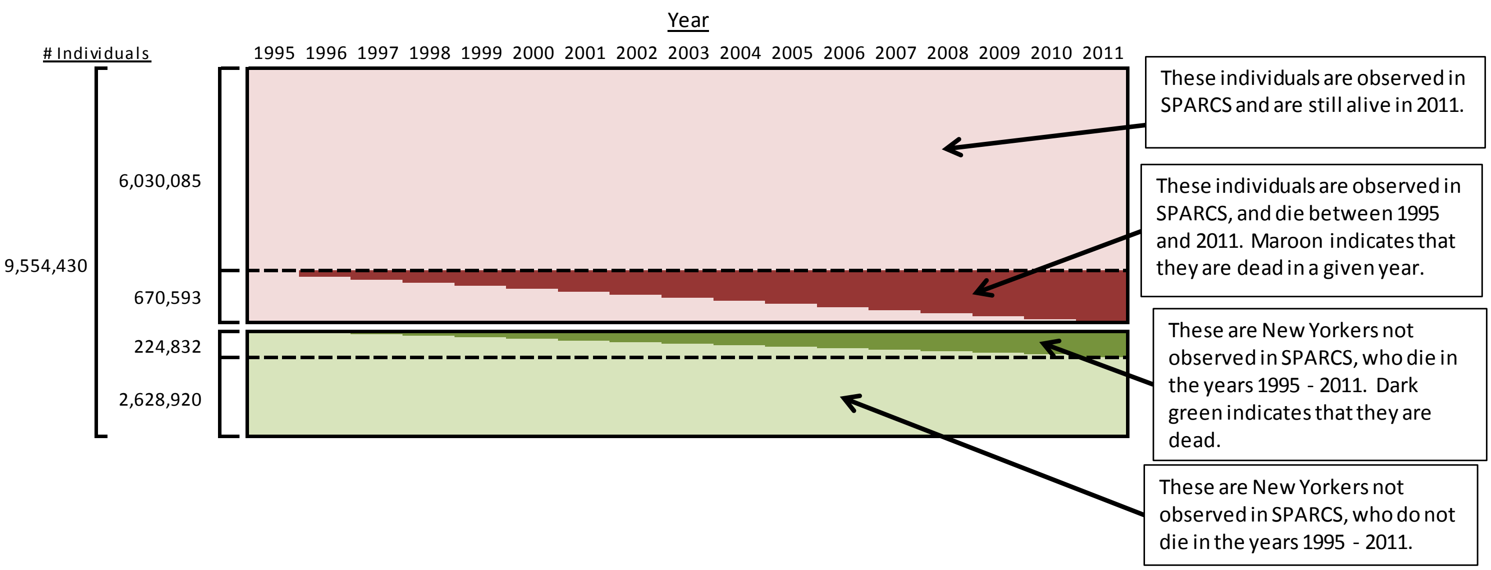
2. After accounting for the “SPARCS population” and the “Non-SPARCS population that dies at some time during the sample period”, we can then derive the remaining NY population for each age group, recalling that we seek to maintain the 1995 NY population age distribution in each year of the sample.
    a. We count the number of individuals in each age group contained in the appended dataset created at the end of step 1 (this gives us total SPARCS population + Non-SPARCS dying population). We then subtract these population totals by age group from the 1995 NY population. This yields the remaining NY population by age that must be added to the dataset in order to account for the total 1995 population of NY in each year.
    b. We expand these totals, to create an observation for each individual in this set. As before, we give each individual a unique id and reshape to

create an observation for each individual in each year. This yields a dataset of the following form:

id	year	deathyear	agein1995
aliveny+_n	1995-2011	.	25-64 yrs

As we discuss more thoroughly in the section "sources of error", the total population of the dataset exceeds the total 1995 population of New York by 4,154 individuals. This is because for ages 62-63, the sum of the individuals observed in SPARCS and the additional individuals who die during 1995-2011 exceeds the total population of these cohorts observed in the 1995. In order to retain observations for all of the individuals who appear in SPARCS in this age cohort, as well as the mortality total for this group, we allow these age cohorts to slightly exceed the population total for the group. This phenomenon is highlighted in blue on the table on page 22.

c. We then append this dataset to the dataset created in step 1. The graphic below illustrates the composition of the final working dataset:



We recode the individual IDs to count the number of individuals in the dataset (the ids thus range from 1 to 9,554,430). The final working dataset is composed of the SPARCS data, a set of individuals with no hospital visits but with death dates and ages, and a set of individuals with ages, but no visits and no death date. There are 17 observations of each individual, one in each year. There are a total of 9,554,430 individuals in the final set. The composition of the working dataset is detailed in the table on page 22.

We consider an individual to be dead the period following their death (ie. if the current year > death year). The following table summarizes the portion of the population that is dead in each year. It is important to keep in mind that we observe more deaths than there are dead individuals in 2011. This is because individuals who are observed to die in the year 2011 or 2012 are never observed as *dead* during the sample period (they would not be considered dead until 2012 or 2013):

Year	# Dead

1996	42,578
1997	83,978
1998	123,503
1999	163,819
2000	206,784
2001	251,816
2002	300,340
2003	350,273
2004	401,756
2005	454,936
2006	510,462
2007	567,702
2008	627,477
2009	690,303
2010	755,895
2011	823,947

Composition of Working Dataset

Age in 1995	**Individuals in SPARCS**		**Individuals Not in SPARCS**		**Total Cohort**	**Actual 1995 NY Population**	**Cohort Pop. - Actual Pop.**
	Death Observed in 1995-2011	**No Death Observed**	**Death Observed in 1995-2011**	**No Death Observed**			
25	2,592	215,029	2,364	52,165	272,150	272,150	0
26	2,842	210,527	2,542	49,966	265,877	265,877	0
27	3,116	206,189	2,656	52,998	264,959	264,959	0
28	3,494	205,293	3,166	45,994	257,947	257,947	0
29	3,956	207,907	3,401	82,945	298,209	298,209	0
30	4,439	208,231	3,813	87,822	304,305	304,305	0
31	5,005	207,271	4,155	86,887	303,318	303,318	0
32	5,755	202,302	4,549	95,015	307,621	307,621	0
33	6,146	192,140	4,646	106,033	308,965	308,965	0
34	6,836	190,017	5,060	126,702	328,615	328,615	0
35	7,667	183,726	5,026	125,677	322,096	322,096	0
36	8,161	177,110	5,519	115,937	306,727	306,727	0
37	8,985	173,420	5,664	117,339	305,408	305,408	0
38	9,650	168,385	5,676	98,457	282,168	282,168	0
39	10,401	159,426	6,076	135,366	311,269	311,269	0
40	11,280	160,068	6,307	119,082	296,737	296,737	0
41	12,225	152,649	6,345	103,827	275,046	275,046	0
42	13,000	148,981	6,269	100,537	268,787	268,787	0
43	13,935	146,882	6,412	94,496	261,725	261,725	0
44	14,511	145,765	6,704	105,002	271,982	271,982	0
45	15,781	145,345	6,451	93,913	261,490	261,490	0
46	16,666	146,062	6,676	76,507	245,911	245,911	0
47	18,206	147,132	7,138	75,673	248,149	248,149	0
48	20,729	157,669	5,922	68,401	252,721	252,721	0
49	17,445	125,501	6,518	61,218	210,682	210,682	0
50	18,966	124,254	5,521	59,502	208,243	208,243	0
51	20,263	124,006	6,247	46,398	196,914	196,914	0
52	23,745	133,916	5,743	45,417	208,821	208,821	0
53	22,652	119,913	5,788	35,167	183,520	183,520	0
54	23,060	113,105	5,546	41,995	183,706	183,706	0
55	24,140	112,524	5,751	28,062	170,477	170,477	0
56	25,630	109,449	5,697	26,987	167,763	167,763	0
57	26,864	108,949	6,243	23,223	165,279	165,279	0
58	28,364	105,420	6,033	6,701	146,518	146,518	0
59	29,897	104,137	6,506	16,507	157,047	157,047	0
60	32,427	103,000	6,485	11,453	153,365	153,365	0
61	33,437	96,798	7,092	2,105	139,432	139,432	0
62	36,844	98,095	7,285	0	142,224	140,025	2,199
63	39,021	96,463	7,716	0	143,200	141,245	1,955
64	42,460	97,029	8,124	7,444	155,057	155,057	0
Total	670,593	6,030,085	224,832	2,628,920	9,554,430	9,550,276	4,154

Potential Sources of Error

Immigration

We are obliged to assume that individuals do not enter or leave the state during the sample period. This means that we must assume that all of the individuals who appear in SPARCS were part of the New York population on July 1, 1995, and that all of the death records from the sample period reflect deaths of individuals from the 1995 population, rather than hospital visits or deaths of individuals moving into the state at a later time. This means that we likely overestimate the number of people from the 1995 New York population who visit the hospital. We also overestimate the number of people from this population who die. We believe that this is the source of the excess population in the older cohorts. Because the aging population is more likely to visit the hospital and more likely to die, any immigration into the state should be most evident in these age cohorts in the SPARCS data (since we probably see most age 60+ people in the hospital at some point, the fact that we are counting too many people is more evident). The following table shows that it is only the combined SPARCS population count that exceeds the 1995 population estimate:

Age in 1995	New York Population	SPARCS Combined 1995 to 2011 Population	SPARCS 1995 Population	NY Population Less Combined SPARCS Pop.	NY Population Less 1995 SPARCS Population
67	147,072	147,217	20,559	(145)	126,513
68	134,939	145,530	21,319	(10,591)	113,620
69	138,719	144,507	21,267	(5,788)	117,452
70	134,996	144,385	21,674	(9,389)	113,322
71	127,952	141,785	21,809	(13,833)	106,143
72	124,516	138,054	22,074	(13,538)	102,442
73	119,139	135,276	22,279	(16,137)	96,860
74	117,666	129,995	22,343	(12,329)	95,323
75	106,822	125,278	22,059	(18,456)	84,763
76	97,672	111,878	20,528	(14,206)	77,144
77	92,749	109,932	20,941	(17,183)	71,808
78	89,542	101,369	20,050	(11,827)	69,492
79	87,625	95,349	19,847	(7,724)	67,778
80	77,302	92,743	19,799	(15,441)	57,503
81	70,857	85,256	18,953	(14,399)	51,904
82	65,148	78,152	18,100	(13,004)	47,048
83	58,165	69,302	16,844	(11,137)	41,321
84	52,899	62,227	15,940	(9,328)	36,959

It is interesting to note that the age 0 population also produces this issue, both for the aggregate SPARCS population and the 1995 population, when age is measured in December rather than in July. We believe that this is because the cohort with age measured at the end of the year includes some infants not yet born as of the population count. When age is measured in July, as it is above, the problem shifts to include age 67 and exclude age 0.

Age Calculations

Our population data, SPARCS data, and mortality (death record) data all provide age in one year intervals. Thus we match the distribution of the population and distribution of deaths using 1 year age cohorts. Unfortunately, each of the data sources differs in the way that age information is derived, which introduces some error into our dataset.

- The population data reports the number of individuals in each age group as of 7/1 of the year in question. We calculate age in 1995 as follows:

$$"age\ in\ 1995" = 1995 - "data\ year" + "age\ in\ data\ year"$$

Thus, age in 1995 is as of 7/1/1995.
- The mortality data does not identify age as of a stable date (such as 12/31 or 7/1). Rather, it provides the age at death of individuals who died within a given calendar year. We are obliged to calculate age in 1995 as:

$$"age\ in\ 1995" = 1995 - "year\ of\ death" + "age\ at\ death"$$

Thus, age at death simply means age at some point in 1995. On average, though, we expect that half of the population dies prior to their birth month, and half dies following their birth month, making the sampling of ages at death somewhat equivalent to sampling age on 7/1. To confirm this expectation, we assessed the relationship between death months and birth months in the SPARCS sample and found that this does appear to be the case:

Variable	Obs	Mean	Std. Dev.
Death after Birth	2111793	**.4525803**	.4977464
Death before Birth	2111793	**.458652**	.4982875
Same month	2111793	**.0887677**	.2844082

- SPARCS data provides patient date of birth, to varying degrees of accuracy. When month of birth is not provided, we assume a birth month of January. We calculate age in 1995 as of 6/30.

Though the three different approaches to calculating age should all approximate populations at the midpoint of the year, they leave room for some minor discrepancies.

When SPARCS age is calculated in December, we see more deaths in SPARCS than in the NY population for some agein1995-year of death combinations, particular at very old or very young ages. The table below shows the extent of these discrepancies. The y axis is agein1995, and the x axis is the difference between total NY deaths and SPARCS deaths for each death-year. As these discrepancies disappear when we calculate age in July rather than December, we attribute them to differences between the age calculations in SPARCS and age calculations in the mortality data.

Age in 1995	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
-15																33
-14															458	(25)
-13														482	(16)	9
-12													490	(8)	14	2
-11												497	(15)	21	24	11
-10											515	(17)	21	25	13	5
-9										502	(2)	35	23	17	4	19
-8									482	(11)	31	15	8	10	15	7
-7								515	(4)	6	21	19	17	14	2	19
-6							565	5	25	21	8	5	11	6	15	6
-5						601	-	24	15	14	10	10	7	20	14	11
-4					693	(2)	26	19	14	16	15	8	5	-	13	19
-3				634	(20)	27	11	9	6	12	18	16	14	12	15	17
-2			675	(12)	17	4	18	7	9	6	-	5	10	6	12	10
-1		742	-	26	41	15	16	20	21	20	10	13	14	17	16	16
0	777	(20)	17	34	13	26	14	9	2	20	10	6	13	12	17	32
81	1,601	1,069	928	765	805	635	467	362	362	326	227	179	71	(38)	36	581
82	1,614	1,235	971	893	786	663	481	561	315	376	232	230	247	90	(26)	542
83	1,514	1,282	958	677	575	389	444	232	187	140	97	23	(40)	(28)	(1)	377
84	1,758	1,190	1,124	975	766	652	418	477	317	256	164	112	1	(15)	(36)	299
85	1,515	1,106	848	668	582	330	315	324	194	203	74	23	45	(18)	(35)	1,393
86	1,653	1,063	837	797	583	604	436	187	127	195	61	20	(22)	18	1,040	
87	1,450	1,080	989	664	605	356	235	293	161	6	44	33	4	1,006		
88	1,375	1,030	791	522	432	348	178	144	67	120	(45)	(61)	989			
89	1,398	912	703	602	379	254	237	61	75	40	78	1,063				
90	1,223	864	585	504	393	206	191	170	75	46	987					
91	1,044	858	639	498	293	262	101	14	71	984						
92	1,177	757	623	400	280	149	75	100	1,008							
93	808	571	373	222	188	25	79	1,039								
94	920	643	425	303	189	147	1,101									
95	671	390	248	195	48	980										
96	605	371	235	162	1,071											
97	469	274	213	1,094												
98	431	273	1,059													
99	317	1,129														
100	670															

Timing of Cohort Measurement

Ideally, we hope to follow a single cohort of people – the residents of NY in 1995. Unfortunately, while our population data reflects the population of NY as of a specific date in 1995, our mortality data and SPARCS data include people who were residents of the state at the time of a given event (a hospital visit or death). Thus, while hospital visits and deaths are being measured for everyone who appears in 1995, the population is counted only on July 1. Our population cohort is the population on one day, but the SPARCS and mortality cohorts are not measured on one day, they are the combination of measurements throughout the year. There is no clean way to adjust for this issue, but it is important to keep in mind as a source of error.

Institutionalized Population

Because the "SPARCS plus dying" population exceeds the 1995 population count only for ages 61 and above, we considered the possibility that the intercensal population estimate was underestimating older populations. This seemed particularly likely because the mortality data is based on death certificate records, a very precise source of data, while the intercensal estimates are based on census surveys. If the survey excluded or undercounted institutionalized populations (such as people in nursing homes), it would disproportionately underestimate the older population. We therefore reviewed the 2000 census methodology. According to the 2000 census residence rules, "People in nursing or convalescent homes for the aged or dependent [are] counted at the nursing or convalescent home" (http://www.census.gov/population/www/censusdata/resid_rules.html). While it is still possible that correctly counting this population is more difficult, it appears that the Census makes every effort to account for this population.

VI. Completing the Working Dataset

The final step in completing the working dataset is to reshape the data to "wide" form, so that there is a single observation for every individual in the dataset.

Procedure

The reshape retains a minimal number of variables – deathyear, cost, agein1995, id. It also makes a few minor changes to the data so that it is compatible with the reclassification modeling code. In particular, a set of "alreadydeadCCYY" variables are created, and all observations where costs are missing are changed to costs==0. The reshaped data is the master "working dataset," which can be used with the reclassification modeling code. All working datasets, beginning with this master set, are saved in the workingdatasets directory. The reshape code also creates smaller working datasets, comprised of a subsection of observations. The working datasets created by inpatientreshape.do are all saved at /katearch/workdingdatsets/ and are as follows:

File Name	**Description**
inpatientreshaped.dta	This is the master working dataset, containing all observations in the balanced data.

VII. Insurance Type Assumptions

Because we only know insurance type for individuals when they appear in the hospital, we must make an assumption about these individuals during years when they are not in the SPARCS data. For the individuals who never appear in SPARCS, we will need to make an assumption in every year. We assign insurance type (as described in the variable *paymentsource*) as follows:

If an individual appears in SPARCS, we assign them the payment type of their most recent SPARCS visit. Thus for individuals who appear in SPARCS at least once, insurance type is decided in this manner for all years following their first visit.

For individuals who do not visit in 1995, an insurance type must be assigned until they first appear in SPARCS. We use the CPS march supplement to calculate the percentage of the population by age with public, private, and no insurance in 1995. We then randomly assign one of these three insurance types in 1995 by age according to these CPS insurance distributions. Individuals retain their 1995 insurance type until they appear in SPARCS.

Before assigning insurance types to individuals without insurance, we use the existing insurance information within SPARCS to determine the insurance choices (private vs uninsured) that the publicly insured individuals would make, absent the safety next. We determine the probability that each individual would choose private insurance and the probability that they would go uninsured, based on their characteristics and the characteristics of individuals with private and no insurance by using a multinomial logit function. We do this before applying insurance type to individuals with a missing type so that our function bases predictions only on the accurate demographics/insurance type combinations observed in SPARCS.

Insurance Type

The variable "Source of Payment Code" provides insight into the type of insurance (or lack thereof) used by individuals who visit the hospital. The possible payment codes are as follows:

"A"=Self-Pay
"B"=Workers' Compensation
"C"=Medicare
"D"=Medicaid
"E"=Other Federal Program
"F"=Insurance Company
"G"=Blue Cross
"H"=CHAMPUS
"I"=Other Non-Federal Program

We further simplify these categories into four major groups:

Group Name	**Payment Codes Included**
Private Insurance ("Private")	F G
Government-Provided Insurance ("Public")	C D E H I
Self-Pay ("Self")	A
Other Payer ("Other")	B L

We then graph the frequency of these groups, out all individuals in the reference group who visit the hospital in a given year.

Procedure

Use the 1995 CPS March supplement from the NBER files to determine coverage rates:

1. We use the CPS March supplements available from the NBER. Directions to access these files are available at http://www.nber.org/data/current-population-survey-data.html. The current NBER location of these files is /disk/nber10/SCCS/cps/cpsmarchYYYY.
   We determine insurance type in the CPS files according to the rules recommended by the Census (www.census.gov/hhes/www/hlthins/methodology/programming/cps/recoding.html). This is not a mutually exclusive set of categories, so we then apply the Kaiser Family Foundation's recommend coverage type hierarchy (http://kff.org/other/state-indicator/total-population/):

Hierarchy
Medicaid
Medicare
CHAMPUS
Private
Uninsured (Self Pay)

2. Within the file **assigninsurance.do**, we then generate weighted insurance rates for private, public, and no insurance (for now, we group all types of public

insurance into one category) by age in 1995. The following table reflects the insurance rates by agein1995 in the year 1995, for individuals ages 25-64:

Age in 1995	Private	Public	Uninsured
25	47%	16%	36%
26	51%	15%	33%
27	63%	9%	27%
28	57%	17%	26%
29	71%	9%	20%
30	62%	11%	27%
31	64%	12%	25%
32	64%	12%	24%
33	71%	8%	21%
34	72%	9%	19%
35	70%	12%	19%
36	77%	8%	15%
37	76%	8%	16%
38	72%	11%	17%
39	78%	8%	14%
40	75%	13%	12%
41	70%	10%	20%
42	75%	11%	14%
43	74%	12%	14%
44	71%	12%	17%

Age in 1995	Private	Public	Uninsured
45	78%	12%	10%
46	69%	11%	20%
47	75%	7%	19%
48	77%	13%	11%
49	78%	8%	14%
50	79%	10%	10%
51	76%	5%	19%
52	71%	16%	13%
53	68%	11%	21%
54	82%	12%	6%
55	74%	12%	14%
56	77%	6%	17%
57	71%	21%	9%
58	71%	15%	14%
59	75%	7%	18%
60	67%	22%	11%
61	64%	25%	12%
62	72%	14%	14%
63	69%	18%	13%
64	60%	26%	13%

Before assigning insurance types to individuals without insurance, we first apply a multinomial logit choice model to the working dataset inpatientreshaped.dta:

1. We convert the relevant insurance and demographic variables that we will use in our model into simple numeric variables:
    a. Instype: simple insurance type (0 = private, 1 = public, 2 = uninsured)
    b. Patientsex: simple sex (0 = F, 1 = M, 2 = U)
    c. Shortzip: first 3 digits of zipcode, where 999 = unknown or miscode **We ultimately use patient county instead of 3 digit zip in order to reduce the number of parameters in our function.
    d. Patientcounty: county number, where 99 = unknown or miscode
2. We run a multinomial logit function for each year of data, including all individuals ages 25-64 who visited the hospital in that year. We include *agein1995*, *patientsex*, *patientrace*, *patientethnicity*, and *patientcountyyear*. Save as /workingdatasets/inpatientinsurance.dta
3. We then use the predict function to calculate probability of being on each type of insurance and reweight these probabilities to exclude public insurance. This yields probabilities for each year in which an individual visits and has public insurance (*probprivyear* and *probselfyear*).

Assign all individuals who appear in SPARCS their most recent insurance type for years in which they do not have an inpatient visit. Also assign most recent probpriv and probpub values for years in which they do not have a visit. Then count the number of individuals with public, private, and no insurance in 1995 and use these counts, as well as a total population count by age, to convert the 1995 CPS insurance rates into population counts, and counts of the number each type (public, private, and no insurance) to assign to individuals who have no 1995 type.

1. Continue using /workingdatasets/inpatientreshaped.dta and assign most recent insurance type to all years where an individual does not appear in SPARCS (this will be missing until an individual appears in SPARCS for the first time). Then collapse the by agein1995 to create a dataset of the number of individuals in each age year with public, private, and no insurance, as well as the total number of individuals of each age in the dataset. Save as /workingdatasets/popdata.dta.
2. Merge popdata.dta on to the CPS insurance rate file (/cpsdata/CPS1995_2011.dta) by age in 1995. Multiply total population by the cps public, private, and no insurance rates to come up with a count of the number of people in 1995 of each age who should have public, private, and no insurance.
    a. Rounding these counts up or down to the nearest person will mean that in some cases the sum of the private, public, and no insurance counts will differ from the total population count by +/- 1. To ensure that the sum of the three categories is equal to the total population, add one individual to the category that was closest to being rounded up instead of rounded down, or subtract one from the category that was closest to being rounded down, as necessary. Save as /workingdatasets/inpatientcomplete.dta.
    Ex:

Exactly Calculated Population (CPS Rate * Total Pop)				**Rounded Population**			
Public	Private	Self	Total	Public	Private	Self	Total
4.55	3.9	1.55	10	5	4	2	11
REVISION: Round down decimal greater than .5 but closest to .5							
Public	Private	Self	Total	Public	Private	Self	Total
4.00	3.9	1.56	10	4	4	2	10