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ABSTRACT
TRENDS OF HOSPITAL UTILIZATION AMONG HIGH-UTILIZERS OF INPATIENT
SERVICES IN AN URBAN, SAFETY-NET HOSPITAL

By
OLUDAMILOLA FAKUNLE
APRIL 28, 2017

Introduction: Although high-utilizers of healthcare services represent only a small portion of hospital population they account for huge healthcare cost in the United States. Hence, there is a need to understand the patterns of hospital utilization among high-utilizers in order to develop intervention to reduce overall hospital cost.

Aim: To determine inpatient hospital utilization pattern among high-utilizers in Grady Hospital, Atlanta.

Methods: Trend analysis was done to understand the pattern of health care utilization among high-utilizer (n=510) patients (HUPs) from 2011 to 2014. Multivariate logistic regression analysis was performed to determine the association between selected socio-demographic characteristics and HUPs.

Results: Almost all HUPs were non-Hispanic Blacks (82.6%) with average mean age of 58. Significant proportion were employed with no health coverage. Approximately 27% of the 510 participants were HUPs at the end of 2012. At the end of 2013, the proportion of patients who became HUPs and NHUPs were 37% and 39% respectively. By 2014, 37% of patients who were HUP in 2013 remained HUP in 2014.

Conclusion: The pattern of hospital utilization among high utilizers is unstable and unpredictable, and may be driven by race. Our study shows that reducing health care cost may require developing predictive models to reduce hospital over-utilization usage among at risk group.

TRENDS OF HOSPITAL UTILIZATION AMONG HIGH-UTILIZERS OF INPATIENT
SERVICES IN AN URBAN, SAFETY-NET HOSPITAL

By

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B.Sc. OBAFEMI AWOLOWO UNIVERSITY

NOVEMBER 15, 2006

A Thesis Submitted to the Graduate Faculty
of Georgia State University in Partial Fulfillment
of the
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APPROVAL PAGE

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Author's Statement Page

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OLUDAMILOLA FAKUNLE

Signature of Author

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INTRODUCTION

In the United States (US), health care spending has contributed to the major share of the economy and now accounted for more than 17 percent of the economy (1). Health care expenditure continues to rise and concerns about the rising costs are not new but now seem persistent (2). A combination of factors can be responsible for the increase in the healthcare spending: rising prices of healthcare services and products, population growth, increases in the quantity of medical services each person receives, advances in medical knowledge and technology, and other factors (3). According to the National Health Expenditure Report, Hospital care expenditures constitute the largest single component of health care spending. In 2015, Hospital Care increased to 5.6 percent of the total health care cost compared to 4.6 percent in 2014 (4).

A substantial part of the problem with health care costs can be attributed to a disjointed system that perpetuates inefficiencies, such as overreliance on Emergency Department (ED) (5). Emergency Department use and/or hospital inpatient service is more expensive to the health care system than going to a primary care physician. Analyses of healthcare spending patterns will shed important light on how best to focus efforts to help prevent rising healthcare costs. Recognizing that a relatively small group of individuals account for a large fraction of spending serves to inform more focused cost-containment strategies (6). To better deal with the rising health care costs and improve care, it will be necessary to understand the pattern of inpatient service utilizations at the Hospital with focus on the high-utilizers.

There are several literatures that dealt with health care interventions for high utilizing populations. These interventions have looked to engage patients and provide them with needed support and resources appropriately (5). In this study, we aim to understand the pattern of Hospital services utilization among inpatients specifically, the purpose of this study is to understand the

pattern of inpatient hospital utilization among High Hospital Utilizers, from 2011 to 2014 at Grady Hospital, Atlanta Georgia. High-utilizers have become the focus of strategies aimed at reducing the disproportionate use of the health care system by improving the delivery and management of their care (7). Grady Health System in Atlanta, Georgia serves the highest need citizens of Atlanta and exploring the demographics and social factors that contribute to preventable or predictable utilization of inpatients services will help to design appropriate interventions for this high-cost population. Hence, the overall focus of this study will be to understand the trends of hospital inpatient services utilization over the period of four years, 2011 to 2014 in an Urban, Safety-Net Hospital. Ultimately, the information and knowledge gained from this study will help to develop intervention(s) and tool(s) to estimate the future inpatient hospital service utilizations which can further predict healthcare cost.

The research questions for this study are:

1. Are 2012 hospital high-utilizers likely to continue to be high-utilizers over the study period? Hypothesis: High-utilizers are likely going to remain high-utilizers during the study period.
2. How does patients' sociodemographic characteristics impact hospital utilization among inpatient population at Grady Health System? Hypothesis: Sociodemographic characteristics of inpatients population are associated with increase rate of hospital utilization at Grady Hospital, Atlanta.

LITERATURE REVIEW

Healthcare costs and utilization

Healthcare spending increased over five percent in 2015, the faster growth in total health care spending was driven largely by stronger growth in spending for private health insurance, hospital care, physician and clinical services, and the continued strong growth in Medicaid and retail prescription drug spending. In a study conducted for many patients who use large amounts of health care services, Tracy Johnson and co-authors found that the super-utilizers cycled in and out of super utilizer status on a monthly. And they recommended that, there is therefore need for future solution to improve predictive modelling, to identify individuals that are likely to experience sustained level of avoidable utilization of hospital services, better classifying subgroups for whom interventions are needed and implementing stronger program evaluation designs (8). US health care spending has continued to increase and now accounts for more than 17% of the US economy (9). Joseph Dieleman and co-author estimated spending for 155 health conditions and found that personal health care spending increased for 143 of the 155 health conditions from 1996 through 2013. The rate of change in annual spending varied considerably among different conditions and types of health care. The modeled estimates of US spending may have implications for efforts to control health care spending (9).

Hospital Inpatient services and emergency department usage

Rebecca Robinson and authors were able to identify factors associated with high hospital utilization. They characterized healthcare costs, resource use and treatment patterns of survey respondents with a history of depression among those who are high-utilizers of healthcare. They found out that history of depression and high utilization of hospital services were also associated with having diagnoses of obesity, cardiovascular disease, high comorbidity severity, other

psychiatric conditions, and pain. Diagnoses of sexual dysfunction or memory loss or medical conditions such as cancer, cerebrovascular disease, or thyroid dysfunction were not associated with being a high-utilizer when all other factors were considered (10). The study on the hospital costs by cost center of inpatient hospitalization for Medicare patients undergoing major abdominal surgery found that room and board costs accounted for nearly half (49%) of all costs and were highly correlated with length of stay. Similarly, operating room time was associated with operating room costs. This study determined the median cost for an inpatient elective colectomy, cholecystectomy, and pancreatectomy to be \$22,193, \$15,651, and \$37,745, respectively (11).

High-utilizers share of healthcare cost

High-utilizers are typically vulnerable populations with complex social components, high behavioral health needs, and multiple chronic conditions (5). they are patients with high medical costs from recurring, preventable inpatient or emergency department visits (12). Understanding the characteristics and patterns of hospitalization for high-utilizing patients can help policy makers and clinicians develop interventions to address the special needs of these patients and reduce their risk for multiple hospitalization (13).

Approaching non-clinical factors that contribute to health care utilization can be a daunting process if done without a guiding theoretical framework. Frameworks can help illuminate how different individual and social elements influence health behaviors, and often focus on personal aspects like demographics, health beliefs, and social structures (24). Ronald Andersen proposed one of the most prominent frameworks explaining determinants of health service utilization. This framework focuses on health service utilization from the individual perspective, and posits that utilization behavior results from individual-level predisposing, enabling, and clinical characteristics (25).

Grady Hospital as an urban safety-net Hospital

Grady Health System in Atlanta is a public hospital that serves the highest need citizens of Atlanta. It has a large population of super-utilizers (14). Its founding mission was to serve poor patients and provide emergency medical care, and this mission still maintain the same today (15). It is the largest public hospital in the Southeast, and the sixth largest nationwide (16, 17). Grady as a safety-net hospital is known to serves lower income populations and they account for 25% of uncompensated care in the United States (18). Grady serves not only those with acute medical needs, but also people with significant barriers to health care such as homelessness, substance abuse, and social instability (14).

METHODS AND PROCEDURES

Study Design

This is an observational study using retrospective chart review of patients admitted to Grady Health System (GHS) in Atlanta, Georgia. Patients were identified via a list of all patients triaged in the Emergency Department (ED) between 2011 and 2014. The study sample were randomly selected patients who had at least one inpatient admission in 2012. For this study, high-utilizer patients (HUPs), were defined as any patient with three or more inpatient admissions in a year. Non-high-utilizer patients (NHUP) were defined as any patient with fewer than three inpatient admissions who had documented contact with the healthcare system. Patients were defined as “no contact” if they did not interact with GHS during the year of interest. Patients were considered deceased if they died at GHS, or if their death occurred elsewhere but was documented in the EMR, or if they were discharged to home or inpatient hospice and did not have further contact with GHS. International Review Board (IRB) approval was granted by Emory University and GHS Research Oversight Committee. All data abstraction, storage, and analysis complied with Health Insurance Portability and Accountability Act (HIPAA) regulations.

Data Collection

Data for this study was abstracted from the electronic medical record (Epic Systems, Verona, WI) of Grady Health System (GHS) in Atlanta, Georgia. Chart reviews were completed between July 2016 and September 2017. Data was stored using RedCap electronic data capture tools hosted by Emory University (SOURCE). Demographic data collected included age, sex, race/ethnicity, whether the patient was deceased, date of death. Race was assigned based on the stated ethnicity in the patient records. Patients were defined as deceased under two conditions: if the patient passed at Grady Hospital, or if the patient was discharged to hospice during their year

of high use with no further contact with GHS. Given the possibility that patients were discharged to hospice in subsequent years, or passed away outside of Grady Hospital, the statistics on deceased patients are likely conservative estimates. Body mass index (BMI) data were collected and it was computed with the following conversion formula: $[\text{weight}/(\text{height}^2)]*703$. Height and weight data were taken from the patient at the time of admission and were measured in inches and pounds, respectively. Socioeconomic characteristics such as insurance status and employment status were also collected as factors of interest for 2012. A patient was considered employed if there was any mention of employment in any of the reviewed sections; classification of unemployment met the same criteria. If there was no explicit mention of employment throughout the patient record, the employment status was classified as “Not Specified.” A patient was considered insured if there is any form of health coverage and uninsured if vice versa.

Healthcare utilization data collected included number of ED to Hospital-Admissions, which was the number of times the patient visited the ED and was later admitted to the Hospital. This information was obtained by reviewing the patient’s encounters for the years of interest. For patient’s data that do not have any record of admission, we investigated further for contact with the healthcare which included Emergency Department (ED) visit, Radiology visit, Procedures, Speech, Dialysis, Anesthesia, Physical therapy, Outpatient visit, appointment, Infusion therapy, Pulmonary Function Testing (PFT) screen and all other forms of office visit. The descriptive list of variables for this study is presented in Table 1.

Analysis

A total of 544 patients were randomly selected for this study. Random selection was done on the criteria that a patient must have at least one inpatient admission in 2012. Thirty-four patients were excluded due to missing values. The reference year or baseline year for the analysis is 2012,

in some cases we looked at the study participants prospectively for two years (2013 and 2014) and retrospectively for one year (2011) to carry-out statistical evaluation. SAS Software (SAS 9.4, Cary, NC) was used for all statistical analyses.

Descriptive analyses were performed to examine the frequency distribution of the demographic data (valid and missing observations). Patient data with missing values from variable race and BMI were excluded from the analysis. New variable was created based on rate of hospital utilizations for analytical purposes, admission counts for each year were dichotomized as 0 or 1. The categories were defined as: 1 for high-utilizer patient (HUP) status, defined as having three or more admissions per calendar year and 0 for non-high-utilizer patient (NHUP) status, defined as having less than three admissions per calendar year. To determine statistical significant differences between high-utilizers and non-high-utilizers chi-square tests of homogeneity were used for all categorical variables except for race. Due to the small number of patients in certain race groups, Fisher's exact test was used. Independent t-tests were used for continuous variables (age and BMI) and the level of significance was set at an alpha level of 0.05.

In addition, logistic regression model was performed to assess associations between the independent variables and outcomes of interest. The statistical modeling process was completed in two stages. The first stage was a bivariate logistic regression analysis. In bivariate analysis, logistic regression was performed to assess associations between each independent variable and each outcome variable resulting in odds ratios (OR) and its 95% confidence intervals (CIs). The second stage of the analysis was multivariate logistic regression model. Individual multivariate models were fit for each dependent variable, and all independent variables were included for this analysis. Trend analysis was done to illustrate the trends of hospital utilization among high hospital utilizer patients.

RESULTS

Descriptive Analysis

Of all the 510 study participants, 137 (27%) were classified as HUPs and 373 (73%) as NHUPs. High-utilizers and Non-high-utilizers' demographic characteristics are displayed in Table 2. Some demographic characteristics are found to be foundational determinants of health care utilization. From this study, we found that the age of patients and their BMI are both statistically significance (p-value < 0.05) between the high-utilizers and non-high utilizers. The gender of the patients was not statistically significance to the rate of inpatient service utilization in the hospital (p-value < 0.05) and race/ethnicity of the patients was also found not to be statistically significant.

Insurance status and Social histories varied significantly between HUPs and NHUPs. Rates of employment were significantly higher in HUPs than NHUPs, at 56% and 10%, respectively. Insurance use was more likely among the HUP, 20% of high-utilizers had insurance in 2012 while 9% of NHUPs had insurance in 2012. Alcohol use and substance use were also more likely among HUPs, 22% and 29% of high-utilizers had history of alcohol use and substance use respectively, compared to only 8% and 13% of non-high utilizers with history of alcohol use and substance use.

Logistic Regression

The logistic regression analyses were reported as odds ratio and 95% confidence (Table 3). This helped to understand which patient characteristics contribute to the odds of becoming a high hospital utilizer patient. The first model is the crude / unadjusted odds ratio, race and history of alcohol use were independent variable was found to be associated with the odds of becoming a high-utilizer. We found that patients who are black / non-Hispanic black had four times higher odds of being a HUP when compared to non-black patients (OR 4.42, 95% CI 2.08, 9.41). The odds of a male patient being a high-utilizer was (OR 1.00, 95% CI 0.67, 1.48) when compared to

female patient. Patients who had insurance were 1.6 times more likely to be a high-utilizer than patients without insurance (OR 1.61, 95% CI 0.89, 2.91). Patient with history of tobacco use had 1.3 times higher odds of HUP status compared to patients with no history of tobacco use (OR 1.29, 95% CI 0.81, 2.04). The second model, which was the adjusted odds ratio, adjusted for demographic factors (age, sex and race). We found that association of male patient becoming a high-utilizer was strengthened by the inclusion of age, sex and race. (from OR 1.00, 95% CI 0.67, 1.48 to OR 1.06, 95% CI 0.70, 1.60) while the association between being black and HUP was weakened (from OR 4.42, 95% CI 2.08, 9.41 to OR 4.39, 95% CI 2.06, 9.37). The third model, with the inclusion of the socioeconomic factors (insurance status and employment status), we observed that sex (male) and race/ethnicity were associated with higher odds of being a high-utilizer (from OR 1.06, 95% CI 0.70, 1.60 to OR 1.23 95% CI 0.74, 2.05) and (from OR 4.39, 95% CI 2.06, 9.37 to OR 4.67 95% CI 2.00, 10.89) respectively. In the final model, we adjusted for all the variables including the social factors (history of alcohol use, history of tobacco use, and history of substance use) and we found changes in the strength of the associations. Associations that were strengthened by inclusion of social factors were the history of alcohol use and history of substance use (from OR 0.36, 95% CI 0.20, 0.64 to OR 0.49 95% CI 0.19, 1.25) and (from OR 0.69, 95% CI 0.40, 1.20 to OR 0.98, 95% CI 0.39, 2.42) respectively. All other independent variables were weakened by the inclusion of the social factors.

Trends of Hospital Utilization among inpatient service population

The trends of hospital utilization among High Hospital Utilizers attending Grady Hospital is seen to be unstable. There were 137 HUPs in 2012. 37% of them continued to be HUPs in 2013, 39% NHUPs, 13% were no contact and 10% were deceased. Following the 37% of the HUPs over time (Figure 1), in 2014 we observed that 41% of the HUPs changed status to NHUPs, 37% of the

patients remained HUPs, 10% of the patients had no contact and 12% were deceased. Following the 39% 2012 NHUPs in 2013 (Figure 2), in 2014 we observed out that 11% became HUPs, 69% were still NHUPs, 11% were no contacts and 9% of them were deceased. In 2014, we also observed that out of 13% of no contact patients, none of them became HUPs, 17% became NHUPs while 78% of them were still no contacts.

Furthermore, we developed a prospective and retrospective (2011 to 2014) trend for 2012 HUPs (Figure 4) and we found that out of the 137(100%) HUPs in 2012, 48(35%) were HUPs in 2011. While 51(37%) and 19(14%) were HUP in 2013 and 2014 respectively. Only 19(14%) of the population of interest remained HUPs all through the study period. 72(53%) of 2012 HUP changed status to become either NHUP or no contact at the end of the first years. 14(10%) were deceased. At the end of the second year (2014), 6(4%) of the HUPs who changed status to either NHUPs or no contact in 2013 regained their HUP status. 60(44%) of the HUP did not regain back their original status of being HUP. 26(19%) lost their HUP status at the end of the study. Lastly, additional 12(9%) HUPs were deceased in 2014.

DISCUSSION AND CONCLUSION

Discussion on the study findings

High-utilizers are medically and psychosocially complex (23), they have high rates of emergency department (ED) visits and hospital admissions, and contribute to rising healthcare costs. Literature has shown that some characteristics of super-utilizers were relatively stable at the population level but non super-utilizers were not stable at the individual level (1). They were seen to be in and out of the HUP status on a monthly basis and has recommended that more research is needed to improve predictive modelling of this group of interest.

This study however was conducted to demonstrate the pattern by which individual moves in and out of HUP status over a four-year period (2011 - 2014), investigating the demographic, social-economics and social factors of the population of interest and we found out that there is significant difference between most of the selected demographics factors, all the selected socio-economics factors and some of the selected social factors of high-utilizers and non-high-utilizers of hospital inpatient services at Grady Hospital Atlanta, Georgia. Most high-utilizers were non-Hispanic black, with age ranges between 23 to 97 years of age. Majority of the HUPs were male patients with at least one form of employment and most of these patients had no insurance in 2012. This could imply that most of the 2012 HUPs were working with organizations that do not offer health coverage. These types of jobs might include menial jobs and part-time jobs that do not provide health coverage for the employee of the organization. The U.S. Department of Health and Human Services reported that there are many menial jobs with very poor or no health insurance benefits (22). And classified blacks at more risk than any other race. However, this could also imply that most of the community that uses Grady hospital are black with low socio-economic status (SES).

High-utilizers experienced less social issues, they were less likely to have used alcohol and tobacco. The rate of hospital usage in this population was seen to be lower among those who do not have any history of substance use than those that had the history of substance use. Interestingly, when we compared the rate of social barriers among HUPs and NHUPs, we found that the rate of alcohol use was higher among HUPs when compared to NHUPs at 22% against 8%. The rate of tobacco use was almost at same rate between HUPs and NHUPs at 25% and 26% respectively. The rate of substance use was higher among HUPs when compared to NHUPs at 29% against 13%. BMI mean did not vary significantly between the two groups but it was found to be statistically significant to high utilization of Hospital inpatient services.

There were some factors associated with an individual's odds of becoming a high-utilizer patient at Grady Hospital. One of the main factor is race/ethnicity of the patient which is not surprising because Metro Atlanta's levels of black race played a significant role in the health care utilization in Grady. When the multivariate analysis was adjusted for demographic factors and socio-economic factors, there was a significant increase in the association between race of the patient being black and increase rate of high hospital utilization. However, the inclusion of social factors in the model weakened the relation between race and the odds of being a high-utilizer. The second factor was sex, the odds of being a male and a high-utilizer increased upon the inclusion of demographic factors, socio-economic factors and there was a decrease in the level of association with the inclusion of the social factors.

The result of the trends of utilizations among inpatient of hospital services was fascinating. We observed that there was a steady rate of HUPs from 2012 to 2013 and 2013 to 2014. 37% of the HUP remained to be HUPs in 2013 and same rate of 37% still retained their HUP status in 2014. It was hypothesized that, high-utilizers are likely going to remain high-utilizers during the

study period. However, this hypothesis was partly supported by this data because a constant percentage of HUPs was observed over time and in the other hand, not all HUPs remained HUPs all through the study period, hence the overall trend is unstable and unpredictable. Also, we identified that its easier for patients in the HUP group to continue to be high hospital utilizers when compared to the rate at which NHUPs change status to HUPs. This can be further explained with the fact that 37% of HUPs remained HUP at the end of the study, 11% of the NHUPs became HUPs at the end of the study while there was no patient from the no contact group that became HUP at the end of the study. Hence, interventions and care that will prevent high utilization of hospital service will bring about overall reduction in healthcare cost.

Study Strengths and Limitations

This study is important for creating new policy and predictive model, also the study has a true representation of real life situation. The main strength of the study is the random selection of study participants which provide better control over possible bias. Also, using a public hospital data is another strength, this give access to population of a wide range of patients that has more diverse demographic, socioeconomic and social profile than patients in private hospitals.

Qualitative data also has unique strengths that would contribute to our understanding of high-utilizer patients. Semi-structured in-depth interviews with select patients could provide rich, qualitative data that would not only supplement knowledge gained from predictive models and patient surveys, but could also shed light on previously unconsidered risk factors to high utilization that could guide future research. Qualitative data also has the potential to identify areas of intervention that may not be apparent from exclusively quantitative data.

One limitation is that there was substantial amount of social data that had not specific responses. It is possible that patient's engagement was not properly done thereby leaving most

responses as not specific and thereby losing some positive responses out of the data. Hence, result should be interpreted with caution and future study should plan to collect more responses on the social history data. Also, the race/ethnicity of the study participant was most black, hence giving little representation of another ethnicity.

Implications of Findings

The implication of this study is that the information from this study can be used to develop interventions and tools to predict a patient's future use of healthcare. In addition, this will help Grady Hospital to keep patients as non-high utilizers because it was seen that the chances of a high-utilizer to continue to be a high-utilizer was much higher than the chances of a non-high utilizer becoming high-utilizer from the trends observed from this study. Also, introduction of coordinate care will be encouraged to reduce the number current number of high-utilizers at Grady Hospital.

Conclusions

This study shows that hospital utilization is impacted by demographic characteristics such as age, socio-economic characteristics such as health coverage (insurance) and employment status. All the social factors except the history of alcohol use were also seen to be impactful in being a high hospital utilizer at Grady. In conclusion, the trends of inpatient hospital utilization at Grady Hospital is predictable. Hence, the pattern of hospital utilization among high utilizers is unstable and unpredictable, and may be driven by race. Our study shows that reducing health care cost may require developing predictive models to reduce hospital over-utilization usage among at risk group. And adequate coordinate care interventions can be set aside for the at risk group to mitigate against high cost of health care.

Table 1: The descriptive list of variables of interest for this study

#	Variable Name	Variable Description	Dependent/ Independent	Variable Type
Demographics				
1	Age	Age	Independent	Continuous
2	Sex	Sex	Independent	Categorical
3	Race	Race/Ethnicity	Independent	Categorical
Socioeconomic Data				
4	Employment Status	Was the patient employed in 2012?	Independent	Categorical
5	Insurance Status	Any health coverage in 2012?	Independent	Categorical
Number of Admissions				
6	All_admit_2011	2011 Admissions	Dependent	Discrete
7	Seen_2011 When [all_admit_2011] = '0'	Was the patient seen at Grady in 2011?	Dependent	Categorical
8	All_admit_2012	2012 Admissions	Dependent	Discrete
9	Seen_2012 When [all_admit_2012] = '0'	Was the patient seen at Grady in 2012?	Dependent	Categorical
10	All_admit_2013	2013 Admissions	Dependent	Discrete
11	Seen_2013 When [all_admit_2013] = '0'	Was the patient seen at Grady in 2013?	Dependent	Categorical
12	All_admit_2014	2014 Admissions	Dependent	Discrete
13	Seen_2014 When [all_admit_2014] = '0'	Was the patient seen at Grady in 2014?	Dependent	Categorical
Social Data				
14	Alcohol use	Any history of alcohol use	Independent	Categorical
15	Tobacco use	Any history of tobacco use	Independent	Categorical
16	Substance use	Any history of substance use	Independent	Categorical
Medical Data				
17	BMI	$(\text{weight}/([\text{height}]*[\text{height}]))*703$	Independent	Continuous

Table 2: Demographic Characteristics of Study Participants in 2012.

Participant Characteristics	All Patients	Non-High-Utilizers Patients (<3 Admissions)	High-Utilizers Patients (≥3 Admissions)	P-Value
Total sample size	N=510	N=373	N=137	
Mean (Range)				
Age, years	58.3 (21.0 – 98.0)	58.0 (21.0 – 98.0)	59.1 (23.0 – 97.0)	<0.0001
BMI, kg/m²	27.7 (13.3 - 73.4)	27.7 (13.6 – 72.4)	27.6 (13.3 – 63.3)	<0.0001
Sample size (Percentage)				
Sex				
Male	287 (56.3)	210 (56.3)	77 (56.2)	0.0046
Females	223 (43.7)	163 (43.7)	60 (43.8)	
Race				
Black	421 (82.6)	292 (78.38)	129 (94.2)	0.0003
White	62 (12.2)	57 (15.3)	5 (3.6)	
Latino/Latina	18 (3.5)	16 (4.3)	2 (1.5)	
Asian	3 (0.6)	2 (0.5)	1 (0.7)	
Others	5 (1.0)	5 (1.3)	-	
Not specified	1 (0.2)	1 (0.3)	-	
Employment status				
Employed	112 (22.0)	36 (9.7)	76 (55.5)	<0.0001
Unemployed	9 (1.8)	4 (1.1)	5 (3.7)	
Not specified	389 (76.3)	333 (89.3)	56 (40.9)	
Insurance status				
Insured	61 (12.0)	34 (9.1)	27 (19.7)	<0.0001
Uninsured	157 (30.8)	69 (18.5)	88 (64.2)	
Not specified	292 (57.3)	270 (72.4)	22 (4.3)	
Alcohol use				
Yes	61 (12.0)	31 (8.3)	30 (21.9)	<0.0001
No	241 (47.3)	179 (48.0)	62 (45.3)	
Not specified	208 (40.8)	163 (43.7)	45 (32.9)	
Tobacco use				
Yes	129 (25.3)	95 (25.5)	34 (24.8)	0.0008
No	298 (58.4)	204 (54.7)	94 (68.6)	
Not specified	83 (16.3)	74 (19.8)	9 (6.6)	
Substance use				
Yes	86 (16.7)	47 (12.6)	39 (28.5)	<0.0001
No	129 (25.3)	82 (22.0)	47 (34.3)	
Not specified	295 (57.8)	244 (65.4)	51 (37.2)	

Table 3: Association Between Selected Socio-demographic Characteristics of 2012 HUPs and High Hospital Utilization of inpatient services.

	Unadjusted / Crude odds ratio		Adjusted for Age, Sex and Race		Adjusted for Insurance status and Employment status		Adjusted for Alcohol use, Tobacco use and Substance use	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Age, years	1.01	0.99, 1.02	1.00	0.99, 1.02	1.00	0.99, 1.02	1.00	1.00, 1.02
Sex								
Females	Ref	-	Ref	-	Ref	-	Ref	-
Male	1.00	0.67, 1.48	1.06	0.70, 1.60	1.23	0.74, 2.05	1.17	0.67, 2.05
Race								
Non-Black	Ref	-	Ref	-	Ref	-	Ref	-
Black	4.42	2.08, 9.41	4.39	2.06, 9.37	4.67	2.00, 10.89	3.93	1.61, 9.56
Employment status								
Unemployed	Ref	-			Ref	-	Ref	-
Employed	0.59	0.15, 2.34			0.59	0.14, 2.56	0.5	0.10, 2.39
Insurance status								
Uninsured	Ref	-			Ref	-	Ref	-
Insured	1.61	0.89, 2.91			1.35	0.69, 2.66	1.04	0.49, 2.19
Alcohol use								
No	Ref	-					Ref	-
Yes	0.36	0.20, 0.64					0.49	0.19, 1.25
Tobacco use								
No	Ref	-					Ref	-
Yes	1.29	0.81, 2.04					1.59	0.85, 2.99
Substance use								
No	Ref	-					Ref	-
Yes	0.69	0.40, 1.20					0.98	0.39, 2.42

OR - Odds ratio, CI – confidence interval

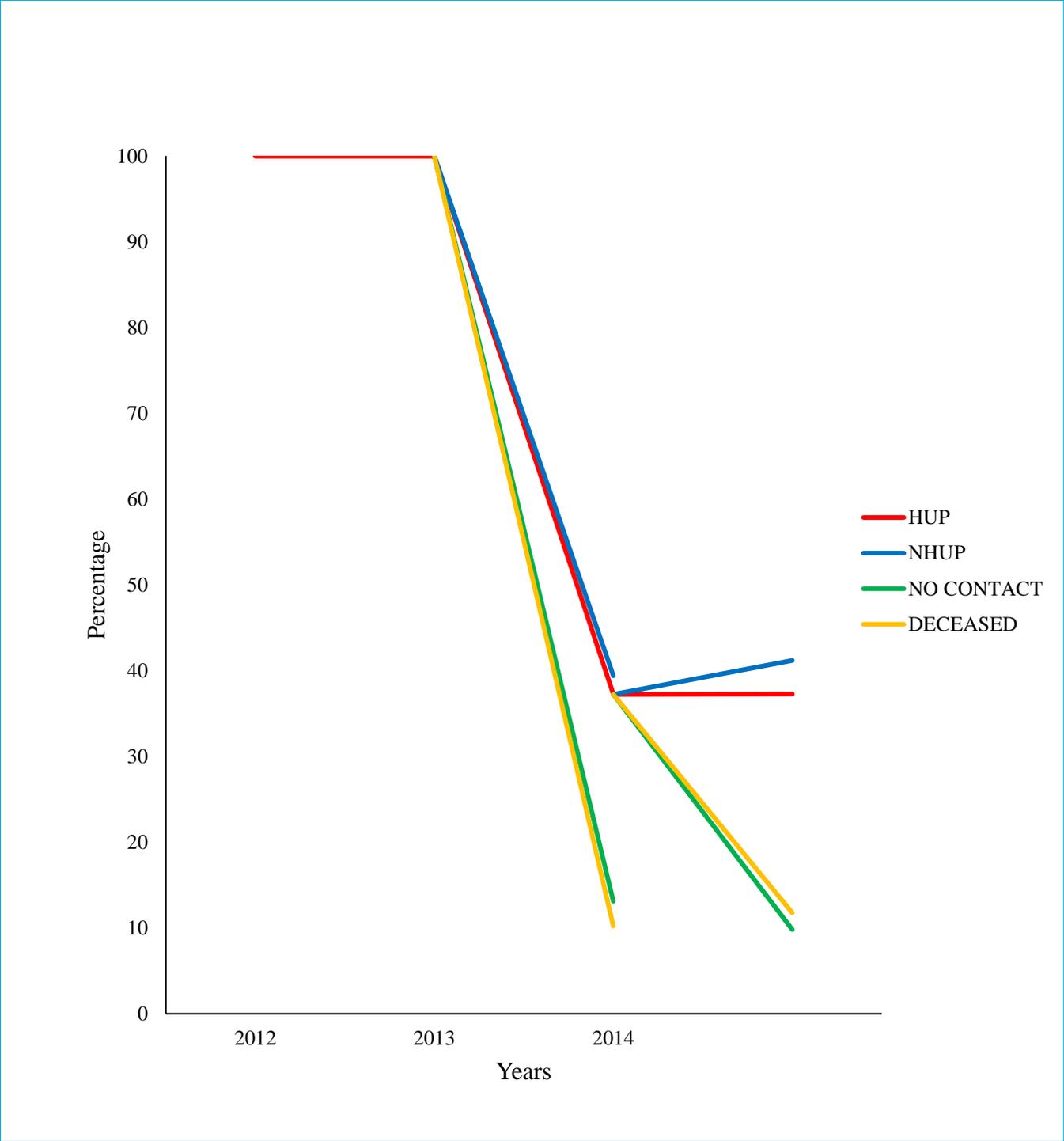


Figure 1: Pre and Post pattern of Hospital Utilization among patients who were identified as High Utilizer Patients in 2013.

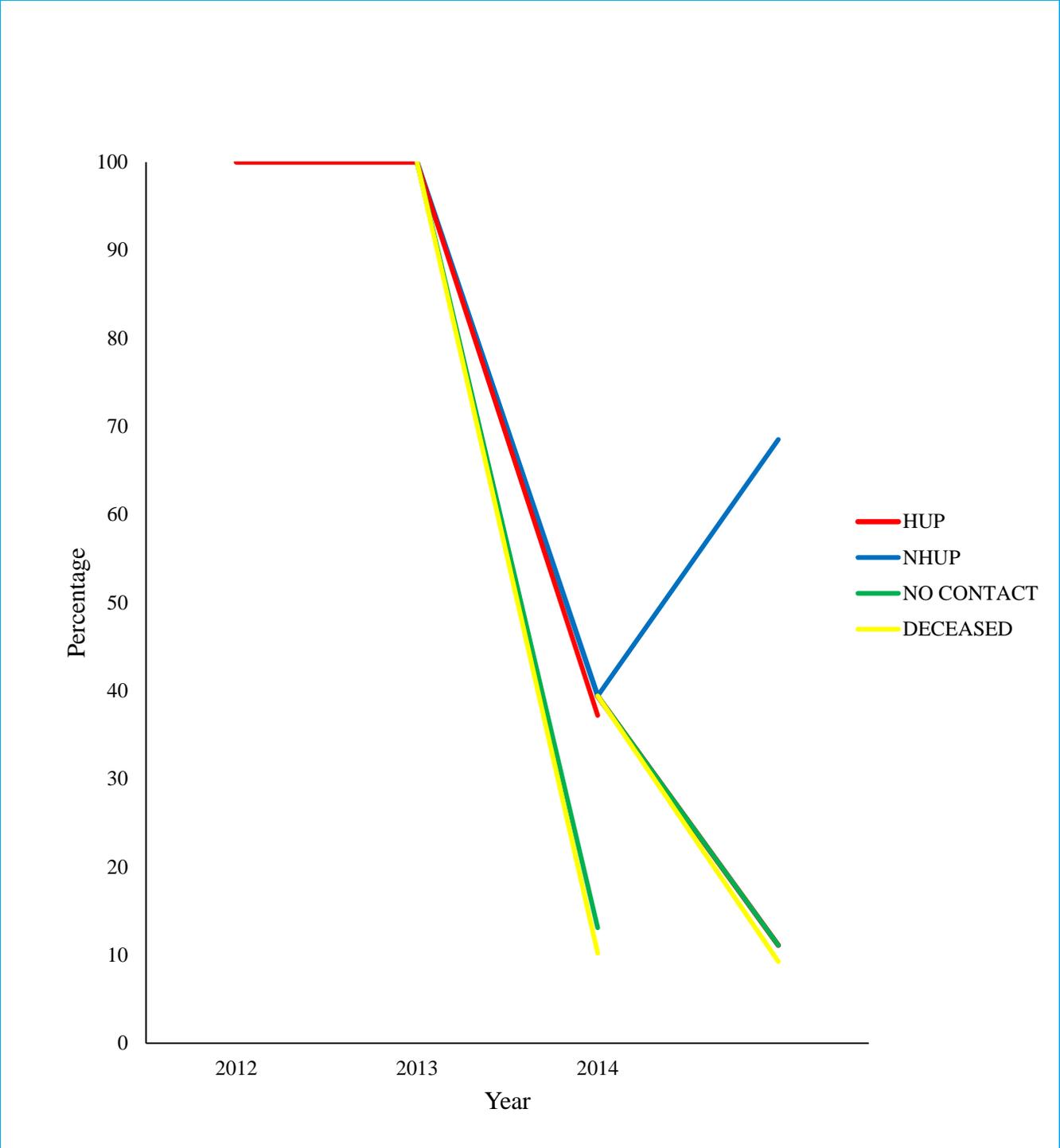


Figure 2: Pre and Post pattern of Hospital Utilization among patients who were identified as Non-High Utilizer Patients in 2013.

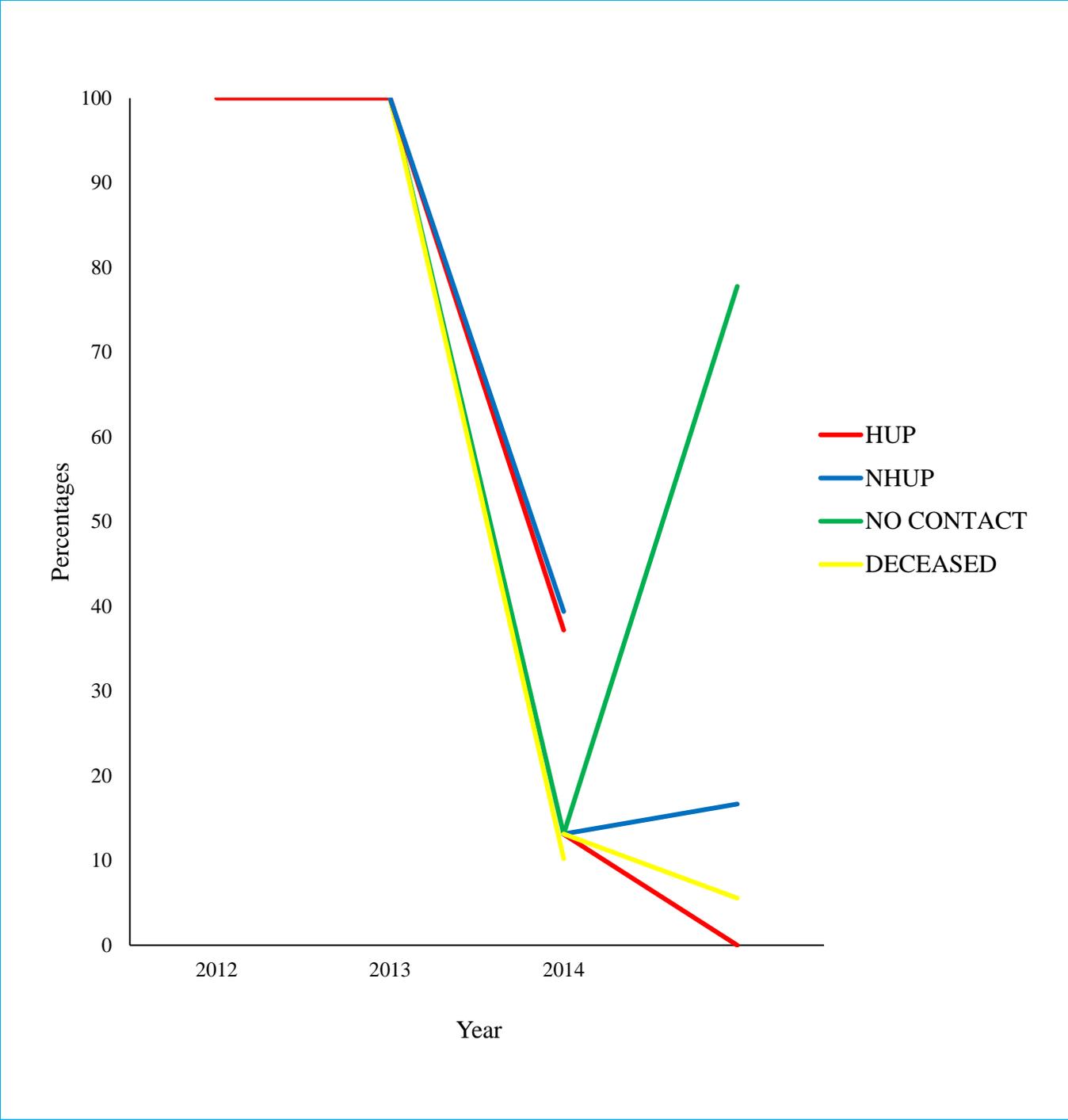


Figure 3: Pre and Post pattern of Hospital Utilization among Patients who were not seen at the Hospital in 2013.

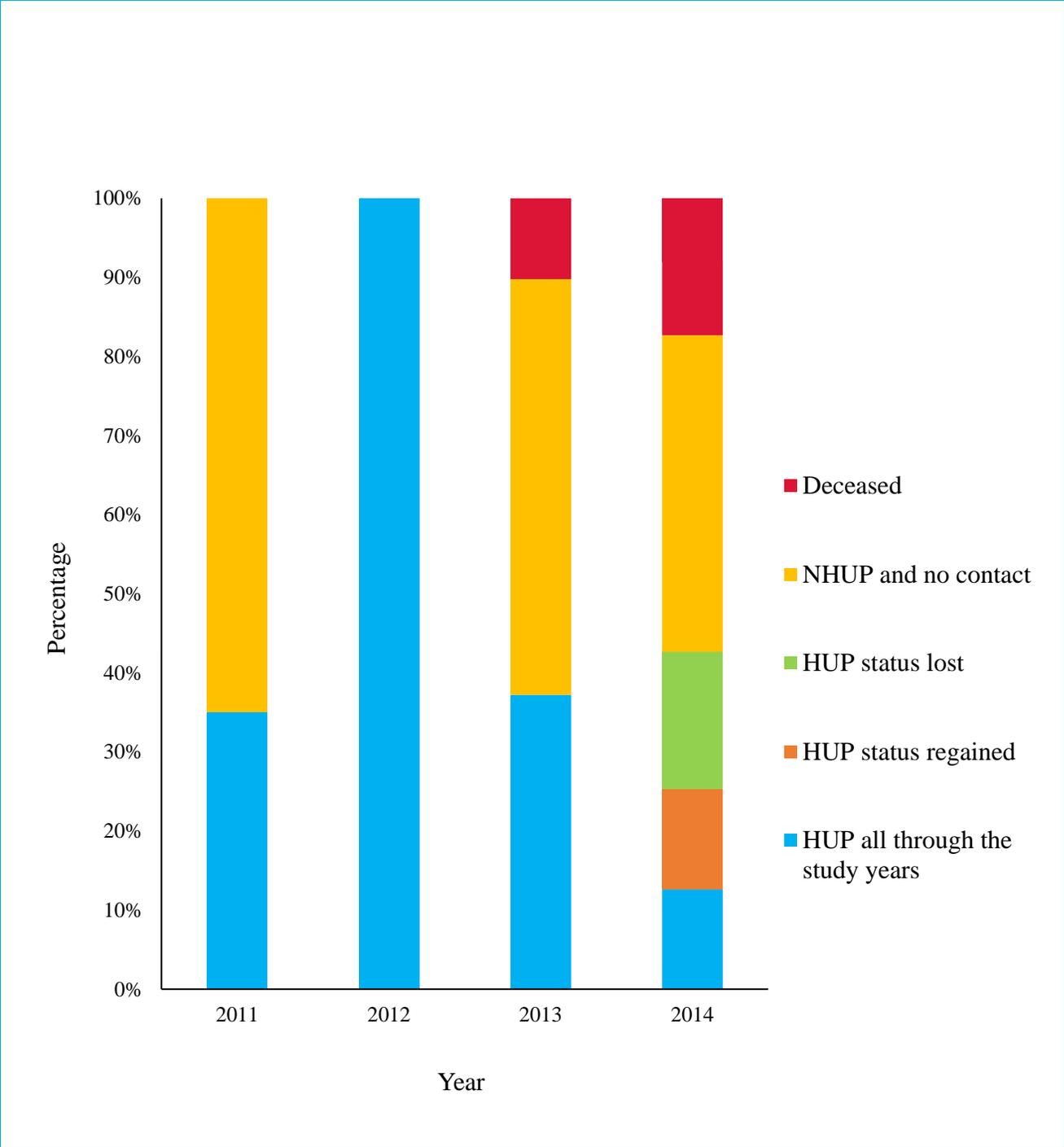


Figure 4: Prospective and Retrospective Trend of 2012 High-utilizers

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APPENDIX A. Chart Abstraction Protocol

- 1.** Log into an outpatient environment in Epic (ex. Green/Purple/Orange Pod).
 - Simultaneously, open the patient's record in RedCap.
 - Copy the MRN from RedCap.
 - Complete the missing field on RedCap from the abstracted chart on Epic
 - Mark the patient information as complete and save.
 - Please use all lowercase letters for free text where necessary.
- 2.** Using the chart review button, type the MRN into the "patient lookup" box and search.
- 3.** Fill in the Demographics form in RedCap from information on the "patient snapshot" page.
 - Race/ethnicity can be found by clicking on where it says "Demographics" above the patient's name and then clicking on "Clinical Information."
 - If the patient is deceased, the date of death will be written in the same box as their name on the snapshot screen.
- 4.** In Epic, click on chart review notes tab
- 5.** Apply a filter by clicking filters tab then type the dates that you want to look at (ex. 1/1/14 to 12/31/14) and search.
- 6.** Sort by encounter date.
- 7.** Crosscheck the admission records for the given calendar year.
 - Fill in the number of admissions field based on the information on Epic.
 - Also, discharged summaries were further reviewed to further establish the admission records.
 - Make sure the number of discharge summaries correlates with the number of admissions your listed on the previous form.

- If there is no admission record in the specific year per patient, then take the next step
- 8.** Check if the patient was seen at Grady in the given year.
 - On RedCap, input record Yes or No where admission is 0.
 - 9.** For number of ED visits, go back to the notes tab. Scroll down and click “ED provider notes.” There is at least one ED provider note per ED visit (if the patient was seen), so you can just count the number of separate visits under this
 - 10.** Click complete and save form.