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Emergency-Only Dialysis Utilization at Grady Memorial Hospital and Emory Hospitals

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Abstract

Background: End-stage renal disease (ESRD) is the most advanced stage of chronic kidney disease (CKD) and necessitates dialysis. In the United States, undocumented individuals do not have access to scheduled dialysis, resorting to emergency dialysis under EMTALA, an arrangement which results in higher morbidity and mortality rates compared to those with scheduled treatments. Additionally, emergency-only dialysis is more costly than scheduled dialysis, creating an economic argument for providing scheduled dialysis to undocumented individuals with ESRD.

Methods: This was a cross-sectional study to assess the frequency of emergency-only dialysis visits, cost, and duration of stay for undocumented ESRD patients at one public and two private hospitals affiliated with Emory University. The study employed univariate and multivariable linear regression models and Lorenz curves.

Results: Patients who relied on emergency-only dialysis had an average of 49.4 annual visits at the public hospital and 8.1 annual visits at the private hospitals. The average expense per visit across all hospitals was $1,363. In the model comparing costs between the two private hospitals, the predicted cost per visit at EUH was $1,492, while at SJH it was $998, with age and sex being significant cost predictors. For visit frequency, cost, and length of stay, the Gini coefficients at the public hospital were consistently lower than those at the private hospitals.

Conclusion: These results highlight the resource-intensive nature of emergency-only dialysis at all the hospitals in the study. This leads to wide-ranging consequences and challenges for healthcare providers and patients alike.

Words: 244/350

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Background

By some estimates, chronic kidney disease (CKD) affects as much as 13% of the population,[1] or nearly 40 million individuals in the United States. The biggest drivers of CKD are diabetes and hypertension. There are multiple means of calculating glomerular filtration rate (GFR), which estimates kidney function and the progression of CKD.[1] The most severe form of CKD is end-stage renal disease (ESRD). It is defined by dependence on dialysis to perform the functions of the kidneys once they become minimally functional.

In the United States, citizens with ESRD are covered under Medicare, which at that time was the only disease-specific coverage, since the program was originally meant to cover only old age and disability. This coverage stems from a 1972 amendment to the Social Security Act of 1935, which expanded the act to include ESRD coverage for those who qualified for Social Security[2]. However, this benefit has never extended to undocumented individuals, even those who contribute to Social Security.[3] Instead, they qualify for emergency dialysis under EMTALA (Emergency Medical Treatment and Active Labor Act). Passed in 1986, EMTALA stipulates that emergency departments must treat or stabilize patients who present with emergent medical conditions, but provided no funding for this mandate.[3] Ten states in the United States have expanded Medicaid so that undocumented individuals with ESRD qualify for scheduled dialysis.[4] In the other 40 states, these individuals present to emergency departments when they feel ill and receive emergency dialysis once their electrolyte derangements become life-threatening.[4]

The morbidity and mortality rates for patients on emergency-only dialysis are higher than for those on scheduled dialysis. A retrospective cohort study published in JAMA in 2018 examined patients who initiated emergency-only versus scheduled hemodialysis from 2007-2014. The three-year mortality for emergency-only dialysis patients was nearly five times that of the standard dialysis group.[2] The five-year hazard ratio for mortality was 48 in the Hispanic subgroup.

A landmark study out of Parkland Memorial Hospital in Dallas, Texas, employed an observational cohort study over 18 months to analyze health outcomes and frequency of healthcare utilization. Of the 181 patients in the cohort who initially all received "emergency-only" dialysis, 105 qualified for and enrolled in private insurance in February 2015 under the Affordable Care Act, allowing them to receive scheduled dialysis. Mortality was significantly decreased in those in the scheduled dialysis arm of the study compared to the control group that continued to receive emergency-only dialysis. Over the year that followed, the mortality rate was 3% in scheduled dialysis group as compared to 17% in the control group, resulting in a hazard ratio of 4.6 for those who remained in the emergency-only dialysis group.[4]

Other measures of healthcare utilization were also improved in the scheduled dialysis group. The number of emergency department visits in this group decreased by 5.2 visits per month, as compared to an increase of 1.1 visits per month in the group that remained on emergency-only dialysis.[4] The number of hospital stays and length of these stays were also highly favorable toward the group with insurance on scheduled dialysis, as these individuals no longer had to report to an emergency department every time they required dialysis. Confounding by other determinants of these outcomes was addressed by the design features of the negative binomial regression model, including a propensity-score adjusted difference-in-difference interaction term between the main exposure (scheduled vs emergency dialysis) and the baseline-follow-up difference.

In addition to the evidence that scheduled dialysis results in improved health outcomes for undocumented immigrants with ESRD, there is also a strong economic argument for scheduled dialysis. The same Parkland Memorial Hospital study showed that the monthly cost savings per patient enrolled in scheduled dialysis was $5,768.[4] An additional study out of Texas found that emergency-only dialysis costs nearly four times as much as scheduled dialysis. The annual per patient cost of emergency-only dialysis was estimated to be $285,000, whereas the annual per patient cost of scheduled dialysis was $77,000.[3] Because undocumented immigrants with ESRD are not in the US Renal Data System data, there is no precise figure for the number of individuals in this category. Extrapolating from California data, however, we can assume there are approximately 6,500 undocumented individuals with ESRD, and the total cost of providing scheduled dialysis to this entire population would be $260 million annually.[5] This population contributes to public health and welfare without receiving its benefits – undocumented workers contribute $15 billion annually to Social Security payroll taxes.

Methods

This was cross-sectional study of patients treated at Grady Memorial Hospital, Atlanta's public safety-net hospital, and two Emory University hospitals, Emory University Hospital and Emory Saint Joseph's Hospital, both private hospitals. For brevity, these will be referred to as the public and private hospitals throughout the rest of the paper. Inclusion criteria for the study were patients presenting to the emergency department at these three hospitals any time during 2019 or 2020 who were given an "observation" designation. Diagnosis codes of ICD-10 code I12.x or I13.x, or a Current Procedural Terminology code 82000002 for hemodialysis were used, as these codes were used to determine ESRD status. Patients also had to fall under the insurance status of self-pay, which was used as the proxy for undocumented status. A previous Emory University study on the same topic conducted a chart review on the patients included in the study to verify the accuracy of this proxy. All of the self-pay patients at Grady Memorial Hospital in this study were undocumented, and half the patients at the Emory University hospitals were undocumented. Exclusion criteria were those admitted to the hospital or patients with a length of stay greater than 48 hours, as these patients were considered miscoded and were assumed to have ultimately been admitted.

The main objective of this study was to evaluate emergency-only dialysis visit frequency, direct cost, and length of stay in the observation unit for undocumented emergency-only dialysis patients in these three Emory-affiliated hospitals. A univariate linear regression was used to examine the relationship between hospital type (public or private) and predicted cost and length of stay. More variables were available in the data from the private hospital dataset. Accordingly, a multivariable linear regression was created to examine the relationship between these two individual private hospitals and predicted cost and length of stay. To understand the inequality in visit frequency across the three hospitals in the study, we used Lorenz curves, a graphical representation of inequality used commonly in economic research. These metrics allow us to quantify the extent to which a small percentage of patients disproportionately utilize the resources under analysis. Understanding these disparities can inform policy and resource allocation. All statistical analyses were performed with Stata/SE 17.9.

Results

I. General summary of utilization of emergency-only dialysis

The overall use of emergency-only dialysis is shown in **Table 1**. There were 15,637 visits for emergency-only dialysis over the two year study period. Of this total, 15,116 visits were to Grady Memorial Hospital. The total number of people utilizing emergency-only dialysis across all hospitals was 185. Of this population, 153 patients went to Grady Memorial Hospital. The average number of annual visits per person was 49.4 at the public hospital, while at the private hospitals the average number of annual visits per person was 8.1. The average length of stay across hospitals was 11.35 hours. The average cost per visit across hospitals was $1,363. The average number of annual visits per person and average length of stay were combined for a measure called total annual observation days per patient. The average patient at the public hospital spent 23.7 days of the year waiting for or receiving emergency-only dialysis. The average patient at the private hospitals spent 2.4 days doing the same. Over the two year study period, the total cost for all emergency-only dialysis visits was $21.3 million ($10.7 million annually). The annual cost to the public hospital was $10.3 million, while the annual cost to the private hospitals was $330,343.

The variation in annual visit frequency is shown in **Figure 1**. At the public and private hospitals alike, the most common visit frequency was a single visit, which is represented as 0.5 visits annually. Of the 32 total individuals who received emergency-only dialysis at the private hospitals, only 13 individuals went for repeat visits. The maximum number of annual visits to the private hospitals was 78.5. For the public hospital, we see that the second most common visit frequency (behind a single visit) was between 90-100 visits annually.

Figure 2 visualizes the cost and length of stay between the public and private hospitals. The differences in cost and length of stay between the public and private hospitals were both statistically significant ($p<0.0001$ for both). The average cost per visit at the public hospital was $1,375. At the private hospitals, the average cost per visit was $1,268. The mean cost difference was $106. In terms of time spent at the hospital, the average length of stay was 11.5 hours at the public hospital and 7 hours at the private hospitals. The mean difference in length of stay was 4.5 hours.

II. Multivariable linear regression

Separate multivariable linear regression between the two private hospitals, Emory University Hospital (EUH) and Saint Joseph's Hospital (SJH), examined cost and length of stay as a function of three independent variables: hospital, age, and sex. The multivariable linear regression examining cost between the two private hospitals was statistically significant, and the adjusted R-squared of the model was 0.28 or 28%. In the model, the predicted cost per visit at EUH was $1,492, whereas the predicted cost per visit at SJH was $998. On average, the predicted cost for patients at SJH was lower by about $495 (SE: +/- $36) compared to patients at EUH, holding age and sex constant. Age and sex were each significant predictors of cost in this model. The coefficient for age was -5.58 (SE:

+/- 1.92). This suggests that the cost decreases, on average, by $5.58 for each additional year of age, holding the hospital and sex constant. The coefficient for sex (males relative to females) was -508 (SE: +/- 113). This suggests that the predicted cost for male patients is lower by about $508 compared to female patients, holding the hospital and age constant.

The model for length of stay was also statistically significant, with an adjusted R-squared of 0.08 or 8%. However, after adjusting for age and sex, there was no statistically significant difference in the length of stay between the two private hospitals. The predicted length of stay for patients at EUH was 7.1 hours (95% CI: 6.68 - 7.52), while the predicted length of stay for patients at SJH was 7 hours (95% CI: 6.53 - 7.45). The difference in the average predicted length of stay between the two hospitals (EUH relative to SJH) is not statistically significant, with a coefficient of -0.106 (SE: +/- 0.319). Age and sex were each significant predictors of length of stay ($p = 0.03$ and $p < 0.0001$, respectively). Age had an estimated coefficient of +0.04, suggesting that, on average, a one-year increase in age was associated with a 0.04 hour increase in the length of stay. Sex had an estimated coefficient of -5.64, suggesting that, on average, males spent about 5.5 fewer hours in the hospital per visit compared to the reference group of females. However, of note, there were far more male than female patients at the private hospitals. Of the total 521 visits to private hospitals for emergency-only dialysis, just 14 of these were made by females. The multivariable linear regression model for cost has more explanatory power than that for length of stay, given that the adjusted R-squared is 0.28 for that model compared with 0.08 for this length of stay model.

III. Metrics of inequality in utilization results

In **Figure 3**, emergency-only dialysis visit frequency, sum of cost, and sum of length of stay is plotted on a Lorenz curve. This curve plots the cumulative percentage of a given variable against the cumulative percentage of the population. A straight line (y=x) represents perfect equality. The further the deviation from this line, the more extreme the inequality. The Gini coefficient, then, is a single numeric value derived from the Lorenz curve that quantifies the degree of inequality in the distribution of a variable. The Gini coefficient ranges from 0 to 1, with 0 indicating perfect equality and 1 indicating perfect inequality, where one person consumes all resources. In this context, a straight line would indicate that each patient is using the same amount of resources. The greater the deviation from the straight line, the more that a small percentage of patients disproportionately utilize the metric under consideration.

Across all metrics, for our study population, the curve deviates further from the straight line in the graphs for the private hospitals. In other words, a smaller number of patients is making a higher cumulative percentage of visits, length of time, and cost at the private hospitals than at the public hospital. The exact Gini coefficients, all of which are statistically different from zero, are compared between the public and private hospitals in **Table 2**. Across all three metrics – visit frequency, cost, and length of stay – the Gini coefficients at the public hospital are all 0.44, albeit with different confidence intervals. At the private hospitals, the Gini coefficient ranges from 0.75-0.79 across these same metrics. The 95% confidence intervals for these values are also wider at the private hospitals given that there are fewer patients in the private hospital study arm.

Discussion

It is established that emergency-only dialysis results in worse health outcomes, higher rates of healthcare utilization, and much higher overall healthcare costs. Our results provide data to further support this argument, as we found that patients relying on emergency-only dialysis likely do not receive the necessary frequency of treatment, with a higher burden of visits and costs borne by the public hospital. Additionally, our analysis using the Lorenz curve and Gini coefficients demonstrated greater inequality in resource utilization at private hospitals compared to the public hospital.

The individuals relying on emergency-only dialysis as treatment are almost certainly not receiving dialysis on the necessary schedule of three times weekly. At the public hospital, the average number of annual visits was 49.4, just under one weekly visit for dialysis. At the private hospitals, the average number of annual visits was 8.1, suggesting that these individuals were not relying on these hospital dialysis sessions as their only source of dialysis.

The public hospital bore the bulk of the visits and, accordingly, the expense of the treatments. Of the nearly $10.7 million spent on emergency-only dialysis annually at these hospitals, $10.3 million was at the public hospital. The figures in this paper are almost certainly an underestimate of the true financial burden of emergency-only dialysis. Since this study only included patients whose visits were less than 48 hours, the cost estimates did not include patients who were admitted for further treatment of the complications stemming from missed dialysis. The study out of Parkland Memorial Hospital in Dallas, Texas, which followed patients who were started on scheduled dialysis after being enrolled in insurance via the Affordable Care Act, found average monthly savings per patient of $5,768.[4] If this same savings figure were used for our study population of 153 individuals at the public hospital, scheduled dialysis would save Grady Memorial Hospital over $10.5 million annually. Grady Memorial Hospital closed its outpatient dialysis center in 2009 after it was losing $2-4 million annually.[6] When this occurred, Grady Memorial Hospital drew up contracts for the existing 90 outpatient dialysis with Fresenius, but at this time, advocates were already voicing concern for future undocumented patients in need of outpatient dialysis.[6]

Medical treatment for non-acute conditions can generally be provided more cost effectively and with better continuity of care in settings outside the emergency department. While there is no universally accepted definition for frequent users, many studies classify them as those making more than four visits to the emergency department annually.[7] Interventions to redirect frequent users to other resources have been met with varying success. This population tends to also have high levels of non-emergency department health expenditures, suggesting that the severity of their health conditions contributes to the frequency of presentations.[7] Effective initiatives often target specific subgroups within the frequent user category, such as those with particular diagnoses.[7] This study aligns with this approach, as we understand the context within which these undocumented ESRD patients seek emergency-only dialysis.

Newer research has further categorized the services used by frequent users, as some patients and some conditions are more resource-intensive than others. One study examining the inequality of the use of imaging in the emergency department modified the "h-index." This index has more traditionally been used to grade the publication records of academic researchers, but it is related to the Gini index. This H-index accounts for both visit frequency and number of radiographic images obtained per visit. The study found that the patients in the study's highest-use category comprised just 0.2% of the sample population but utilized 18.6% of imaging resources.[8]

The Lorenz curve and Gini coefficients summarized in the results section provide an analysis of the inequality within the population in our study. For context, when Gini coefficients are used to quantify income inequality between nations, the most unequal country in the world is South Africa, with a coefficient of 0.63, or 63%.[9] The inequality at the private hospitals exceeded this, with the Gini coefficients ranging from 0.75-0.79, seen in **Table 2**. This inequality aligns with the distribution of visits seen in **Figure 1**, where the vast majority of patients visited the private hospitals once, and only several patients made repeated visits. For a distribution like this, a person-level intervention, such as a social worker or case worker, would be useful to target the needs of these individuals. Alternatively, for the public hospital in our study, the Gini coefficients were relatively low – 0.44, or 44% – for all metrics. This Gini coefficient, taken alongside the overall patterns of use shown in **Figure 1**, suggest that there is high need overall. A solution at the public hospital, then, would be more comprehensive and would likely stem from policy-level change at the hospital or legislative level. The Gini index could indeed join other federally required emergency department metrics, such as laboratory turnaround time, recently used to sanction low-performing emergency departments. The use of inequality measures has been hampered in the past by HIPAA privacy laws which limit the use of patient identifiers, but methods for medical record number anonymization have the potential to fix this issue. These efforts have been ongoing by an advocacy group of clinicians and researchers at Grady Memorial Hospital since the closure of the outpatient dialysis clinic.

Limitations

As discussed in the methods section, we used the insurance status of "self-pay" as a proxy for documentation status. While this proxy was accurate for all charts at the public hospital, it was only accurate for half of the patients who visited the private hospitals. Many more patients visited the public hospital, Grady Memorial Hospital, for emergency-only dialysis. As such, the weight of our overall averages skewed toward the averages at the public hospital, and the sample size for the private hospitals was relatively small. Although the majority of the data came from Grady Memorial Hospital records, there were fewer available variables in this dataset. As a result, we could not explore the demographics of the patients utilizing emergency-only dialysis and identify demographic factors potentially associated with greater rates of utilization.

Conclusions

This study aimed to understand the visit frequency, length of stay, and cost for patients seeking care at one public and two private hospitals. The length of stay was longer and the cost was higher at the public hospital, where the vast majority of emergency-only dialysis was performed within the Emory University hospital system. The implications of this resource-intensive dialysis arrangement have ramifications beyond the patients who seek dialysis in the emergency department. When ESRD patients without scheduled dialysis report to the emergency department for dialysis, the impact of these frequent ER visits has wide-ranging consequences. Overcrowding and increased demand for emergency department services can negatively affect the quality of care provided to other patients presenting with severe acute illness, leading to a cascade of challenges for healthcare providers and patients alike.

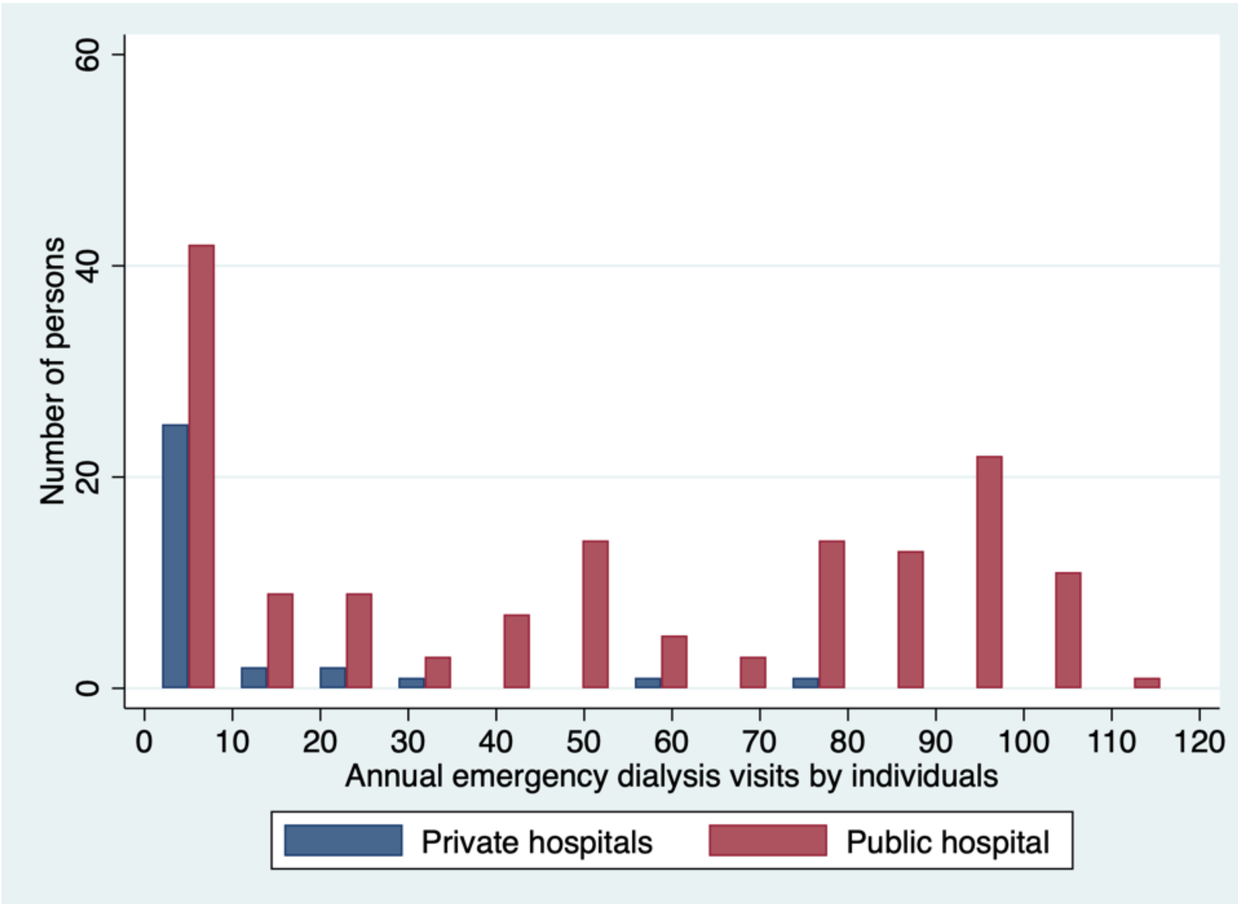
Table 1: General demographics

	Public hospital (95% CI)	**Private hospitals (95% CI)**	**Overall**
Total visits	15,116	521	15,637
Total persons	153	32	185
Mean visits/person/year	49.4	8.1	42.3
Mean cost per visit ($)	1,375 (1,373-1,376)	1,268 (1,240-1,297)	1,373
Mean length of stay (hours)	11.5 (11.4-11.6)	7 (6.7-7.4)	11.35
Total annual cost ($)	10,322,634	330,343	10,652,977
Total annual observation days per patient	23.7	2.4	20

Table 2: Gini coefficients

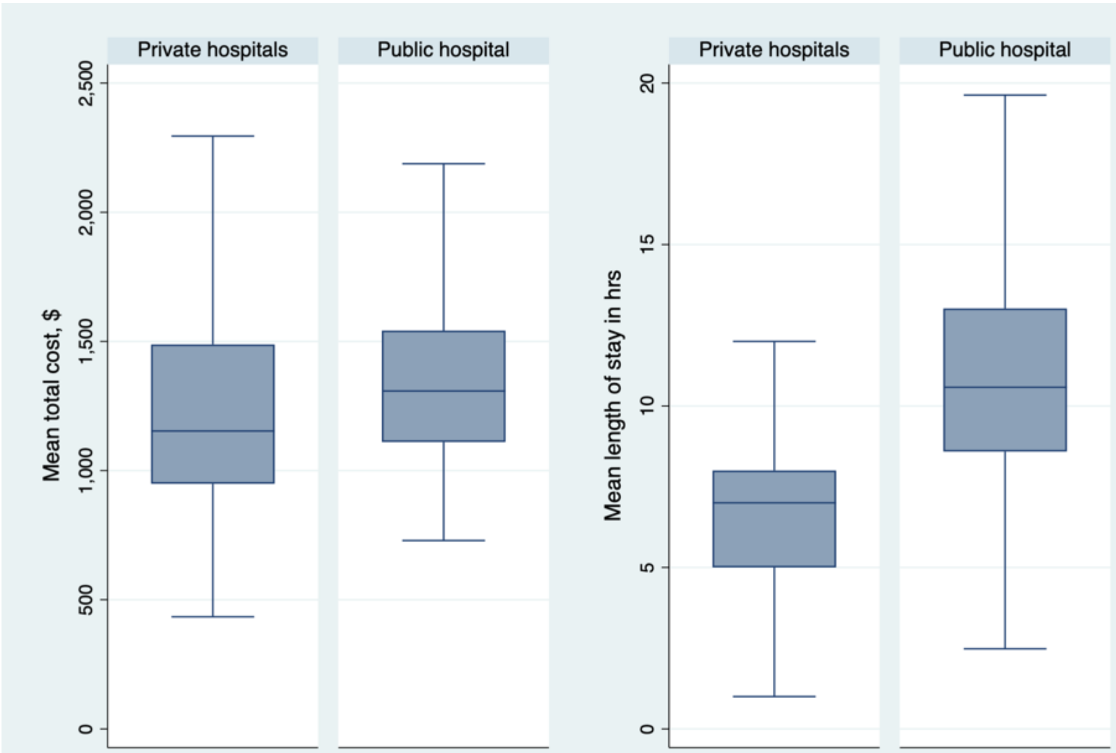
	Public hospital (95% CI)	**Private hospitals (95% CI)**	**Overall (95% CI)**
Visit frequency	0.44 (0.39-0.48)	0.79 (0.72-0.86)	0.51 (0.46-0.57)
Sum cost	0.44 (0.38-0.50)	0.78 (0.69-0.86)	0.51 (0.46-0.57)
Sum length of stay	0.44 (0.39-0.49)	0.75 (0.65-0.85)	0.52 (0.49-0.56)

Figure 1



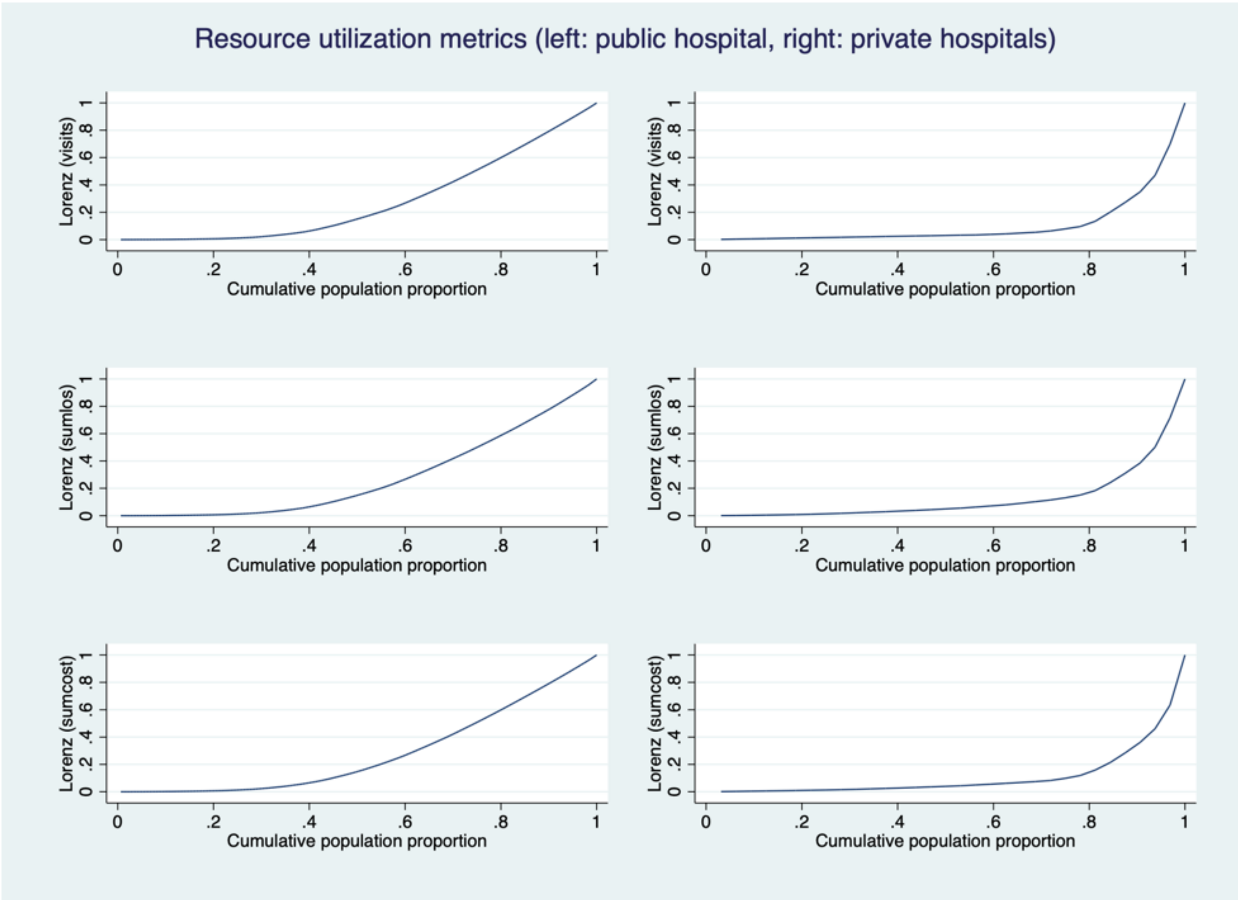
Number of persons
0
20
40
60
0
10
20
30
40
50
60
70
80
90
100
110
120
Annual emergency dialysis visits by individuals
Private hospitals
Public hospital

Figure 2



Private hospitals
Public hospital
Mean total cost, $
0
500
1,000
1,500
2,000
2,500
Private hospitals
Public hospital
Mean length of stay in hrs
0
5
10
15
20

Figure 3


Resource utilization metrics (left: public hospital, right: private hospitals)
Lorenz (visits)
Lorenz (sumlos)
Lorenz (sumcost)
Cumulative population proportion
0
.2
.4
.6
.8
1

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