

THE IMPACT OF SOCIAL SERVICES ON THE UTILIZATION  
OF HEALTH CARE SERVICES

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## **Chapter One.**

### **Introduction**

The unnecessary medical care causes a huge waste of medical resources and becomes a compelling issue nowadays. The research found that 30 percent, or nearly \$700 billion, of all health care spending is wasteful<sup>1</sup>. Among all preventable health care services, two stood out; one is emergency department (ED) visit, and the other one is hospitalization. ED overuse represents the fourth largest category of waste and is responsible for up to \$38 billion in wasteful spending in the U.S. every year<sup>1</sup>. An estimated 13% to 27% of ED visits in the United States could be managed in physician offices, clinics, and urgent care centers, saving \$4.4 billion annually<sup>4</sup>. Hospitalizations have the same problem. A previous research found that 26 percent of hospitalizations were potentially avoidable at a cost of \$5.6 billion in 2005<sup>2</sup>.

Unnecessary ED visits and the overuse or misuse of other health care services can cause a heavy financial burden for the patients themselves and the society, and they also negatively impact the quality of medical care. It is unfair for the patients who are in need of true emergency care to endure the crowding and long waiting due to the overuse by non-urgent patients. For non-urgent patients themselves, experts believe that the ED simply cannot provide the continuity of care that the primary care system offers<sup>3</sup>. For avoidable hospitalizations, besides the over charge, they also lead to poor health outcomes<sup>2</sup>.

Why are people overusing emergency health care? Because it is the only place that patient can have full range of services without long wait time for appointment, and regardless their ability to pay due to federal law. Why are people overusing hospitalization? Because it is the easiest way to have after-hours medical care. Some people believe that ED overuse is solely the result of the poor and the uninsured flooding

EDs for non-urgent health needs, however, a research found that emergency department overuse is high across all payer groups<sup>5</sup>.

The reality is, ED overuse occurs because many patients don't have or are not aware of other options, explained Robin Shannon, RN, director of performance solutions at T-System Inc. in Dallas. If we can help people become more aware of health care services, it could be a potentially effective way to reduce emergency service overuse. Aurora Sinai Medical Center, a Milwaukee hospital had successfully reduced preventable emergency visit, by providing social work to help people change their habits when they get sick. The social workers developed a plan for each patient, including of helping patients find transportation to a care facility and make a first appointment, and sometimes accompanying them to the visit. In four months, the visitors to the Aurora Sinai emergency room fell from 487 to 155, and saved 1.06 million dollars<sup>6</sup>.

To demonstrate the efficiency of these social services to reduce the unnecessary cost of ED visits and hospitalization, a study was conducted in a panel of patients seeking care from Eskenazi Health's FQHC sites. An incredible and longstanding data aggregation was provided from and managed by the Regenstrief Institute for this study. Integrated services were offered to patients as intensive wrap-around services from teams of licensed social workers, care managers, peer recovery coaches, behavioral health specialists, and primary care providers. The team provides pharmacy services, financial counseling, social work, dietician services, dental and integrated mental health and health coordination in the primary care setting. The date of having the specific service within the time period of 2011-2014 was recorded for each patient. Accordingly, the frequency of using the specific health care service per year from 2011 to 2014 for each patient was calculated. Indianapolis Network for Patient Care (INPC) which was created by investigators at Regenstrief Institute provided the patient demographics (gender, age, race) and utilization history of health care services (primary care visit per year before 2011, ACG risk score at 2011, ED visit per year before 2011). In this study, we only focus on

mental health service and social work service as intervention variable, preventable ED visit, preventable ED visit due to mental health problem and hospitalization due to mental health problem as outcomes to determine the impact of specific social service on utilization of specific health care service adjusting for other characteristics of patients (demographic and utilization history information).



## Study Design

Table 1. Data structure for numerical variables

| Variable Name                | Type                          | Definition   | Frequency         |
|------------------------------|-------------------------------|--|-------------------|
| <b>Gender</b>                | Categorical<br>(2 categories) | male   | 6002(24.93%)      |
|                              |                               | female   | 18072(75.07%)     |
| <b>Race</b>                  | Categorical<br>(3 categories) | white  | 7070(33.60%)      |
|                              |                               | black  | 10122(48.11%)     |
|                              |                               | other  | 3848(18.29%)      |
| <b>Mental Health Service</b> | Categorical<br>(3 levels)     | <b>Service=0</b> : received no mental health service from 2011 to 2014 (4 years)               | 23456<br>(97.43%) |
|                              |                               | <b>Service=1</b> : received one mental health service from 2011 to 2014 (4 years)              | 329<br>(1.37%)    |
|                              |                               | <b>Service&gt;1</b> : received more than one mental health service from 2011 to 2014 (4 years) | 289<br>(1.20%)    |
| <b>Social Work Service</b>   | Categorical<br>(3 levels)     | <b>Service=0</b> : received no social work service from 2011 to 2014 (4 years)                 | 21460<br>(89.14%) |
|                              |                               | <b>Service=1</b> : received one social work service health service from 2011 to 2014 (4 years) | 1903<br>(7.90%)   |
|                              |                               | <b>Service&gt;1</b> : received more than one social work service from 2011 to 2014 (4 years)   | 711<br>(2.95%)    |

Table 2. Data structure for categorical variables

| Variable Name            | Type      | Definition  | Mean/ST       |
|--------------------------|-----------|---|---------------|
| <b>ACG2011</b>           | Numerical | ACG risk score recorded at 2011                                       | 1.074/1.606   |
| <b>PCVPerYearBef2011</b> | Numerical | mean of number of annual primary care visits before 2011              | 3.477/3.095   |
| <b>EdPerYearBef2011</b>  | Numerical | mean of number of annual emergency department visits before 2011      | 1.111/2.261   |
| <b>Age</b>               | Numerical | Patient's age at 2011   | 43.97/21.58   |
| <b>PreEDcount</b>        | Numerical | preventable emergency department visits                               | 0.9818/2.722  |
| <b>PreMHEDcount</b>      | Numerical | preventable emergency department visits due to mental health problems | 0.1393/0.8569 |
| <b>HospMHcount</b>       | Numerical | hospitalization due to mental health problems                         | 0.1644/0.6340 |

A total of 24074 patients were involved in this study, including 618 patients who received mental health service, 2614 who received social work service, and 20909 patients who did not receive any of these two services from 2011 to 2014 (4 years). There were 11 variables included in this study with 4 categorical variables summarized in Table 1 and 7 numerical variables summarized in Table 2. Each service variable, as the main investigational variable, was categorized into 3 levels: “no service”, “one service”, and “more than one service” from 2011 to 2014. We set “no service” group as a reference group which contains most of patients (97.43% in mental health service, 89.14% in social work service) for comparison. There were 3 categories of race: white as the reference group, black which had the highest frequency (48.11%), and other races (Asian and unknown).

For the 7 numerical variables three outcome variables were explored in this study, preventable ED visits (PreEDcount), preventable ED visits due to mental health problems (PreMHEDcount), and hospitalization due to mental health problems (HospMHcount). The value of each outcome variable represents the number of visits in the time period of

2011 - 2014, corresponding with service variables. For each patient, age (recorded in 2011), ACG2011 (a risk score indicating patients' health status developed by Adjusted Clinical Group system recorded in 2011), primary care visits per year before 2011 (PCVPerYearBef2011), and ED visits per year before 2011 (EdPerYearBef2011) were also calculated as baseline information in 2011.

## **Chapter Two.**

### **Descriptive Analysis**

We first described the association between the specific service and each of other variables of interested (EdPerYearBef2011, PCVPerYearBef2011, ACG2011, age, gender, race) graphically and explore the statistical significance by ANOVA for continuous variables and  $\chi^2$ -text for categorical variables.

#### **Mental Health Service:**

The incidence of having mental health service was different between male and female. There were 18072 women and 6002 men involved in this study. The proportion of female in service=1 group and that in service>1 group were obviously higher than that in no service group, while the proportion of male in service=1 group and that in service>1 group were obviously lower than that in no service group ( $p<0.0001$ , Figure 1), which means female is more likely to take mental health service than male. The incidence of having mental health service was different among races. There are 7070 white people, 10122 black people, and 3848 other races people involved in this study. The proportion of white people increased from service=0 group to service>1 group, while the proportion of black people decreased from service=0 group to service>1 group ( $p<0.0001$ , Figure 2), which means white people are more likely to take mental health service than black people (Figure 2). The mean score of PCVPerYearBef2011 among three groups is significantly different ( $p<0.0001$ ). The mean score of PCVPerYearBef2011 in service=1 group (1.94) was lower than that in other two groups, 3.16 and 2.85 respectively (Figure 3), which means people with a relatively good health condition are more likely to take appropriate amount of mental health service (Figure 3). There was no evidence showing that the number of mental health service is related with EdPerYearBef2011 ( $p\text{-value}=0.3453$ ), ACG2011 ( $p\text{-value}=0.0507$ ) and age ( $p\text{-value}=0.1020$ ).

Figure 1. Distribution of gender by mental health service

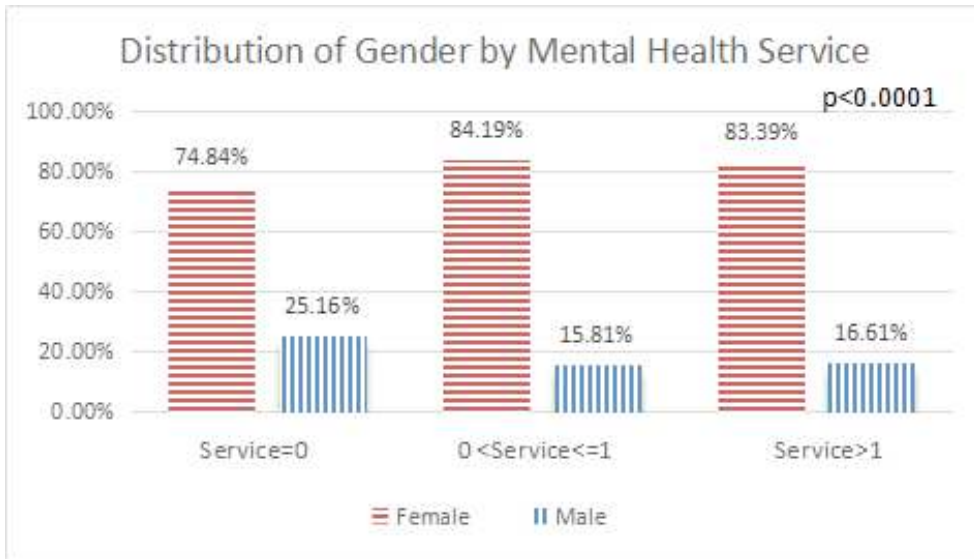


Figure 2. Distribution of race by mental health service

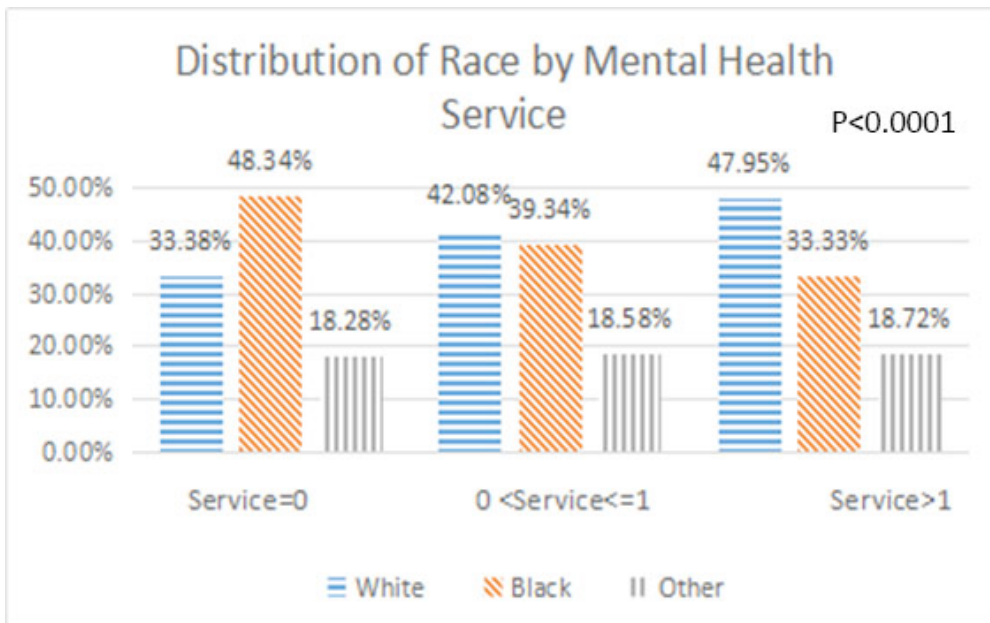
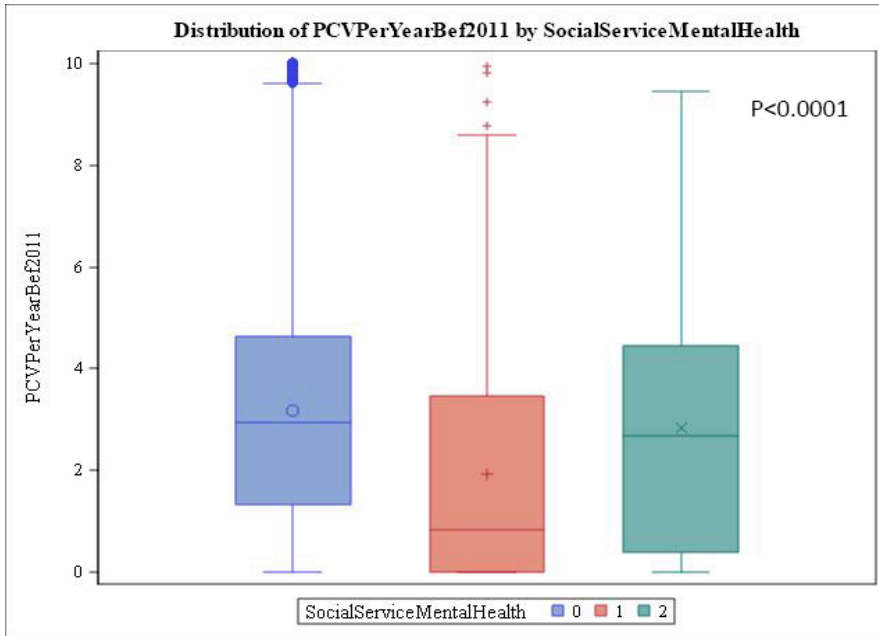


Figure 3. Distribution of PCVperYearBef2011 by mental health service

(0 stand for no service, 1 stand for one service, 2 stand for more than one service)



### Social Work Service:

The incidence of having social work service was different between male and female. The proportion of female increased from service=0 group to service>1 group, while the proportion of male decreased from service=0 group to service>1 group ( $p < 0.0001$ , Figure 4), which means female is more likely to take mental health service than male. The incidence of having social work service was different among races. There were 7070 white people, 10122 black people, and 3848 other races people involved in this study. The proportion of white people in service=1 group and that in service>1 group were obviously higher than that in no service group, while the proportion of black people decreased from service=0 group to service>1 group ( $p < 0.0001$ , Figure 5), which means white people are more likely to take social work service than black people. The mean score of PCVperYearBef2011 in 2011 among three groups was significantly different ( $P < 0.0001$ ). The mean score of PCVperYearBef2011 in service=1 group (2.07) was lower

than that in other two groups, 3.26 and 2.44 respectively (Figure 6), which means people with a relatively good health condition are more likely to take appropriate amount of social work service. The mean EdPerYearBef2011 among three groups was significantly different ( $P<0.0001$ ). The mean score of EdPerYearBef2011 in service=1 group (0.49) is lower than that in other two groups, 0.76 and 0.58 respectively (Figure 7), which means people who have less EdPerYearBef2011 are more likely to take appropriate amount of social work service. The mean ACG2011 among three groups was significantly different ( $P<0.0001$ ). The mean ACG2011 in service=1 group (0.44) is lower than that in other two groups, 0.71 and 0.51 respectively (Figure 8), which means people with a relatively good health condition are more likely to take appropriate amount of social work service. The mean age among three groups is significantly different ( $P<0.0001$ ). The mean age decreases from service=0 group (50.48) to service>1 group, which means younger people are more likely to take social work service than elder people (Figure 9).

Figure 4. Distribution of gender by social work service

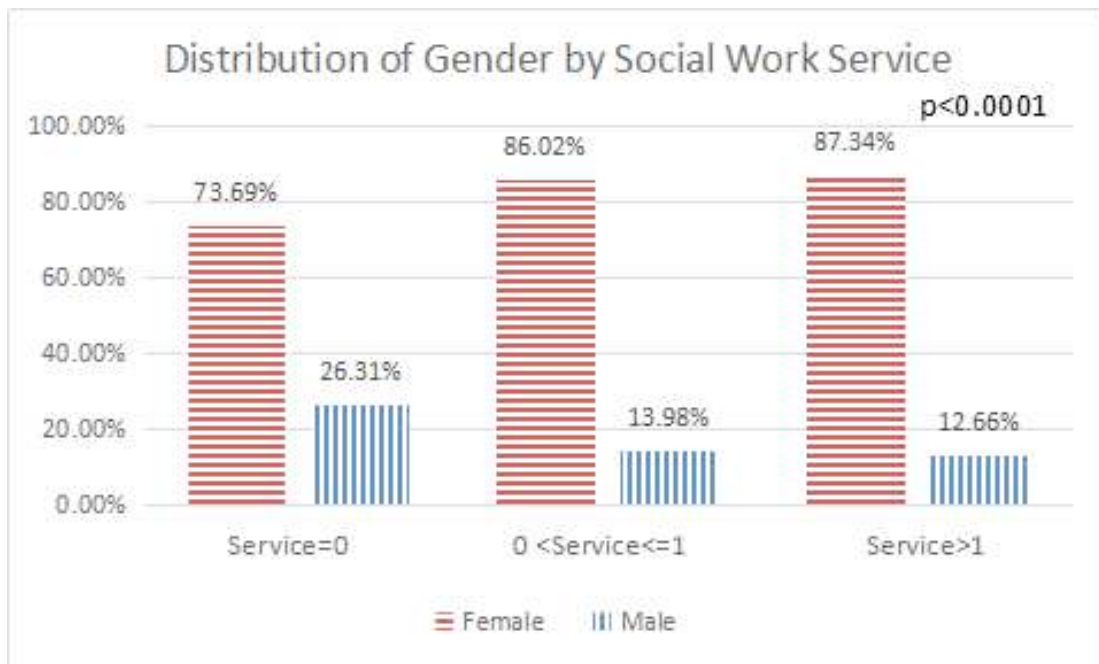


Figure 5. Distribution of race by social work service

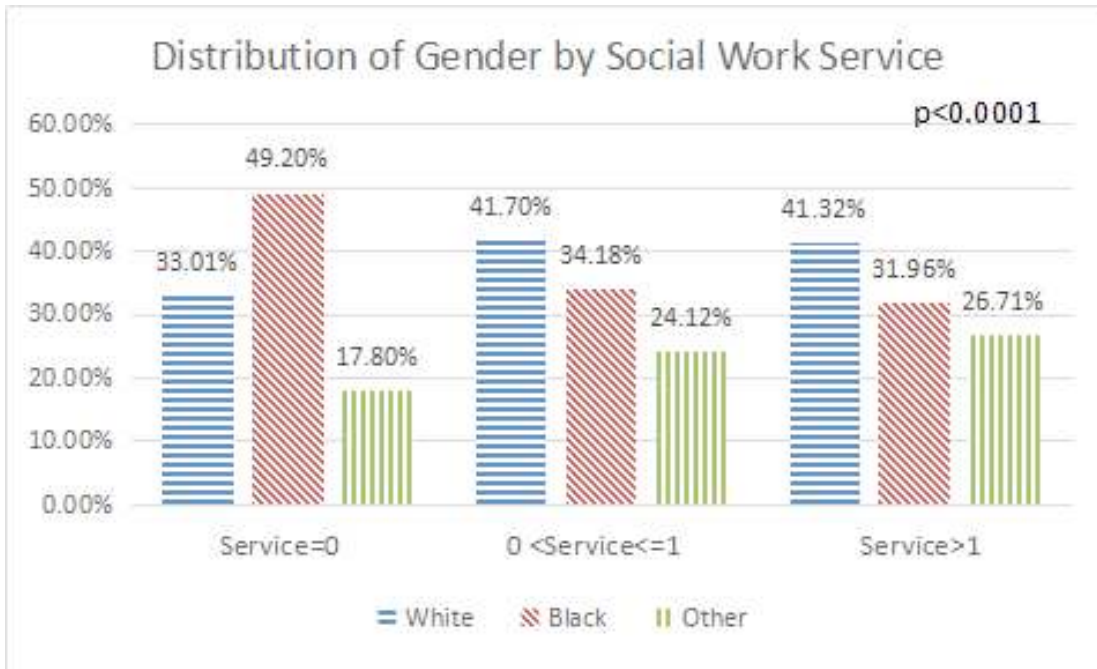


Figure 6. Distribution of PCVperYearBef2011 by social work service

(0 stand for no service, 1 stand for one service, 2 stand for more than one service)

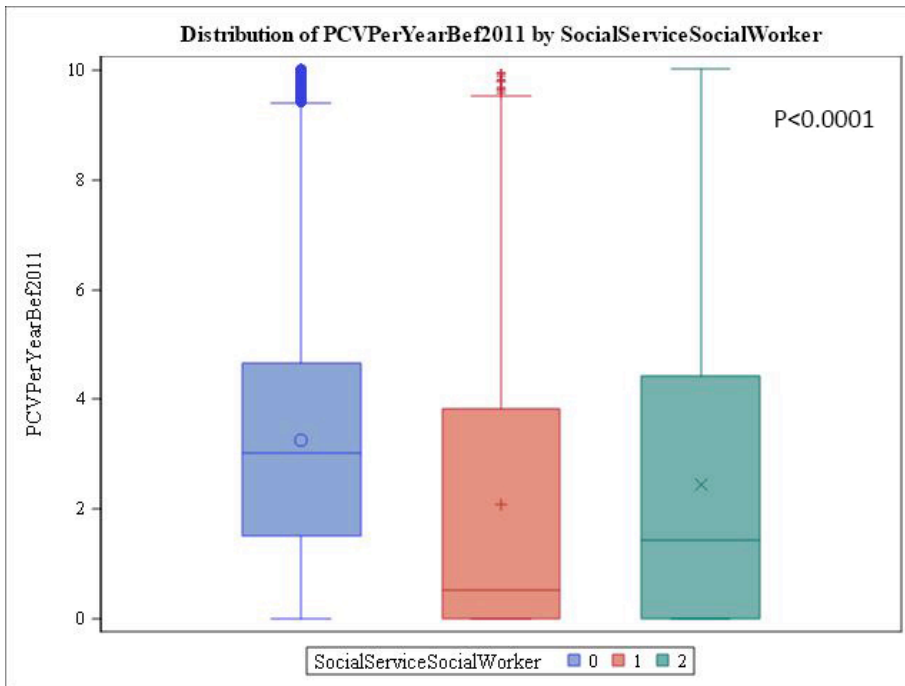




Figure 7. Distribution of EDperYearBef2011 by social work service

(0 stand for no service, 1 stand for one service, 2 stand for more than one service)

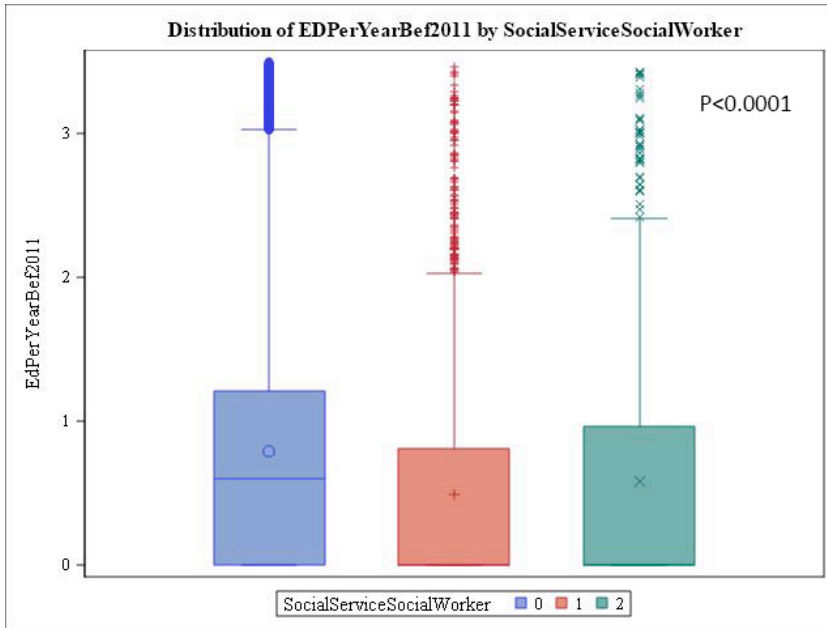


Figure 8. Distribution of ACG2011 by social work service

(0 stand for no service, 1 stand for one service, 2 stand for more than one service)

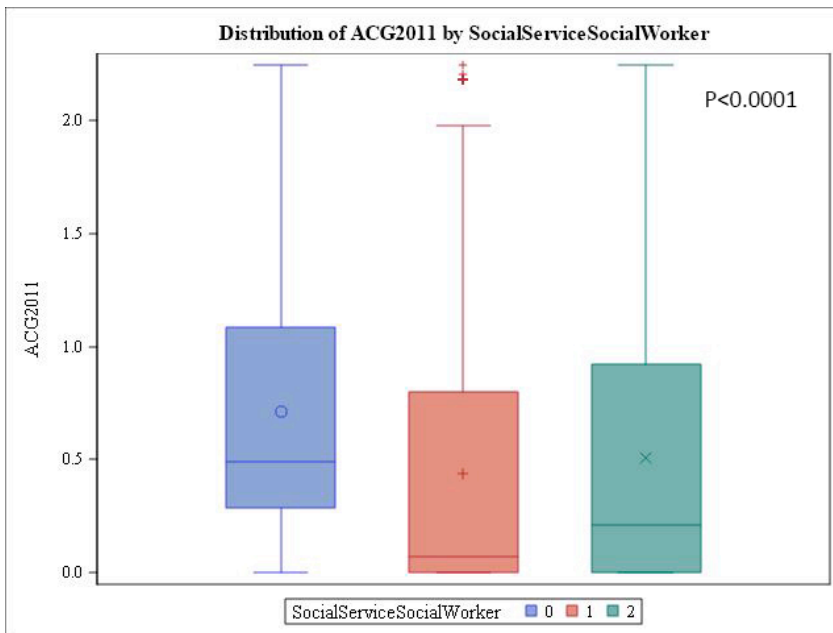
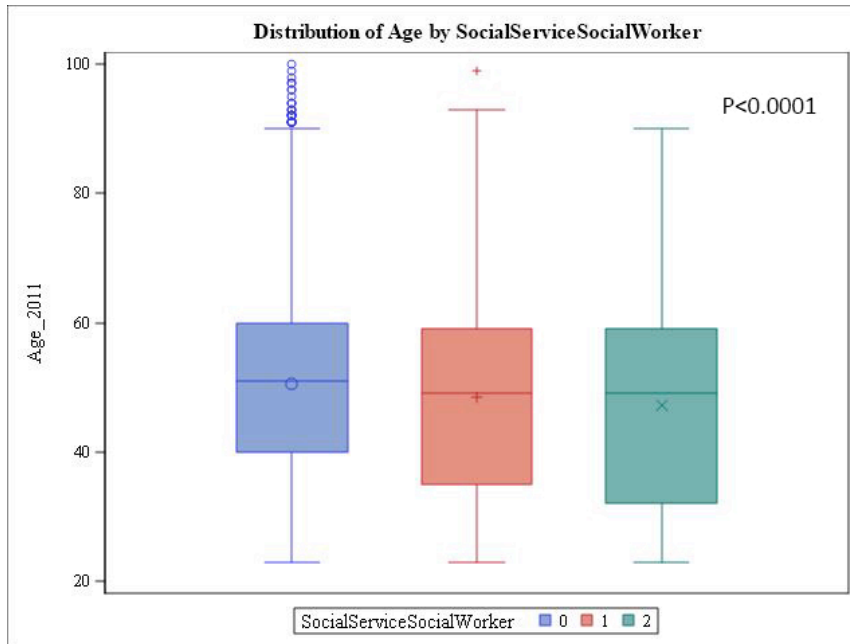


Figure 9. Distribution of age by social work service

(0 stand for no service, 1 stand for one service, 2 stand for more than one service)



## Regression Analysis

For each of the outcome variables, we fitted a multiple linear regression model to ascertain the effects of mental health service and social work service adjusted for the baseline information (PCVperYearBef2011, EDperYearBef2011, ACG2011, gender, race, and age). Since our main objective was to test the efficacy of social service in reducing the utilization of target health care systems, we only selected models with a statistically significant effect at level 0.05 for the presentation. They were significant relationships between preventable ED visits and mental health service; hospitalization due to mental health problems and mental health service; hospitalization due to mental health problems and social work service adjusted for the baseline information (Table 3). We added the interaction terms between the service and each variable we found significantly affect the outcome successively in the main effect models to examine whether the effect of the social service on the outcome is modified by the baseline variables. To make it more interpretable graphically we converted the numerical effect modifier into categorical variable by categorizing it into 3 levels corresponding with the independent variable (mental health service/ social work service). Then we added the significant interaction terms together into the main effect model (after converting) and removed the non-significant interaction terms, which served as the final model for interpretation.

Table 3. Significant mean effects of social services on the outcomes

| Outcomes        | Service Type            | p-value |
|-----------------|-------------------------|---------|
| 1.PrevEDcount   | 1.Mental Health Service | 0.0025  |
|                 | 2.Social Work Service   | 0.2868  |
| 2.PrevMHEDcount | 1.Mental Health Service | 0.7816  |
|                 | 2.Social Work Service   | 0.3962  |
| 3.HospMHcount   | 1.Mental Health Service | 0.0036  |
|                 | 2.Social Work Service   | <.0001  |

## Results

### Mental Health Service:

Mental health service was significantly associated with preventable ED visits ( $p=0.0025$ ). Patients who received mental health service once from 2011 to 2014 have higher rate of ED overuse than patients who did not receive services. Patients who received mental health service more than once from 2011 to 2014 also have higher rate of ED overuse than patients who did not receive services (Table 4). Results shown in Table 4 indicate that there are 5 more variables collectively affect the ED overuse. EdPerYearBef2011 and ACG2011 are positively associated with preventable ED visits with  $p$ -value  $< 0.0001$ , which is interpretable as patients in poor health conditions have more demand for health care services and are more likely to overuse those services. Comparing to male, female has higher rates of ED overuse ( $p$ -value  $< 0.0001$ ). Rate of ED overuse is also significantly different among the races ( $p$ -value  $< 0.0001$ ) with the possible ordering being black  $>$  white  $>$  other races (Table 4). Number of preventable of ED visits decreases over age ( $p$ -value  $< 0.0001$ ).

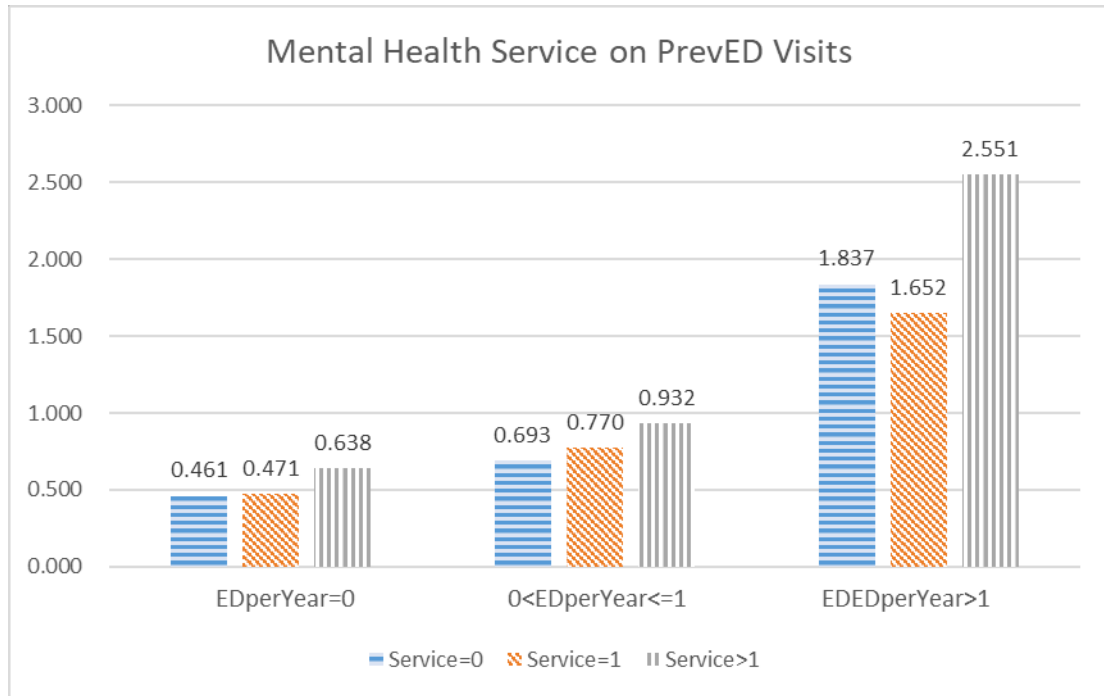
Only the interaction effect between mental health service and EDperYearBef2011 is significant ( $p<0.0001$ ). To make it more interpretable and graphically, we converted EDperYearBef2011 to categorical variable with 3 levels: no ED visit, less or equal to one ED visit, and more than one ED visits. There were 9 groups (3 service groups x 3 EDperYearBef2011 groups), and Figure 10 shows the estimated preventable ED visits for white women (reference group) who were 44 years old in 2011 with an ACG2011 of 1.074 (sample average) for those 9 groups. As can be seen in Figure 10, the estimated preventable ED visit was positively related with EDperYearBef2011; the estimated preventable ED visit increased from service=0 group to service>1 group in both EDperYearBef2011 = 0 group and  $0 < \text{EDperYearBef2011} \leq 1$  group, while in EDperYearBef2011  $> 1$  group, the estimated preventable ED visit for patients who received one service were the lowest among 3 service groups. We can conclude that

patients who used to have ED visit less than or equal to once per year had a positive relationship between mental health service were and preventable ED visit, while receiving mental health service once tends to have less preventable ED visit for patients who used to have ED visit more than once per year.

Table 4. Model fitting results for the effect of mental health service on preventable ED visit.

| Parameter  | Estimate  | DF | SE        | P-value |
|--|-----------|----|-----------|---------|
| <b>Intercept</b>   | 1.1011667 |    | 0.0924024 | <.0001  |
| <b>ACG2011</b>   | 0.3470028 | 1  | 0.0119462 | <.0001  |
| <b>PCVPerYearBef2011</b>   | 0.0147447 | 1  | 0.0063892 | 0.0579  |
| <b>EdPerYearBef2011<br/>(Ref: EdPerYearBef2011=0)</b>                  |           | 2  |           | <.0001  |
| <b>0&lt;EdPerYearBef2011&lt;=1</b>                                     | 0.2311263 |    | 0.0546707 |         |
| <b>EdPerYearBef2011&gt;1</b>   | 1.3755416 |    | 0.0568041 |         |
| <b>Gender (Ref: Female)</b>  |           | 1  |           | <.0001  |
| <b>Male</b>  | -0.145193 |    | 0.0420707 |         |
| <b>Race (Ref: White)</b>   |           | 2  |           | <.0001  |
| <b>Black</b>   | 0.1532468 |    | 0.0423895 |         |
| <b>Other</b>   | -0.014483 |    | 0.0574824 |         |
| <b>Age_2011</b>  | -0.023011 |    | 0.0013729 | <.0001  |
| <b>Mental Health Service<br/>(Ref: Mental Health Service=0)</b>        |           | 2  |           | 0.0025  |
| <b>0&lt; Mental Health Service&lt;=1</b>                               | 0.0090765 |    | 0.4616534 |         |
| <b>Mental Health Service&gt;1</b>                                      | 0.1769776 |    | 0.5347292 |         |
| <b>MentalHealthService*EdPerYear<br/>(Ref: Service=0, EdPerYear=0)</b> |           | 4  |           | <.0001  |
| <b>0&lt;Service&lt;=1*0&lt;EDPerYear&lt;=1</b>                         | 0.0686058 |    | 0.5678352 |         |
| <b>0&lt;Service&lt;=1*EDPerYear&gt;1</b>                               | -0.193647 |    | 0.553398  |         |
| <b>Service&gt;1*0&lt;EDPerYear&lt;=1</b>                               | 0.0619801 |    | 0.6355745 |         |
| <b>Service&gt;1*EDPerYear&gt;1</b>                                     | 0.5372552 |    | 0.5863016 |         |

Figure 10. Effect of mental health service on preventable ED visit by EDperYearBef2011



Mental health service was significantly associated with the number of hospitalization due to mental health problem (p-value=0.0036). Patients who received mental health service once from 2011 to 2014 were less hospitalized due to mental health problems than patients who did not receive any services. Patients who received mental health service more than once from 2011 to 2014 appeared to be more hospitalized due to mental health problems than patients who received no services. Results shown in Table 5 shows there are 5 other baseline variables that also explained the number of hospitalization due to mental health problem. EdPerYearBef2011 and ACG2011 are positively associated with hospitalization due to mental health problem (p-value <0.0001). Comparing to female, male is more hospitalized due to mental health problem (p-value <0.0001). Rate of hospitalization due to mental health problem is also significantly different among the races (p-value < 0.0001) with the possible ordering being white > black > other races (Table 5). The number of hospitalization due to mental health problems slightly increased with age (Table 5).

Table 5. Model fitting results for the effect of mental health service on hospitalization due to mental health problem.

| Parameter   | Estimate | DF | SE          | P-value |
|---|----------|----|-------------|---------|
| <b>Intercept</b>  | -0.11757 |    | 0.019315    | <.0001  |
| <b>ACG2011</b>  | 0.087757 | 1  | 0.002832    | <.0001  |
| <b>PCVPerYearBef2011</b>                                    | -7.3E-05 | 1  | 0.0015      | 0.9612  |
| <b>EdPerYearBef2011</b>                                     | 0.044115 | 1  | 0.001945    | <.0001  |
| <b>Gender (Ref: Female)</b>                                 |          | 1  |             | <.0001  |
| <b>Male</b>   | 0.053187 |    | 0.00988390. |         |
| <b>Race (Ref: White)</b>                                    |          | 2  |             | <.0001  |
| <b>Black</b>  | -0.0284  |    | 0.00994     |         |
| <b>Other</b>  | -0.07291 |    | 0.013439    |         |
| <b>Age_2011</b>   | 0.003038 | 1  | 0.000323    | <.0001  |
| <b>Mental Health Service (Ref: Mental Health Service=0)</b> |          | 2  |             | 0.0036  |
| <b>0&lt;Mental Health Service&lt;=1</b>                     | -0.04672 |    | 0.04741     |         |
| <b>Mental Health Service&gt;1</b>                           | 0.138706 |    | 0.043404    |         |

### Social Work Service:

Social work service was significantly associated with the number of hospitalization due to mental health problem (p-value<0.0001). Patients who received social work service once from 2011 to 2014 were more hospitalized due to mental health problems than patients who received no services. Patients who received social work service more than once from 2011 to 2014 were also more hospitalized due to mental health problems than patients who received no services. Results shown in Table 6, 5 other baseline variables explained hospitalization the number of hospitalization due to mental health problem. Relationships between hospitalization due to mental health problem and EDperYearBef2011, ACG2011 race and age were same as and demonstrated in the last model.

There were two significant interaction terms, the interaction effect between the number of hospitalization due to mental health problem and EDperYearBef2011, and the interaction effect between the number of hospitalization due to mental health problem and gender (Table 6).

Figure 11 shows the estimated number of hospitalization due to mental health problem for white women (reference group) who were 44 years old in 2011 with an ACG2011 of 1.074 (sample average) among 9 groups (3 service groups x 3 EDperYearBef2011 groups). As can be seen in Figure 11, the estimated number of hospitalization due to mental health problem was positively related with EDperYearBef2011; the estimated number of hospitalization due to mental health problem was obviously higher in service > 1 than other two service groups for patients who used to have hospitalization due to mental health problem less than or equal to once per year; while in EDperYearBef2011 > 1 group, the estimated hospitalization due to mental health problem for patients in service > 1 group exceeded that in service = 1 group and became the highest one, which indicates that patients who used to overuse hospitalization due to mental health problem were likely to receive more social work service and have more hospitalization due to mental health problem.

Figure 12 shows the estimated number of hospitalization due to mental health problem for white people (reference group) who were 44 years old in 2011 with an ACG2011 of 1.074 (sample average) and did not have hospitalization due to mental health problem before 2011 among 6 groups (2 gender groups x 3 service groups). The estimated number of hospitalization due to mental health problem was approximately equal among three service groups for female; while for male, social work service is positively related to hospitalization due to mental health problem (Figure 12).



Table 6. Model fitting results for the effect of social work service and hospitalization due to mental health problem.

| Parameter  | Estimate | DF | SE       | P-value |
|--|----------|----|----------|---------|
| <b>Intercept</b>   | -0.11918 |    | 0.022091 | <.0001  |
| <b>ACG2011</b>   | 0.094885 | 1  | 0.002833 | <.0001  |
| <b>PCVPerYearBef2011</b>   | 0.000563 | 1  | 0.001516 | 0.6708  |
| <b>EdPerYearBef2011<br/>(Ref: EdPerYearBef2011=0)</b>                    |          | 2  |          | <.0001  |
| <b>0&lt;EdPerYearBef2011&lt;=1</b>                                       | 0.029993 |    | 0.013241 | <.0001  |
| <b>EdPerYearBef2011&gt;1</b>   | 0.142347 |    | 0.013736 |         |
| <b>Gender (Ref: Female)</b>  |          | 1  |          | <.0001  |
| <b>Male</b>  | 0.047677 |    | 0.010259 |         |
| <b>Race (Ref: White)</b>   |          | 2  |          | <.0001  |
| <b>Black</b>   | -0.03261 |    | 0.010048 |         |
| <b>Other</b>   | -0.07676 |    | 0.013628 |         |
| <b>Age_2011</b>  | 0.002549 | 1  | 0.000326 | <.0001  |
| <b>Social Work Service<br/>(Ref: Social Work Service=0)</b>              |          | 2  |          | <.0001  |
| <b>0&lt;Social Work Service&lt;=1</b>                                    | 0.026134 |    | 0.054814 |         |
| <b>social work Service&gt;1</b>  | 0.010279 |    | 0.077576 |         |
| <b>SocialWorkService*EdPerYear<br/>(Ref: service=0, EdPerYear=0)</b>     |          | 4  |          | <.0001  |
| <b>0&lt;Service&lt;=1*0&lt;EDPerYear&lt;=1</b>                           | 0.031593 |    | 0.063399 |         |
| <b>0&lt;Service&lt;=1*EDPerYear&gt;1</b>                                 | 0.023773 |    | 0.062193 |         |
| <b>Service&gt;1*0&lt;EDPerYear&lt;=1</b>                                 | 0.001294 |    | 0.093026 |         |
| <b>Service&gt;1*EDPerYear&gt;1</b>                                       | 0.040123 |    | 0.091053 |         |
| <b>SocialWorkService*Gender<br/>(Ref: Female, social work Service=0)</b> |          | 2  |          | <.0001  |
| <b>Male*0&lt;Service&lt;=1</b>   | 0.068496 |    | 0.04713  |         |
| <b>Male*Service&gt;1</b>   | 0.374081 |    | 0.078406 |         |

Figure 11. Effect of social work service on hospitalization due to mental health problem by EDperYearBef2011

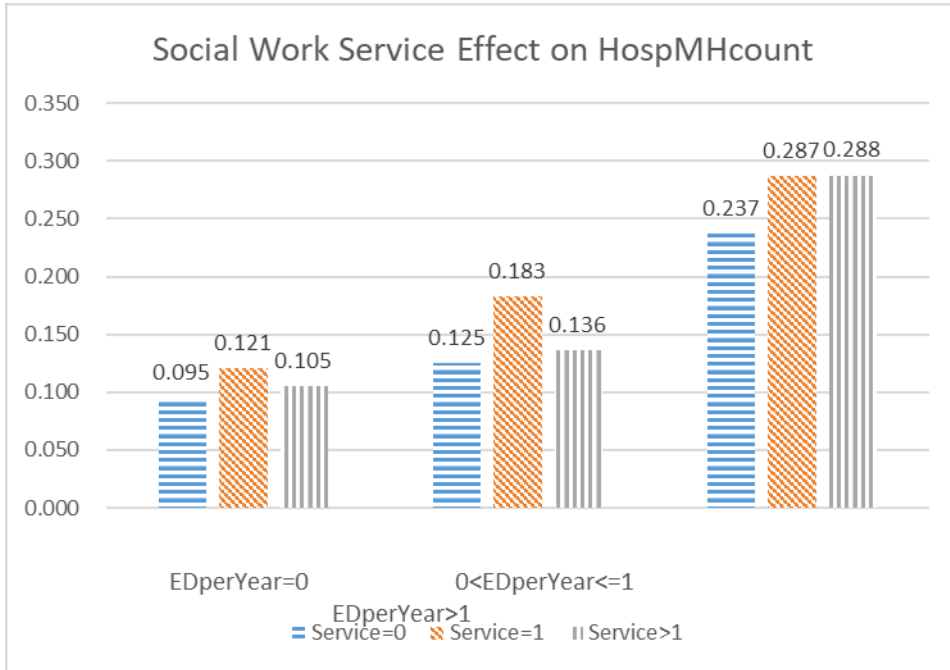
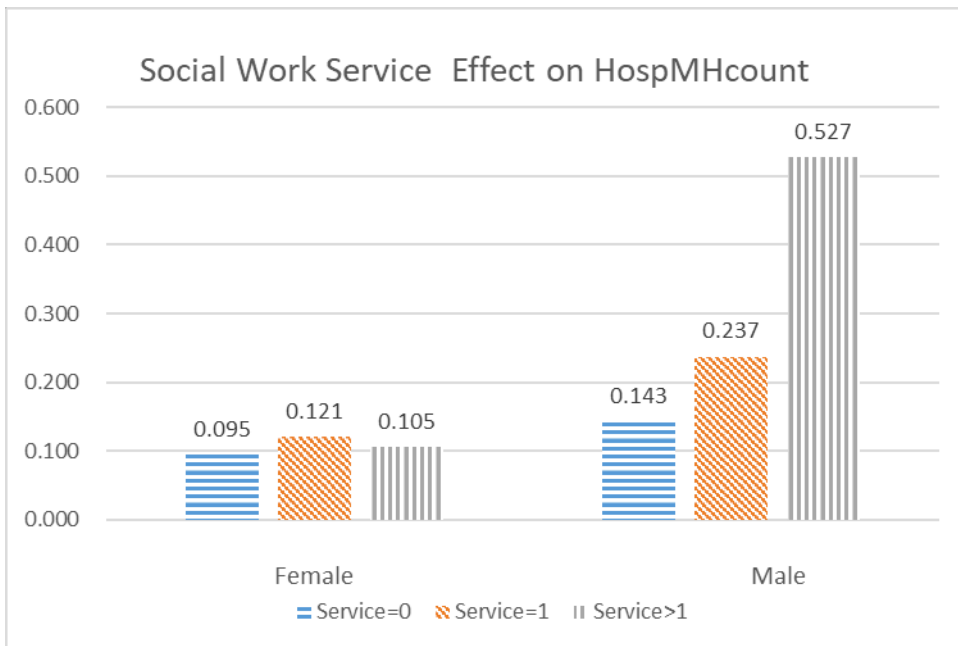


Figure 12. Effect of social work service on hospitalization due to mental health problem by gender



## **Discussion**

As what we found in previous section, there was significant relationship between preventable ED visit & mental health service, hospitalization due to mental health problems & mental health service, as well as hospitalization due to mental health problems & social work service. We found that in most situation, social services were positively associated with health care service. But in the second model which described the impact of mental health service on utilization of hospitalization due to mental health problem, receiving one mental health service can reduce the utilization of hospitalization due to mental health problem, which is as our expectation.

This study has a number of limitations. In our data set, we have the exact date of service, but we only have the year of each outcome variable, and some ED visits or hospitalization may happen before services. Since the goal of this work was to examine the efficacy of mental health service and social work service on reducing the overuse of targeted health care systems, we only want to know the number of visits after having services. The outcome values were over calculated by just summed up all visits from 2011 to 2014, which may potentially underestimate the effects of these services. From the linear regression models, we learn that about 35% of variation in the number of preventable ED visits can be explained by mental health service adjusted for other 5 variables (age, gender, ACG2011, EdPerYearBef2011) in the first model (R-square = 0.347); and about 11% of variation in the number of hospitalization due to mental health problems can be explained by mental health service adjusted for other 5 variables (age, gender, ACG2011, EdPerYearBef2011) in the second model (R-square = 0.106); about 11% of variation in the number of hospitalization due to mental health problems can be explained by social work service adjusted for other 5 variables (age, gender, ACG2011, EdPerYearBef2011) in the third model (R-square = 0.109). Therefore, the models established in this work may not have a great predictability for the outcomes, a further study is needed to improve the model in the future. According to our study, appropriate

amount of services appears helpful on reducing the overuse of ED and hospitalization due to mental health problem. However, people who overused ED or hospitalization in the past were also more likely to be frequent service users, and they tended to continue overuse ED or Incur more hospitalization. There is a group of people who overuse ED or hospitalization without having any service. ED or hospitalization may be their first choice because of their financial condition or other factors, which makes them have no interest to take services.

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