

Treatment at home or in Hospital? A cost analysis using SAS.

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ABSTRACT

Economic crisis imposes fiscal policies in the health care sector. However, the provision of health care and the improvement of health will always be of top priority regardless the source of funding, private or public. As a result, the costs of health care must be minimized, while at the same time a high quality has to be maintained in the delivery of health care to achieve the optimal allocation of given resources. Therefore, cost analysis standards must be set. Hospitals are the field where analysis is performed to compare their effectiveness versus hospital care at home. However, little research has been done using SAS software as an analytical tool. In this paper, we conduct such an analysis with the assistance of SAS to show its effectiveness when the analysis demands the usage of big data and the transparency in the results for the decision makers.

INTRODUCTION

The rapid growth of costs related to health care sector over the last decades throughout the entire world regardless the type of health care system and the way it is funded, either by private or public capitals, has become a great concern for all the parties involved in the industry of health, from individuals who consume health care to pharmaceutical companies, hospitals and governments. OECD, the organization for economic co-operation and development has done many valuable analyses which have concluded that health care expenditures of countries as a percentage of Gross Domestic Product have been raised twice as high over the last 30 years. Progress and innovation in medical technology, variation in medical practice, increase in income, unhealthy lifestyles, increase of the population globally, new epidemiological needs as a result of the previous are the main key determinants of growing health care expenditures. In addition to the previous mentioned, times of crisis as the current one that we are experiencing where budgetary restrictions are the rule of thumb for all the economy, leads to the fact that evaluation of health and health care sector from the economic perspective is a necessity more than ever. Hence, governments and private entities as well, such as hospitals, have and should incorporate economic evaluation of new therapies and medical technologies which are willing to enter to the market in order to investigate with validity the adding value, if any, to health in relation with the costs accompanied by financing them. Moreover, even existing technologies already in use are evaluated to improve efficiency of their use. Furthermore, in the specialized field of health economics, three different types of economic evaluations have been developed and conducted to show comparative analysis of alternative courses of action. These are the following:

Type of economic evaluation	Measures of costs	Measures of consequences
Cost analysis	Monetary units	None
Cost effectiveness analysis	Monetary units	Natural units (e.g. points of blood pressure reduction)
Cost utility analysis	Monetary units	Quality-adjusted life years
Cost benefit analysis	Monetary units	Monetary units

An interesting sector where economic evaluation of health care units is of high importance is hospitals, either private or public funded. Hospitals are traditionally a great contributor for economy not only due to the fact that they are the main provider of the sensitive product of "health", but also because of employing people to provide this service and support implicitly additional sectors of the economy. As a result of this, there is great focus to analyze how the management of them allocates its resources and the alternatives in the provision of health care services can be implemented to decrease costs and achieve optimal allocation of existing resources. Moreover, hospitals are considered as a great determinant for the increase of health care expenditures (USA study case) due to their consolidation. Many merges of hospitals have occurred and empirical evidence and theoretical background have shown that in an economic environment where competition and economy of scales don't function properly, merges can result to monopoly and increase of prices for the given services. In regards to the alternatives, there is new trend of shifting costs and responsibilities to the individuals by providing

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health care services at home instead of the actual hospitals. The latter is not in the concern of this paper but the costs derived from such a shift and tier analysis are. There are types of treatments that allow a patient to receive health care service at home.

This paper will describe the implementation of a cost analysis between treatment in hospital and treatment at home using SAS 9.4 on the base of a fictional data created by the author for that purpose. The fictional data consists of 200 subjects where costs of hospitals are compared against home treatment in an rehabilitation program after mild surgery. A unique environment is considered for the hospitals and homes in order to guarantee that all cases face the same determinants for their prices; as well the same prices for costs related at home, hence the same tax environment. In addition, it will be described the techniques that were used to conduct the analysis using SAS 9.4 as a tool. The scope of this paper is not only to introduce the implementation of such an analysis but also to show that using SAS software for the methodological part of the research is really beneficial for companies and institutions specialized in health economics since it gives results with validity and faster than other software already in use in the industry.

COST

Before illustrating our analysis, it is critical to describe the distribution of costs in both Hospitals and home care. Hospital calls are shown in Table 1 and home costs in Table 2.

HOSPITAL COSTS	
BED PER DAY	200
OVERHEAD COSTS (Electricity, administration costs, laundry etc.)	50
MEDICAL USE (Doctor, nurses, physiotherapists)	60

Table 1.

HOME COSTS	
PHYSICIAN VISITS	120
MONITORING	30

Table 2.

It is clear from the tables' description that hospital treatment is more expensive than the one received from home. However, hospital treatment guarantees less days spent under treatment, hence it is appropriate to investigate the total costs based on our data for both costs and days spent under treatment. For example, if one patient spends 4 days in the hospital, the total costs will be 1240 euros. For the patient who will choose to get the treatment at home, the total costs for 7 days will be 1050. The exact time needed for total rehabilitation cannot be estimated in advance and we need data of the days spent in order to conclude which treatment is more expensive.

ANALYSIS

Furthermore, the first step of our analysis is to link the costs of the patients with the days of hospitalization spent in both cases, at hospital and at home.

```
/*Merging hospital costs and days of hospitalization*/  
  
proc sort data=work.hospital_c;  
  by patient;  
run;  
  
proc sort data=work.hosp_days;  
  by patient;  
run;
```

```
data work.total_hosp;
  merge work.hospital_c
        work.hosp_days;
  by patient;
run;

/*Merging home costs and days of home treatment*/

proc sort data=work.home_c;
  by patient;
run;

proc sort data=work.home_days;
  by patient;
run;

data work.total_home;
  merge work.home_c
        work.home_days;
  by patient;
run;

/*Calculating total costs hospital*/

data work.total_hosp1;
  length patient $ 12 total_c_hosp days_hosp 8;
  set work.total_hosp;
  total_c_hosp = sum_costs_hosp * days_hosp;
  keep patient total_c_hosp days_hosp;
run;

/*    Calculating total costs home*/

data work.total_home1;
  length patient $ 12 total_c_home days_home 8;
  set work.total_home;
  total_c_home = sum_costs_home * days_home;
  keep patient total_c_home days_home;
run;
```

The above code links the costs and days under treatment and then calculates the total costs for each case.

Then we will merge the datasets of both hospital and home data in order to calculate the total costs and derive the differences through proc means, a data step of SAS which gives you the basic statistics of the data in need.

```
/* Merging total costs from both datasets */

proc sort data=work.total_home1;
  by patient;
run;

proc sort data=work.total_hosp1;
  by patient;
run;
```

```
data work.total_c_table;
  merge work.total_home1
        work.total_hosp1;
  by patient;
run;

/*By using the mean procedure we can calculate the arithmetic mean costs
and days per case */

proc means data=work.total_c_table nonobs maxdec=2 sum mean median std;
  var total_c_home total_c_hosp days_home days_hosp;
  output out=work.results;
run;
```

Below the output of proc means that SAS generates.

The SAS System					
The MEANS Procedure					
Variable	Label	Sum	Mean	Median	Std Dev
total_c_home		114300.00	1143.00	1050.00	202.01
total_c_hosp		128650.00	1286.50	1240.00	318.88
days_home	days_home	762.00	7.62	7.00	1.35
days_hosp	days_hosp	415.00	4.15	4.00	1.03

We can observe that for the number of 100 observations the total costs related to home are 114.000 euros while the total costs for hospital are 128.650. However, we can also observe that the days spent on hospital on average are 4.15 while at home are 7.62.

diff_c	total_c_home	total_c_hosp
14350	114300	128650

The difference in costs is 14.350 euros.

diff_d	days_home	days_hosp
3.47	7.62	4.15

The difference in days is 3.47 on average

The results shows that Hospital costs are higher than the ones related to Home.

SENSITIVITY ANALYSIS

Our results are derived from a small sample of the population and not the entire one, hence it is crucial to include a sensitivity analysis of our findings in order for the decision makers to obtain results with validity. Such an analysis shows how sensitive our results are in case our parameter changes, particularly the costs. In our paper we will produce confidence intervals for the difference between the costs of hospital and home treatment.

CONFIDENCE INTERVALS

We decided to perform a complex technique to produce confidence intervals, the Bootstrap method. This non-parametric Bootstrapping method will produce N subsamples which are redrawn from our original sample. In our paper we will produce 1000 replications from our data which consists of 100 patients by using the datasets which include the costs for each case. It is worth mentioning that through these replications, the patients can occur more than once in the new enriched dataset the bootstrapping method will generate. Below the code to perform such an analysis.

```
/*bootstrap method for hospital data*/

data work.hosp_boot;
  set work.total_hosp1;
  keep patient total_c_hosp;
run;

data work.boot1;
  do sampnum = 1 to 10000;
    do i=1 to nobs;
      x = round(ranuni(0) * nobs);
      set work.hosp_boot
      nobs = nobs
      point = x;
      output;
    end;
  end;
  stop;
run;
```

```

/*bootstrap method for home data*/

data work.home_boot;
  set work.total_home1;
  keep patient total_c_home;
run;

data work.boot2;
  do sampnum = 1 to 10000;
    do i=1 to nob;
      x = round(ranuni(0) * nob);
      set work.home_boot
      nob = nob
      point = x;
      output;
    end;
  end;
  stop;
run;

/*merging the two datasets and derive the final one with 10000
observation to calculate the new difference between the hospital costs and
home costs*/

proc sort data=work.boot1;
  by i;
run;

proc sort data=work.boot2;
  by i;
run;

data work.boot_final;
  merge work.boot1
        work.boot2;
  by i;
  cost_diff = total_c_hosp - total_c_home;
run;

/*Then we use the proc univariate procedure to calculate the mean
value of the difference, 2.5th and 97.5 percentiles*/

proc univariate data=work.boot_final;
  var cost_diff;
  output out=work.stat_boot
         mean=mean_diff
         pctlpre=P_ pctlpts= 2.5, 97.5;
run;

```

The result dataset which was generated through proc univariate shows the calculated 2,5 and 97,5 percentiles which represent the two tailed 95% confidence intervals of the difference in costs.

the mean, cost_diff	the 2.5000 percentile, cost_diff	the 97.5000 percentile, cost_diff
146.98052	-420	1280

The results shows that after the sensitivity analysis hospital treatment is still more expensive than home treatment, hence makes our initial estimation valid and robust to changes in costs.

CONCLUSION

With increasing health care expenditures and fiscal policies force to maintain costs low without risk quality of health, our analysis shows that the alternative of home treatment instead of the traditional hospitalization is less costly from the health care perspective. However, this comes with an additional time for the patient to fully be treated. However, from the perspective of society, more analysis should be done to obtain the satisfaction level and the utility of the patients experiencing the alternative treatment at home in order to conclude for its efficiency rather than just the efficacy or the costs. We used very basic economic analysis but SAS shows that for studies related to health economics, it can be a powerful tool to assist the industry of health in the decision for the optimal allocation of its resources.

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RECOMMENDED READING

Drummond et al. (1988). Methods for the Economic Evaluation of Health Care Programmes. New York: Oxford University Press.

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