IS4250 HEALTHCARE ANALYTICS

An analysis of "The Development of Quality Indicators in Mental Healthcare: A Discrete Choice Experiment"

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1. Paper Introduction

The paper which we have chosen to analyse was published in 2012 by Schellings et al. This paper aims to find out the influence of health care indicators in assessing mental health care quality. The authors felt that there was a lack of knowledge about whether all of the assessment indicators are equally important in judging the quality of care in mental hospitals. In order to achieve the desired result, the authors of the paper conducted an experiment using Discrete Choice Experiment with employees of Dutch Healthcare Inspectorate who usually do the inspections of hospitals in Netherlands. Therefore, the scope of this experiment is the mental hospitals in Netherlands.

In the following sections, we will discuss the type of experiment used in this paper in general, and a brief description of audits in healthcare industry.

1.1. Discrete Choice Experiment (DCE)

DCE or Discrete Choice Experiment is a technique to discover people's preferences over a desired topic. To be more specific, DCE is used to rank and value the significance of some attributes regarding the context of the research (Mangham LJ, 2008). In DCE, respondents are asked to choose between several hypothetical alternatives with different attribute levels. For example, if researchers want to know what are cancer patients' choices in undergoing treatments, they can use DCE to obtain patients' preferences over several alternative treatments. The hypothetical alternatives in DCE are made up of different combination of the attribute levels (Tidy, 2014), but all alternatives contain the same number of attributes.

1.2. Healthcare Audits and Inspections

Healthcare audit is a process where current practices are evaluated and measured against standardized guide by auditors (Tidy, 2014). The purpose of this process is to maintain the high quality of health services provided by healthcare professionals. It is important for hospitals to undergo the audit process periodically in order to keep the quality level up to date with current medical trends and issues.

2. The Experiment

2.1. Attribute Selection Process

Before the actual experiment, the authors did preliminary survey to formulate the appropriate attributes. This process was done to simplify the choices given to respondents in the actual data gathering process later. In this process, 51 indicators for schizophrenia treatment were assessed in 33 mental hospitals in Netherlands. These indicators are grouped in 10 clusters based on content association. 14 inspectors and 4 co-inspectors from Dutch Healthcare Inspectorate who did the usual audit and inspection in the hospitals were asked to assess these indicators based on 4-scale operational level:

0 - no policy is present

1 - policy is present, all employees are aware of the policy

2 - policy is fully applied

3 - effects of policy is periodically evaluated

On top of that, they were asked to assess whether sufficient care in the attended hospitals were present. Using the result from this exercise, logistic regression analysis was done to find the 7 most important clusters with the following variables:

1. Dependent variable = whether sufficient care in the attended hospitals was present
2. Independent variable = sum score of each indicators' operational level per cluster

The authors created another survey and asked the previous subjects to select 3 most important and 3 least important clusters from the result of the first assessment. From this additional survey, 6 most important clusters were concluded to be used as the attributes for the next experiment, which is the actual Discrete Choice Experiment.

The following assumption is made by our group regarding this selection process:

- All inspectors had a consensus regarding judgement for each hospital, so the data is not from each individual inspectors (eg. for hospital A, all inspectors discussed together whether there is sufficient care).

2.2. Statistical Analysis of the Actual Experiment

From the previous attribute selection process, authors obtained 6 attributes (Figure 1) to construct a choice-set. The choice-set consists of 2 hospitals where each hospital has a scenario of different operational level combination for the 6 attributes. Compared to what was used in attribute selection process, the operational level now was simplified to present or not present. The example of a choice set can be seen in Figure 2. For each choice-set, respondents were asked to choose which hospital provides better quality care based solely on the attributes' operational level. No other information regarding each hospital was revealed except the attributes' operational level. A web-based questionnaire consisting of 10 choice-sets were then developed.

Table 1 Definitions of attributes

Attribute	Definition
Treatment plan	An elaborate plan for the individual patient including information about psychiatric diagnosis, informed consent, goals of treatment, therapeutic interventions.
Care program	A general program in which a comprehensive view on the treatment of patients is presented.
Treatment outcome measurement	Treatment outcome is periodically measured by means of a standardised method and results are used for the revision of the individual treatment plan and for the purpose of the aggregation of treatment results.
Involvement in treatment of patients and relatives	The treatment plan is determined in consultation with the patient and his or her relatives.
Pharmacotherapy	Pharmacotherapy is based on medication guidelines.
Governance responsibility	The governing body is informed about the quality of care and will adjust the policy.

Figure 1 Table 3 of the paper

Table 2 Example of a choice-set

Attributes/	Psychiatric institute A	Psychiatric institute B
Treatment plan	Operational	Not operational
Involvement in treatment of patients and relatives	Not operational	Operational
Care program	Operational	Not operational
Treatment outcome measurement	Operational	Not operational
Pharmacotherapy	Not operational	Operational
Governance responsibility	Not operational	Operational
Which hospital do you choose?	A	B

Figure 2 Table 2 of the paper

The questionnaire was sent to 33 employees from Dutch Healthcare Inspectorate and no employees were given the same order of choice-set. However, only 25 of them responded to the request of filling in the survey. The resulted data was used to do logistic regression analysis with the following variables:

- Dependent variable = choice of hospital
- Independent variable = operational level in each attribute

As a result, elaborate treatment plan was considered as the most important attribute, followed by care program, measurement of treatment outcomes, and involvement of patients and relatives in the treatment. The rest of the attributes, namely pharmacotherapy and governance responsibility, were deemed less important. For more detailed result, the odds ratio between 2 attributes can be seen in Figure 3.

Table 3 Odds Ratio's as measure of the relative importance between the attributes

Attributes	Governance responsibility	Pharmaco-therapy	Involvement in treatment	Outcome measurement	Care program
Plan of treatment	3.7§	3.2§	2.6§	2.1§	1.8§
Care program	2.0§	1.7§	1.4	1.1	
Outcome measurement	1.8§	1.5¶	1.2		
Involvement in treatment	1.5¶	1.2			
Pharmaco-therapy	1.2				

§: $p < 0.01$, ¶: $p < 0.05$.

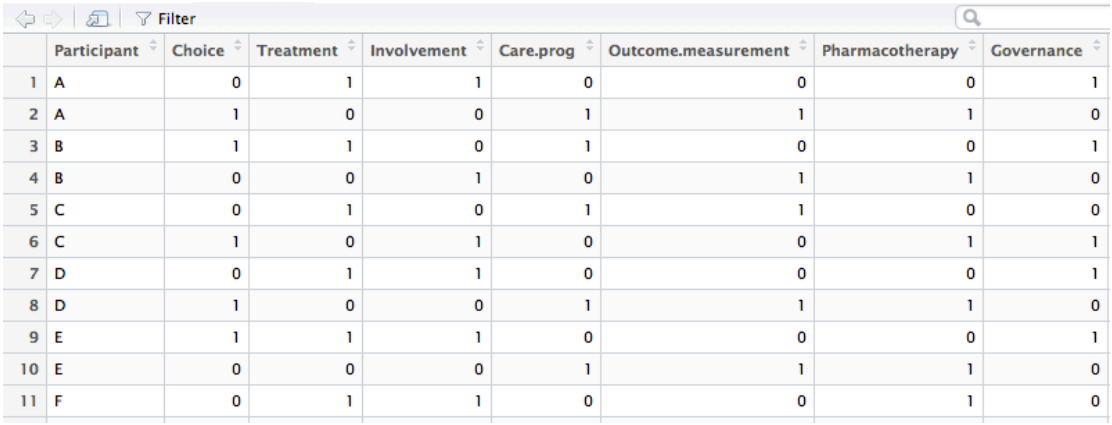
Figure 3 Table 3 of the paper

3. Simulation of the Experiment

As part of this project, our group tried to replicate the experiment that was done in the paper that we used. Since the focus of this experiment is the DCE, we simulated only that part of the experiment where choice-sets are given to respondents. Our simulation is based on the followings assumptions:

- One respondent was given 1 choice-set that was randomized from the available 10 choice-sets in order to simplify the dataset.
- Each attributes were effect coded with 1 = operational and 0 = not operational.

Each respondent's choice is randomly generated using sample() function in R that will randomly choose either 0 or 1, with 1 as being chosen by respondent and 0 is otherwise. Below (Figure 4) is one sample of dataset that we randomly generated:



Filter

	Participant	Choice	Treatment	Involvement	Care.prog	Outcome.measurement	Pharmacotherapy	Governance
1	A	0	1	1	0	0	0	1
2	A	1	0	0	1	1	1	0
3	B	1	1	0	1	0	0	1
4	B	0	0	1	0	1	1	0
5	C	0	1	0	1	1	0	0
6	C	1	0	1	0	0	1	1
7	D	0	1	1	0	0	0	1
8	D	1	0	0	1	1	1	0
9	E	1	1	1	0	0	0	1
10	E	0	0	0	1	1	1	0
11	F	0	1	1	0	0	1	0

Figure 4 Dataset of the experiment

Each respondents has two rows of data where each row corresponds to one scenario of the assigned choice-set. This can be seen by the fold-up design of the effect coded attributes. Furthermore, since each respondent can only choose one option between the two hospitals, the value of Choice column will be 0 for one row and 1 for another row of each respondents.

After generating aforementioned dataset, logistic regression is run on the dataset. We use logit model, hence using glm() function in R. You can refer to the full R code in the appendix. You can refer to Figure 5 for the result of regression analysis done to dataset in Figure 4.

```
Call:
glm(formula = Choice ~ Treatment + Involvement + Care.prog +
    Outcome.measurement + Pharmacotherapy + Governance, family = "binomial",
    data = mydata)

Deviance Residuals:
    Min       1Q   Median       3Q      Max
-1.7730  -0.9158   0.0000   0.9158   1.7730

Coefficients: (1 not defined because of singularities)
                   Estimate Std. Error z value Pr(>|z|)
(Intercept)         -0.6829     1.6562  -0.412   0.6801
Treatment            0.6705     0.9120   0.735   0.4623
Involvement         -0.6868     0.9578  -0.717   0.4733
Care.prog            1.1682     0.8390   1.392   0.1638
Outcome.measurement -1.1373     0.9456  -1.203   0.2291
Pharmacotherapy      1.3513     0.7585   1.782   0.0748 .
Governance               NA         NA      NA       NA
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

(Dispersion parameter for binomial family taken to be 1)

    Null deviance: 69.315  on 49  degrees of freedom
Residual deviance: 60.525  on 44  degrees of freedom
  (951 observations deleted due to missingness)
AIC: 72.525

Number of Fisher Scoring iterations: 4
```

Figure 5 Logistics Regression results

4. Contributions to the Field of Health

The result of this discrete choice experiment shows that it is possible to use a limited number instead of a large set of indicators in an assessment or audit process of mental healthcare service quality. The resulted 4 important attributes were deemed sufficient for the audit process.

The result might also contribute to the development of uniform and consistent guidelines for inspections performed by regulatory agencies. In this paper, mental health regulatory institute is one of the examples where DCE can be used to determine a set of important audit indicators. This can be set as a standard of the inspection guidelines as the need to consider a long list of indicators is no longer necessary. Furthermore, this information might be useful to enhance the transparency and efficiency of the quality assessment process for both regulatory agencies and hospitals.

5. Limitations of the Paper

5.1. Sample Selection

The paper mentioned that, a strength of the study is they have selected the entire population of inspectors who are involved in the regulation of institutes that care for schizophrenia patients. They have selected all the 33 persons that help evaluate all of the 33 integrated psychiatric institutes in the Netherlands. Even though there were 8 inspectors that did not respond, the authors argued that they do not differ from those respondents who participated in the DCE.

Regarding this, we would like to point out that, even though the participation rate is 75.8%, the sample size of 33 was small to begin with, and the inspectors were chosen from Netherlands only. On top of that, individuals having the same characteristics like age, gender

and background (which is what we assume the authors meant) will not necessarily be identical in terms of judgment about quality indicators. Considering only Schizophrenia and not the other mental diseases, we find this study not very representative as Schizophrenia affects more than 21 million people worldwide (World Heath Organization, 2016), and Netherlands have a rather small population compared to other countries that might be more badly affected. Figure 6 below, with legend, shows the Age-standardized disability-adjusted life year (DALY) rates from Schizophrenia by country per 100,000 inhabitants, obtained from the World Health Organization. The DALY is a metric that combines the burden of mortality and morbidity of non-fatal health problems into a single number (Give Well, n.d.). What is evident here is that, Netherlands, which is coded as light yellow (170 – 185) is not one of the countries most badly affected by Schizophrenia. Rather, we observe the majority of the dark red color (more than 320) to be concentrated at the Southeast Asia region. Similarly, by observing the prevalence data for Schizophrenia in Figure 7 (Ayuso-Mateos, 2006), we can see that the prevalence percentage for Schizophrenia in males in the Netherlands (DSMIIIR Lifetime 0.4%) is much lower compared to Iceland (DIS Lifetieme 0.7%) or Puerto Rico (Lifetime 1.9%).

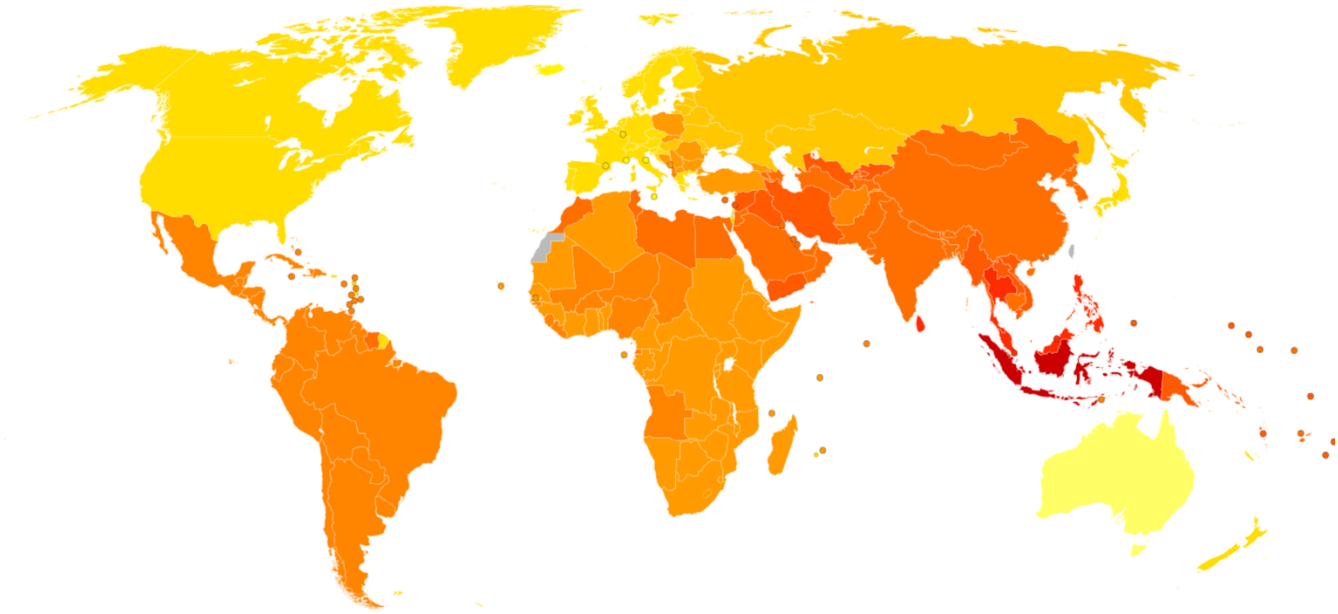
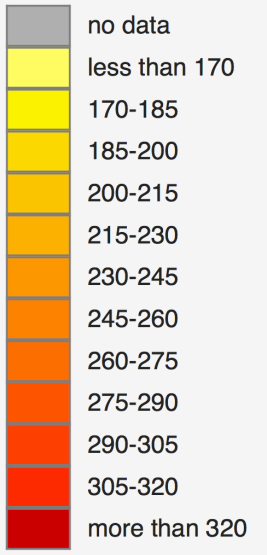


Figure 6 DALY rates from Schizophrenia by country (per 100,000 inhabitants)



Country	Site	Prevalence	Age range	Prevalence %	
				Male	Female
Netherlands (5)	Netherlands 1996	DSMIIIR Lifetime 12 month One month	All ages	 0.4 0.2 0.1	 0.3 0.2 0.2
Spain (6)	Badalona 1997	SCAN one month	18 years	0.7	0.6
Spain (7)	Formentera 1997	SCAN one month	> 15	0.3	0.65
Spain (8)	Santander 1984	Pse one month	> 17	0.9	0.3
Iceland (9)	Iceland	DIS lifetime	55-57	0.7	0.0
Iceland (10)	Iceland	DIS one month DIS one year	55-57	0.5 0.5	0.0 0.0
Canada (11)	Edmonton	DIS 6 month DIS lifetime	> 18	0.4 0.5	0.2 0.6
USA (12)	N Haven	SADS-PD point	> 18	0.9	0.0
USA (13)	ECA 5 sites	DIS one month	> 18	0.7	0.7
USA (14)	NCA	CIDI one year CIDI lifetime	15-54	0.5 0.6	0.6 0.8
Puerto Rico (15)	Puerto Rico	6 month lifetime	18-64	2.0 1.9	1.1 1.2
Mexico (16)	Mexico	PSE one month	Adults	0.7	0.71
Chile (17)	Santiago	CIDI lifetime	> 18	0.5	1.4
Taiwan (18)	Taipei	DIS lifetime	> 18	0.3	0.3

Figure 7 Prevalence data for schizophrenia

Therefore, we feel that, on a national scale, the number of participants should be increased to make sure that the result obtained is representative and reliable. As for an international scale, if the authors want to conclude that DCE is indeed useful for choosing

quality indicators (if we just look at Schizophrenia alone), using data from Netherlands alone is far from enough, because it is not the country most adversely affected by Schizophrenia.

5.2. No Prior Estimates of the Utility Related to the Attributes

The authors have mentioned in the paper that there were no prior estimates of the utility related to the attributes used in the research. We interpret this as: not enough research or studies were being done regarding these attributes and if they are really indicative of the institutes' quality of care or not. Because of this, the authors needed to create a scenario composed of three attributes that are operational and three other attributes that are not operational. Similar to what they have mentioned in their paper, we agree that this is not the most optimal design since there are no past experiments or findings to rely on.

5.3. Not Enough Experimental Details

We feel that the paper lacks in transparency and level of details in regards to its experimental design and statistical analysis. Although the authors mentioned that a logistics regression model was used to get their results, it was unclear exactly how this was done and what were the exact graph and function that they had obtained. We understood that there were 25 inspectors taking part in the DCE where each one of them was handed 10 choice-sets, and that no choice-sets are the same, and they had to choose only one institute given the set of 6 attributes classified as either operational or not operational. We plotted the choice-sets, as shown below in Figure 8, and found out that our interpretation was right as there could be no more choice-sets (more than 10) that would give a different desirability for each attribute and that the sets are not repeated. However, after performing this step, we were confused about how did the authors get the relative weights of the attributes in Figure 3. We tried using odds ratio, which is defined as "the odds that an outcome will occur given a particular exposure, compared to the odds of the outcome occurring in the absence of that exposure"

(Szumilas, 2010). We could not investigate what was this "exposure" that the authors used to get the odds ratio, therefore even though we have the data-sets structure, we were unable to simulate the odds ratio calculation.

As a result, we feel that the paper could be more transparent and descriptive when providing details about the statistical analysis and experimental design. With more details, it would be easier for other organizations or inspectors to reuse their experiment in their own context, which is exactly what the authors want: develop quality indicators, make the experiment more international, and enhance transparency and efficiency.

	A	B	C	D	E	F	G	H
1	**Attribute**	Treatment	Involvement	Care prog	Outcome m	Pharmacother	Governance	**Choice-set**
2	**Scenario**							
3	g1	1	1	1	0	0	0	cs1
4	g2	0	0	0	1	1	1	
5	g3	1	0	1	0	1	0	cs2
6	g4	0	1	0	1	0	1	
7	g5	1	0	1	1	0	0	cs3
8	g6	0	1	0	0	1	1	
9	g7	1	0	0	1	1	0	cs4
10	g8	0	1	1	0	0	1	
11	g9	1	0	0	0	1	1	cs5
12	g10	0	1	1	1	0	0	
13	g11	1	0	0	1	0	1	cs6
14	g12	0	1	1	0	1	0	
15	g13	1	1	0	1	0	0	cs7
16	g14	0	0	1	0	1	1	
17	g15	1	1	0	0	1	0	cs8
18	g16	0	0	1	1	0	1	
19	g17	1	1	0	0	0	1	cs9
20	g18	0	0	1	1	1	0	
21	g19	1	0	1	0	0	1	cs10
22	g20	0	1	0	1	1	0	
23								

Figure 8 The 10 choice-sets that we have simulated

6. Conclusion

As a conclusion, we feel that the findings and experiments used in this paper will indeed be highly useful and influential if used on a bigger scale. With better understanding of the indicators used to assess quality of care in mental institutions, greater number of sample size for testing, bigger geographical area being assessed, and more transparent experiments,

we believe that this research will not only benefit patients with Schizophrenia but also their family members, caretakers, the healthcare quality inspectors and other healthcare professionals. Additionally, more accurate and a smaller set of indicators used to evaluate quality of care in healthcare institutions can help save time, cost and human resource. Therefore, we think that this paper's research direction has a lot of potential if its limitations are addressed.

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Appendix

```r
treatment = c(1,0,1,0,1,0,1,0,1,0,1,0,1,0,1,0,1,0)
involvement = c(1,0,0,1,0,1,0,1,0,1,0,1,1,0,1,0,1,0,0,1)
careprog = c(1,0,1,0,1,0,0,1,0,1,0,1,0,1,0,1,1,0)
outcome = c(0,1,0,1,1,0,1,0,0,1,1,0,1,0,0,1,0,1,0,1)
pharma = c(0,1,1,0,0,1,1,0,1,0,0,1,0,1,1,0,0,1,0,1)
governance = c(0,1,0,1,0,1,0,1,1,0,1,0,0,1,0,1,1,0,1,0)
scenario = data.frame(treatment, involvement, careprog, outcome, pharma, governance)

respondent = c('A', 'A', 'B', 'B', 'C', 'C', 'D', 'D', 'E', 'E', 'F', 'F', 'G', 'G', 'H', 'H', 'I', 'I',
               'J', 'J', 'K', 'K', 'L', 'L', 'M', 'M', 'N', 'N', 'O', 'O', 'P', 'P', 'Q', 'Q', 'R', 'R',
               'S','S', 'T', 'T', 'U', 'U', 'V', 'V', 'W', 'W', 'X', 'X', 'Y', 'Y')
choice = c(1:50)
rTreatment = c(1:50)
rInvolvement = c(1:50)
rCareprog = c(1:50)
rOutcome = c(1:50)
rPharma = c(1:50)
rGovernance = c(1:50)
mydata = data.frame(respondent, choice, rTreatment, rInvolvement, rCareprog, rOutcome, rPharma, rGovernance)

# randomly allocate a choice-set for each respondent
for(i in 1:25){
  cs <- sample(c(1:10), 1);
  row <- cs;
  mydata$rTreatment[2*i-1] <- scenario$treatment[2*row-1];
  mydata$rTreatment[2*i] <- scenario$treatment[2*row];
  mydata$rInvolvement[2*i-1] <- scenario$involvement[2*row-1];
  mydata$rInvolvement[2*i] <- scenario$involvement[2*row];
  mydata$rCareprog[2*i-1] <- scenario$careprog[2*row-1];
  mydata$rCareprog[2*i] <- scenario$careprog[2*row];
  mydata$rOutcome[2*i-1] <- scenario$outcome[2*row-1];
  mydata$rOutcome[2*i] <- scenario$outcome[2*row];
  mydata$rPharma[2*i-1] <- scenario$pharma[2*row-1];
  mydata$rPharma[2*i] <- scenario$pharma[2*row];
  mydata$rGovernance[2*i-1] <- scenario$governance[2*row-1];
  mydata$rGovernance[2*i] <- scenario$governance[2*row];
}

# randomly generate respondents' choice
for(i in 1:50){
  if(i%%2==0){
    y <- mydata[(i-1), 'choice'];
    x <- 1-y;
  } else {
    x <- sample(c(0,1), 1);
  }
  mydata$choice[i] <- x
}

# use logit model to determine which factors are significanlt important
mylogit <- glm(choice ~ rTreatment + rInvolvement + rCareprog
               + rOutcome + rPharma + rGovernance, data = mydata, family = "binomial")
summary(mylogit)
```