

Informing patients about the climate impact of healthcare may lead to more climate-friendly treatment choices.



Name: Raphael Alexander Verhaar  
Student number: 545815

Supervisor: David Gonzalez Jimenez  
Second Reader: ...

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The views stated in this thesis are those of the author and not necessarily those of the supervisor, second assessor, Erasmus School of Economics or Erasmus University Rotterdam.

## Preface

In front of you is the bachelor thesis “Informing patients about the climate impact of healthcare can lead to more climate-friendly treatment choices.”. This thesis has been written to meet the graduation requirements of the Economics and Business Economics program at Erasmus University in Rotterdam. I have been researching and writing my thesis from May to August 2023.

During my studies, I noticed that I felt more and more involved in tackling climate change. In addition to my studies, I worked as an assistant scientific researcher at a knowledge institute for healthcare. I then asked whether it was possible to conduct my research into the climate impact of healthcare. In particular, the behaviour of consumers and patients when they learn how climate-polluting healthcare is. In 2022 I finished my first research. With success, it was shared by the ministry. In 2023 I will also complete my second study. In both studies, I could not do a discrete choice experiment, which I wanted to do. I also looked at whether providing information has an impact on the choices consumers and patients make, but not which form of information will have the greatest impact. This thesis was a great opportunity for me to research this.

I would like to thank my supervisor, David Gonzalez Jimenez, for guiding and supporting me through the process. I deliberately chose you as a supervisor because of the research you are conducting at this moment. I thank you.

Finally, I would like to thank my family and friends for being there for me during my research process.

I wish you a lot of reading pleasure.

Alex Verhaar

Rotterdam, October 2023

## Abstract

Our effect on the climate has been noticeable over recent years. Healthcare is one of the biggest polluters in the world. In this thesis, we take a closer look at which flyer, about the climate impact of healthcare, will encourage patients to choose climate-friendly medication the most in hypothetical situations. The research is conducted through a discrete choice experiment and analysed with a probit model and a conditional logit analysis. The findings show that those who didn't receive a flyer opted for medication B, the eco-friendly option, in only 36% of cases. In contrast, respondents who received a text-only flyer chose medication B 56% of the time. Those who received a flyer with both text and a graph favoured medication B the most, with nearly 70% choosing it. Furthermore, people who received a flyer put more weight on the climate impact of their treatment when deciding, than people who did not receive a flyer. Handing out a flyer, about the climate impact of healthcare, to patients may make their decision for treatment possibly more climate-friendly.

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# 1 Introduction

## 1.1 Healthcare plays a big role in climate change

Heat waves, wind storms, rising sea levels and hailstorms in summer. All consequences of climate change. IPCC (2014) concluded in their AR5 climate change report, that it is extremely likely that human activities are the dominant cause of global warming. Climate change has a direct and indirect effect on our health. According to the WHO (2021), tens of thousands of people die each year because of climate change and this number is only going to rise. The healthcare sector naturally tries to care for and remedy these health consequences of climate change. Patients are administered anaesthetic gases or prescribed a lot of medication. This harms the climate. The healthcare sector in the Netherlands emits 7% to 8% of total CO<sub>2</sub> emissions (Steenmeijer et al., 2022; De Bruin, 2019). This is more than KLM or TATA Steel (Faber & De Bruyn, 2019; Nederlandse emissieautoriteit, 2021). This creates a perpetual cycle, the more people they help, the bigger the climate impact and the more people get sick.

The KNAW's recent report, Planetary Health (2023), identified where knowledge is lacking about the effects of environmental change on health. According to them, an important research field where more knowledge is needed is the behavioural change of citizens for climate change in combination with health care. They also mention the importance of "promoting implementations of sustainable health".

Studies in the Netherlands and England have shown that almost three-quarters of the population is not aware of the climate impact caused by the healthcare sector (Verhaar et al., 2022; NHS, 2021). When people were informed about the impact healthcare has on the climate, they were prepared to choose more climate-friendly healthcare than before they knew about healthcare's climate impact (Verhaar et al., 2022). Informing the population can therefore bring about a change of choice that benefits the climate.

## 1.2 Goal of the thesis

In this thesis, we will look at the effect of informing patients about the climate impact of healthcare and what form of informing patients is most effective for making patients make, theoretically, more sustainable choices. It will be effective if more people choose a climate-friendly medication. We will specifically look at flyers as a form of informing patients. The use of flyers has been selected because hospitals and General practitioners (GPs) often use flyers to inform patients about their disease or injury. It is implementable and would not be out of place to hand another flyer with an explanation about the climate impact of health care.

There is currently a great demand for this type of research. Besides the recent report of KNAW, it has also come to light by talking to researchers in the research field and doing further literary research. There has been a lot of research into the best way of informing people about climate change. Papers have been written on how to close the gap between the science of climate change and actions against climate change (Moser & Dilling, 2011). Other papers discuss the impact of climate change on public health and how this should be communicated to the outside world (Weathers et al., 2017). But there are no papers on the behaviour of citizens in combination with the climate impact of their health care when being informed with a flyer". This research is going to be more zoomed in than previous research. This thesis will be more specific and will broaden the current knowledge we have. It will also build a foundation for further research into making healthcare more sustainable.

When informing patients about the climate impact of healthcare you create more awareness. This is not only reflected in their possible choice for more sustainable care but also in their behaviour in daily life. More sustainable choices ensure a more sustainable planet and less climate change. As a result, society is healthier and less care is needed. The most effective and informative method can be easily implemented on a large scale because the methods are simple and non-invasive.

### 1.3 Research question

This paper will try to answer the main research question: Which style of flyer, informing citizens about the climate impact of healthcare, is more likely to encourage patients to choose healthcare that is more climate-friendly? Former research tells us that visual aids help people understand numbers and problems (Tufte, 2001; Cleveland & McGill, 1984). Based on these papers the hypothesis is that a flyer with information that is substantiated with percentages and a figure will be the most effective way of informing patients. To answer the research question, two sub-questions must first be answered. The first sub-question is whether certain population groups will answer differently. This question is divided into whether people want medication or not, and if so which medication they prefer. The second sub-question is about whether patients are interested in the climate impact of their medication. The general idea has always been that people want to receive the best care possible.

The main research question and the two sub-research questions will be answered with quantitative data.

### 1.4 Reading guide

In the remainder of this thesis, further literature and important concepts will be discussed first. Subsequently, the methodology will be substantiated and explained. After the methodology, the results of the research are discussed, followed by a discussion of the results and the research itself. The thesis is concluded with a conclusion of the research.

## 2 Literature review

### 2.1 Important concepts

Regarding the main research question: “Which style of flyer, discussing the climate impact of healthcare, is more likely to encourage patients to choose healthcare that is more climate-friendly?”. It is important to define the relevant concepts of the research question.. A flyer is a one-page document that conveys information to a target audience about a certain product, in this case, treatment. Climate impact refers to the effects human activities have on the change of climate on Earth. A patient is someone who is or may be receiving medical care or treatment from a healthcare professional or a healthcare facility.

When talking about CO<sub>2</sub> in this paper, we do not only talk about carbon dioxide but also other greenhouse gases. When a number of CO<sub>2</sub> is mentioned, it is the CO<sub>2</sub> equivalent to the accumulated amount of greenhouse gases that are emitted.

### 2.2 Different research fields

This report uses literature on climate change in general and the climate impact of healthcare to address the issue. It also looks at solutions or where the knowledge gaps are based on previous research on the subject. Furthermore, literature is needed to see which research method is most appropriate for this research and how it should be applied.

#### 2.2.1 Climate change

The most important publications on climate change are the Intergovernmental Panel on Climate Change (IPCC) reports. The primary function of the IPCC is to evaluate scientific papers, carry out investigations, and generate regular reports that present a comprehensive overview of climate science, potential consequences of climate change, and possible strategies for adaptation and mitigation. These reports are founded on a thorough examination and consolidation of peer-reviewed scientific literature, along with input from numerous experts and researchers globally. Within the collection of IPCC assessment reports, the "Fifth Assessment Report" (AR5) released in 2014 extensively examined the influence of human activities on climate change.

The Lancet Countdown Health and Climate Change aims to track the relationship between climate change and public health. It is an annual report that gives an in-depth assessment of the health impacts of climate change and the progress being made. It includes data and literature from several sources including, the World Health Organization (WHO). The WHO writes about the impact of climate change on our health. In a published factsheet they describe the consequences of climate change on our social

and environmental determinants of health. Direct damage costs to health could rise to 2 to 4 billion a year by 2030 (WHO, 2021).

### 2.2.2 Climate impact of healthcare

The Lancet Countdown (Watts et al., 2021) describes that the healthcare sector on average emits 5% of the total CO<sub>2</sub> emissions per country. Steenmeijer et al., (2022) of RIVM and De Bruin et al. (2019) of Gupta Strategists reported that this number is between 7% and 8% in the Netherlands. RIVM researches public health and, healthy and safe environments for the Dutch government. The Dutch government uses their research as support for their policies. Gupta Strategists is one of the leading organizations in advising healthcare institutions about more sustainable care. They have several reports and recommendations about the climate impact of the healthcare sector. Their report in 2019 was an eye-opener for the sector (Gupta Strategists, 2019). It was the first time that the climate impact of Dutch healthcare had been mapped out. RIVM confirmed the findings of Gupta Strategists in 2022 by publishing their report (RIVM, 2022). The Gezondheidsraad is a Dutch independent scientific advisory body with the statutory task of advising the government and parliament on issues in the field of public health and healthcare research. Based on the reports of RIVM and Gupta Strategists, the Gezondheidsraad advised to include the climate impact of medication as a factor in a healthcare practitioner's decision on which treatment should be given (Gezondheidsraad, 2023). Their advice is the most important advice the parliament can receive about public health and healthcare.

## 2.3 Gaps in knowledge

The KNAW (2023) recently published their report “Planetary Health” about where the gaps in knowledge are for the effects of environmental changes on health, and where steps can be taken. KNAW is a society of outstanding scholars and an advisory body to the government in the field of science. They are an independent and renowned institute in the Netherlands that focuses on promoting scientific research and promoting scientific excellence. In this report, they have divided the steps that need to be taken into four subcategories. The first category is “Understanding human health impacts of global environmental change”. The second category is “Developing mitigation and adaptation strategies to protect human health”. The third and most important category for this thesis is “Promoting the implementation of mitigation and adaptation strategies”. The last category is “Enabling research on global environmental change and health”.

One of the top priorities this report brings to light is changing citizens' behaviour and promoting the implementation of sustainable healthcare practices. NIVEL has researched to see if there is a willingness among citizens to choose more climate-friendly care, even if that means there is a chance that the medication is less effective (Verhaar et al., 2022). NIVEL is an independent research institute



in the Netherlands that specializes in conducting scientific research in the field of healthcare. The research concluded that almost three-quarters of the population didn't know the healthcare sector was so bad for the environment. But when they were informed about this fact they chose in a questionnaire the more climate-friendly treatment. Sustainable healthcare practices can be implemented when we look at the changing behaviour of citizens when they are informed about the climate impact of healthcare.

NHS is the public healthcare system of the United Kingdom. NHS has always been one of the most progressive healthcare organizations in the world. They are trying to take the lead compared to the rest of the world in making healthcare more sustainable. They have also conducted research into public support for making healthcare more sustainable (NHS, 2021). In England, only a quarter of the population is aware of the pollution of the healthcare system. Furthermore, the research found that 65% of respondents would consider the environmental impact of their treatment options as part of deciding their treatment with their health professional. Furthermore, 70% said they would prefer a certain treatment option because it has less of an impact on the environment.

## 2.4 Research method

The research method for the thesis will be a discrete choice experiment (DCE). Through this method, we can understand which attributes are important for patients when they choose what kind of treatment they would like to receive.

### 2.4.1 What is a discrete choice experiment?

A DCE is a quantitative research method used to understand individuals' preferences and decision-making processes when faced with multiple discrete alternatives (Discrete Choice Model and Analysis, 2022). People are presented with several hypothetical choice scenarios. In each scenario, they must choose between multiple alternatives. These alternatives are described by attributes and levels. The goal is to determine how individuals weigh these attributes when making a choice.

### 2.4.2 Why discrete choice experiments?

Louviere et al. (2000) introduced a comprehensive overview of DCE and the practical use of stated preference in decision analytics. De Bekker-Grob et al. (2012) state the growing importance of patient preferences in healthcare decision-making and highlight the strengths of DCEs. They give an overview of the use of DCEs in health research. A lot of healthcare research is being done by systematic reviews and meta-analyses, randomized controlled trials or observational studies. Observational studies make use of revealed preferences (RP). Revealed preferences are preferences of people that can be observed by looking at actual choices and behaviours. In an ideal world, you would always want to use revealed preferences. Then you could see how people responded in a certain situation. The downside is that

you can't always get this data. Another way of analysing people their preferences is stated preferences (SP). These are preferences which individuals express through surveys and hypothetical scenarios. Van Den Broek-Altenburg, E., & Atherly, A. (2020) emphasize that a discrete choice experiment (DCE) is an appropriate estimation method and opens up a new world of data and possible research. This data could be collected by stated preference.

Besides de Bekker-Grob et al., Louviere et al. and Van Den Broek-Altenburg, E., & Atherly, A., more researchers and institutions have made clear that discrete choice experiments are preferred when researching stated preferences. The Food and Drug Administration (FDA, 2016) promotes the use of patient preference information in research they have to review. They recommend the use of DCEs. The Erasmus Choice Modelling Centre (ECMC) focuses in particular on healthcare because DCEs are so applicable in healthcare. The paper of Pfarr et al. (2014) advocates the integration of DCEs in healthcare research. They substantiated their opinion by explaining that understanding the preferences of patients can lead to improved patient satisfaction and health outcomes. The most applicable and recommended research method for this type of research is a DCE,

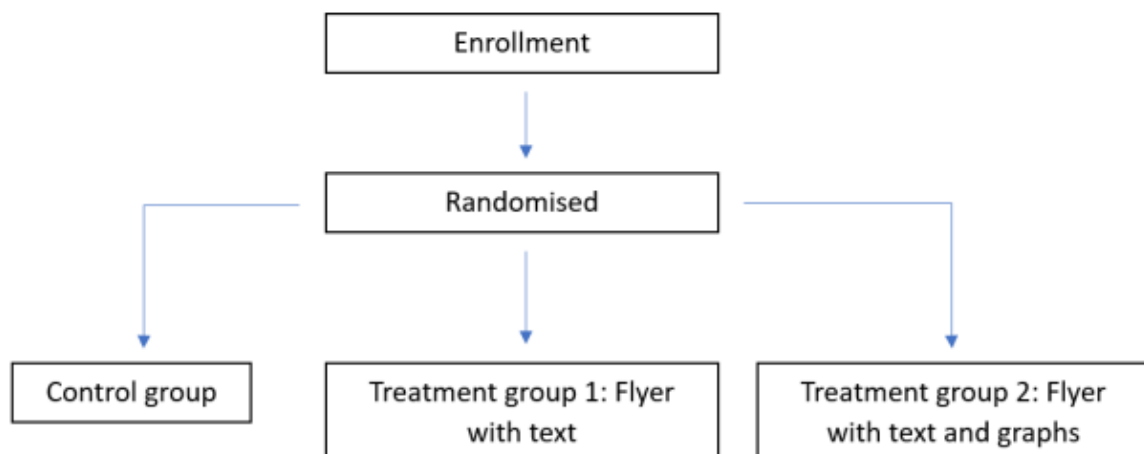
## 2.5 Communication methods used by healthcare workers

The most used communication method in hospitals is face-to-face interaction between the patient and hospital staff. Patients receive information about their (possible) treatment and can ask questions. The second most used communication method is often used around or during face-to-face conversations. Patients receive a pamphlet or a flyer about their disease and/or possible treatment. There is more information for the patients in these additional forms of communication. This answers the third sub-question. As mentioned in the introduction, flyers are implementable because they are often chosen in hospitals and by General practitioners (GPs) to inform patients about their disease or injury. It would not be out of place to hand another flyer with an explanation about the climate impact of health care.

## 3 Methodology

### 3.1 Receiving responses

The main research question and sub-research questions will be answered through quantitative data. A survey is made to collect the stated preferences of the respondents. The paper is about the Dutch healthcare system and its climate impact, hence the target audience is Dutch citizens. Cross-sectional study in a sample of the general population. The questionnaire is shared at various spots in the city of Rotterdam and Alkmaar. It is also published on the internet and social media. The questionnaire has primary data that consists of personal details and the answers to the choice tasks. First, personal questions are asked to see if different population groups answer differently. After the personal questions respondents will be randomised into three groups, two treatment groups and one control group. The control group did not receive a flyer before the choice sets. The two treatment groups received the flyer after the general questions. The first flyer will consist of information that is substantiated with just facts and numbers. The second flyer will have the same information but a graph will be added to create a visual aid. Both flyers are shown in Appendix 1 and 2.



The flyer contains information about the climate impact Dutch healthcare has. It explains what climate change can lead to, what the role of the Dutch healthcare system is in polluting the climate, how much other big organizations pollute in comparison and that different medications can have different climate footprints.

### 3.2 Discrete choice experiment design

#### 3.2.1 Alternatives and Attributes

Alternatives are the options a respondent gets per choice set. These alternatives differ from each other because the attributes of the treatment can have different levels. The DCE is made with the guide that is written by Lancsar, E. & Louviere, J. (2008) and the book of Manski, C. F., & McFadden, D. (1981).

The book made the foundation for structural analysis of discrete data. The guide has been the most used guide when making a DCE.

Each choice set consisted of three alternatives with five attributes. For the research, the most important attributes are the effectiveness and climate impact of the treatment. The other three attributes are cost, side effects and the number of times you had to take the medication. An example of one of the choice sets that respondents have been presented with is shown in Appendix 3.

The levels of the attribute Effectivity were decided upon a realistic difference between the medications and no medication. For the attribute Climate impact, statistics of the CBS (2022, 2023) were used. By looking at the size of emissions and the average distance people drive in a day, the levels were calculated. For the levels of the other three attributes, previous research was reviewed. Effectiveness, cost and side effects of treatment are the most used attributes in healthcare-related DCEs (Bertran et al., 2019). The climate impact of the treatment is an important attribute to see if the flyer has an impact on the respondent. The number of times you have to take the medication is also an attribute that is used a lot in medication preference research.

### 3.2.2 Importance of an understandable questionnaire

To make the questionnaire more understandable, tips from several papers are used. Schapira et al. (2001) look at the difference in frequency and probability when communicating risk. They suggest using clear graphics that add context to numeric information. Fagerlin et al. (2011) suggest ten steps of communicating with a patient to help them decide. This includes plain language with verbal material, absolute risks and the use of pictograms. Caponecchia (2009) did research to make strategies that improve communication of probability information. He mentioned several issues and recommendations when informing people about probability communications. As well as the tips, a checklist from Bridges et al. (2011) is used to limit the number of possible biases. It is important to follow these steps to avoid biases and to have clear questions for the respondents so they understand the questions.

Kløjgaard et al. (2012) advise strongly that during the design of a stated choice experiment interviews are conducted. It is important to conduct qualitative research to make sure the questionnaires are understood the same way as they were meant to be understood. Before the questionnaire was published, the first four qualitative interviews were conducted with people who all had completed a different level of education and worked in different sectors. These interviews were meant to find out where the bottlenecks were in the questionnaire. These bottlenecks have been removed or modified.

### 3.3 Data

The survey got 98 respondents, each answered 7 choice sets. All responses are aimed at an aggregate response of a respondent, the questions will not be looked at individually but only as a whole. Because of the methodology of a discrete choice experiment this thesis therefore has a total of 98 respondents and 686 responses. Furthermore, the dataset will include the age, gender, education level, whether they have had a strong headache before, which Flyer they have seen and whether they knew that the healthcare sector has such an impact on the climate.

Responses were excluded from the results when they answered the questionnaire within 120 seconds because they could not have read everything and thus did not follow the procedure. Responses were also excluded when they did not finish the questionnaire. For the sample size of a discrete choice experiment often the rule of thumb of Johnson and Orme is used (De Bekker-Grob et al., 2015). In short the rule of thumb, as proposed by Johnson, R., & Orme, B. (2010), suggests that the sample size required for the main effects depends on the largest number of levels for any of the attributes (c), the number of alternatives (a), and the number of choice tasks (t). The following equation is used:  $N > 500c/(t \times a)$ . The largest number of levels is four, there are three alternatives and 7 choice tasks. The minimum sample size should be 95 people according to the rule of thumb.

### 3.4 Analysis

A conditional logit model has been used as the statistical method to analyse the data of the DCE. It provides a systematic way to understand human decision-making. By quantifying the importance of different attributes, it offers insight and could enable policymakers to make different decisions. This method of analysing the DCE is recommended by both Lancsar, E. & Louviere, J. (2008) and Hauber et al. (2016). The publication of Hauber et al. (2016), also includes a guide on how to perform a conditional logit model with DCE data.

For the analysis, extra variables have to be made. One variable that is created is whether patients want medication (NOMED). Another variable is which type of medication has the patients' preference in case they want medication (YESMED). For each level of each attribute, a variable is made for the conditional logit model. The last variables that are made are the choice sets that people had to answer. With these extra variables, we can start analysing the responses.

First, a probit model of the binary situation of whether people want medication or not will be analysed. After the first probit model is analysed, a second one will be analysed for the binary situation of whether people want medication A or B. People who answered they preferred "No medication" were dropped. With these tests, we can answer the first sub-question and look at whether certain groups of people have a significantly different preference towards treatment from other groups of people. As

well as looking at possible differences in preference between more effective or more climate-friendly medication, medication A or medication B. These groups of people can be divided by several independent variables, for example, age, gender or education.

To answer the second sub-question a conditional logit model will be made. This way we can see whether the climate impact of treatment is even taken into account when choosing a medication.

Lastly, we will have a look at whether people seeing a certain flyer has had an impact on which medication people choose. When answering the main question, a discrete choice experiment is used. The probit model will look solely at the difference the intervention of handing out a flyer, with or without a graph, makes between the control and two treatment groups. To look at the difference in detail, a graph of the descriptive statistics will be made. The conditional logit model will be used to look at whether people who received a flyer put more weight on the climate impact the medication has. Will seeing the flyer make the patients take the climate impact of medication more into account and therefore choose a more climate-friendly medication?

## 4 Results

### 4.1 Respondents characteristics

Of the 98 respondents, 53 people were male and 45 people were female. The respondents are divided into four age groups, 18 to 25 years old, 26 to 40 years old, 41 to 65 years old and people older than 65 years old. The youngest age group had 44 respondents, the age group of 26 to 40-year-olds had 17 respondents, the third age group had 20 respondents and the oldest age group had 17 respondents. 47% of the respondents have had strong headaches which prevented them from engaging in their daily lives before. This means they were unable to work, exercise or study. Of the respondents, 32% have enjoyed high school or MBO as their highest level of education. 24% studied in a college or HBO institution and 44% went to university. The youngest age group is overrepresented and the 41 to 65 years old age group is underrepresented compared to general population (CBS, 2023). The sample also has slightly more males than females. The Dutch population is slightly dominated by females.

### 4.2 Dutch citizens are open to more climate-friendly and less effective medication

Table 1: How much was each treatment option preferred? (responses=686)

Medication	Frequency	Percentage
Medication A	255	37.17%
Medication B	300	43.73%
No medication	131	19.10%

In Table 1 we can see that Medication B has been chosen 300 times, making it the most chosen option. Medication A closely follows by being chosen 37% of the time. No medication has been chosen the least but still almost 20%.

Table 2: How many people knew about the climate impact of Dutch healthcare before the research (N=98)

Knowledge of the climate impact	Frequency	Percentage
Yes	16.2	16.50%
No	81.8	83.50%

In table 2 we can see that only a small part of respondents has knowledge about the size of the climate impact Dutch healthcare has.

### 4.3 Population groups differ in medication preference

Table 3: Probit model whether people want medication or not (NOMED-model).

Probit model NO Medication (N=98)			
	Coefficient	Std. err.	P-value
Flyer	-.04	.07	.594
Gender	.15	.11	.184
Age	-.10	.05	.060
Education	.10	.07	.165
Headache	-.02	.12	.896
Know about the climate impact	.22	.15	.149
Question 1	.04	.20	.855
Question 2	-.27	.21	.208
Question 3	-.03	.20	.876
Question 4	-.37	.22	.093
Question 5	-.14	.21	.491
Question 6	.13	.20	.504
Question 7		Omitted	
Constant	-1.32	.46	.004
Log-likelihood		-324.9	

Note: \*P < 0.05 \*\*P < 0.01 \*\*\*P < 0.001

Explanation of variables: People who did not receive a flyer are Flyer=1, people who only received a flyer with text are Flyer=2 and people who also got a graph in their flyer are Flyer=3. Males are Gender=1 and Females are Gender=2. The youngest age group is Age=1 and the oldest age group is Age=4. People with the lowest level of education are Education=1 and people with the highest are Education=3. People with a headache are Headache=1 and people who do not have a headache are Headache=2. Respondents who knew about the climate impact of healthcare are numbered 1 and people who did not know are numbered 2.

If people chose either option “Medication A” or “Medication B” variable NOMED is 1, if people chose “No medication” variable NOMED is 2. Table 3 shows us a probit model with NOMED as a dependent variable and several independent variables. We can see that none of the independent variables are significantly different. There was no difference in preference for “no medication” between people who received a flyer and people that did not. The only difference we can see is when we look at the descriptive statistics of the independent variable “Age”.

Table 4: Descriptive statistics of the dependent variable, NOMED, and independent variable, Age.

Age and NO Medication (N=98)					
	18-25 years	26-40 years	41-65 years	66+ years old	Total
Wants medication	228 (74%)	108 (90.8%)	127 (90.7%)	92 (77.3%)	555 (80.9%)
No medication	80 (26%)	11 (9.2%)	13 (9.3%)	27 (22.7%)	131 (19.1%)
Total	308	119	140	119	686

In Table 4 we can see that the youngest and oldest generations chose “No medication” more often than people who are 26 to 65 years old.



Table 5: Probit model whether people would prefer medication A or B (YESMED).

Probit model YESMED (N=80)			
YESMED	Coefficient	Std. err.	P-value
Flyer ***	.40	.07	.000
Gender **	.33	.11	.004
Age	.01	.05	.844
Education *	-.15	.07	.036
Headache	-.03	.12	.794
Know about the climate impact	-.25	.15	.090
Question 1	-.31	.21	.144
Question 2	-.22	.21	.280
Question 3 **	-.62	.21	.003
Question 4	.09	.21	.659
Question 5	.25	.21	.248
Question 6	-.29	.21	.171
Question 7		Omitted	
Constant	-.25	.46	.585
Log-likelihood		-343.4	

Note: \*P < 0.05 \*\*P < 0.01 \*\*\*P < 0.001

Explanation of variables: People who did not receive a flyer are Flyer=1, people who only received a flyer with text are Flyer=2 and people who also got a graph in their flyer are Flyer=3. Males are Gender=1 and Females are Gender=2. The youngest age group is Age=1 and the oldest age group is Age=4. People with the lowest level of education are Education=1 and people with the highest are Education=3. People with a headache are Headache=1 and people who do not have a headache are Headache=2. Respondents who knew about the climate impact of healthcare are numbered 1 and people who did not know are numbered 2.

In the model of Table 5, we can see that we have some independent variables that are significantly different from each other. If people chose option “Medication A” variable YESMED is 1, if people chose “Medication B” variable YESMED is 2. At first glance, we can see that receiving a Flyer, especially a flyer with a graph, makes people choose medication B, the more climate-friendly medication, more often. Females tend to choose medication B more often than males. Furthermore, we can see that the higher the education one has enjoyed, the more likely she is to choose medication A, the more effective medication. The last effect we can see from this probit model is that a lot more people chose medication A at question 3 than any other question. This is the only question where the climate impact of the medication was equal for both medications A and B. Here the difference between the medication were the other 4 attributes.

When we zoom into the effect of the independent variable, Education and the dependent variable, YESMED, we can see that the difference is mainly due to people who are educated at the university level.

Table 6: Descriptive statistics of the dependent variable, YESMED, and independent variable, Education.

Education and YESMED (N=80)				
YESMED	High School/MBO	College/HBO	University	Total
Medication A	73 (40.6%)	56 (38.9%)	126 (54.5%)	255 (45.9%)
Medication B	107 (59.4%)	88 (61.1%)	105 (45.5%)	300 (54.1%)
Total	180	144	231	555

Table 6 shows us that there is almost no difference between the groups High School/MBO and College/HBO. The significant effect is caused by people who have enjoyed university-level education. They are more likely to choose medication A, the more effective medication, than the other two groups of people.

Table 7: Descriptive statistics of the dependent variable, YESMED, and independent variable, Gender.

Gender and YESMED (N=80)			
YESMED	Males	Females	Total
Medication A	160 (52.5%)	95 (38%)	255 (45.9%)
Medication B	145 (47.5%)	155 (62%)	300 (54.1%)
Total	305	250	555

Females chose medication B more often than medication A as seen in Table 7. Males on the other hand are more indifferent, they slightly prefer medication A.

#### 4.4 Climate impact of medication matters for patients

Table 8: Conditional logit model about the attributes, effectivity and climate impact.

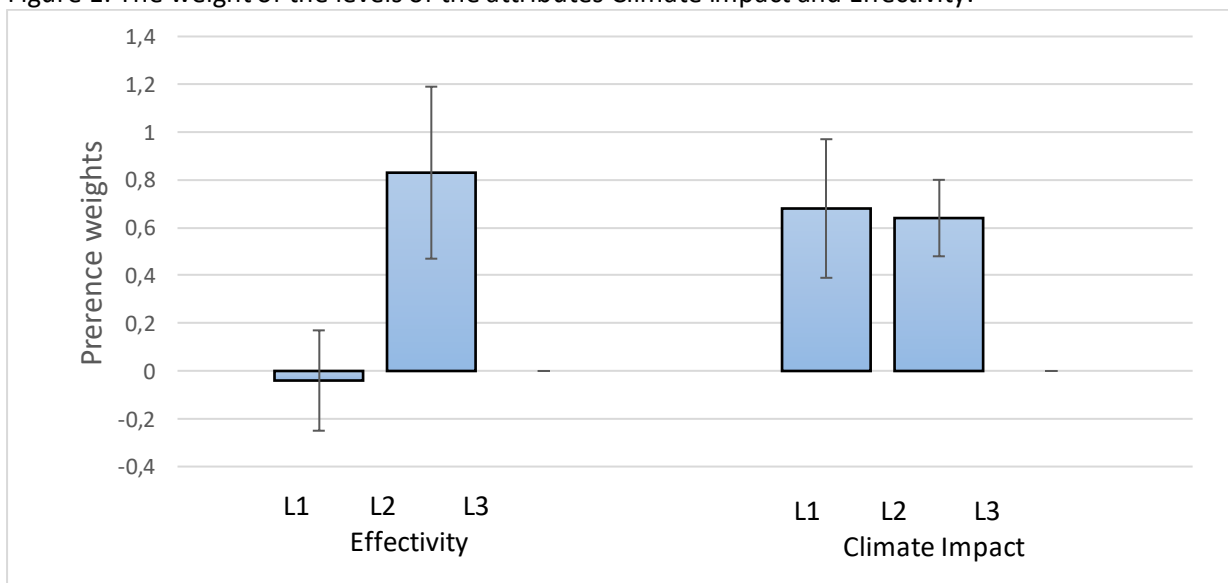
Dummy-variable coding (N=80)					
Attribute	Level	Coefficient	SE	T value	P value
Effectivity	L1	-0.04	0.21	-0.19	0.848
	L2	0.83	0.36	2.35	0.019*
	L3	0		Omitted	
Climate impact	L1	0.68	0.29	2.30	0.021*
	L2	0.64	0.16	4.08	0.000***
	L3	0		Omitted	
Log-likelihood		-350.2			

Note: \*P < 0.05 \*\*P < 0.01 \*\*\*P < 0.001

Both the attribute Effectivity and Climate impact have different levels in which they were shown. L1 stands for level 1, for effectivity this was that the headache would be gone after one hour. Level 2 was four hours and level 3 was twelve hours. The levels for climate impact are how much the emissions are for driving a car for a certain period. Level 1 is one week, level 2 is two weeks and level 3 is four weeks of emissions.

The two most important attributes of these choice sets were Effectivity and Climate impact. The question is whether patients are willing to compromise on the effectiveness of the medication they receive if it is better for the environment. In the table above it is shown how much the weight of the attributes is in people their decision-making. In Figure 1 below it is presented graphically.

Figure 1: The weight of the levels of the attributes Climate impact and Effectivity.



The higher the coefficient, the higher the weight. The more weight an attribute has, the more impact it has on people their decision-making. Level 1 is not significantly different from level 3, but level 2 shows a big effect in comparison to level 3.

Level 1 and level 2 are significantly different from level 3. The attribute Climate impact shows that the more climate-friendly the level in the choice set is, the more weight it has towards the decision people will make.

#### 4.5 Climate impact of medication is taken into account more, depending on the flyer

In Table 5 we can see that seeing a certain Flyer makes a significant difference. Receiving a flyer with information about the climate impact of the healthcare sector has an impact on whether people choose medication A or medication B, the climate-friendly medication. This effect is shown in Figure 1. We can see that people who did not receive a flyer chose medication A, the effective medication, more often than medication B. The first Flyer creates a shift in comparison to people who did not receive a flyer. People who received a flyer with text about the climate impact of the healthcare sector chose medication B more often than medication A. But people who besides the text also received a graph about the climate impact chose medication B two times more often than medication A. In comparison to the people who did not receive a flyer, they chose medication B two times more often.

Figure 2: Descriptive statistics of the dependent variable, YESMED, and independent variable, Flyer.

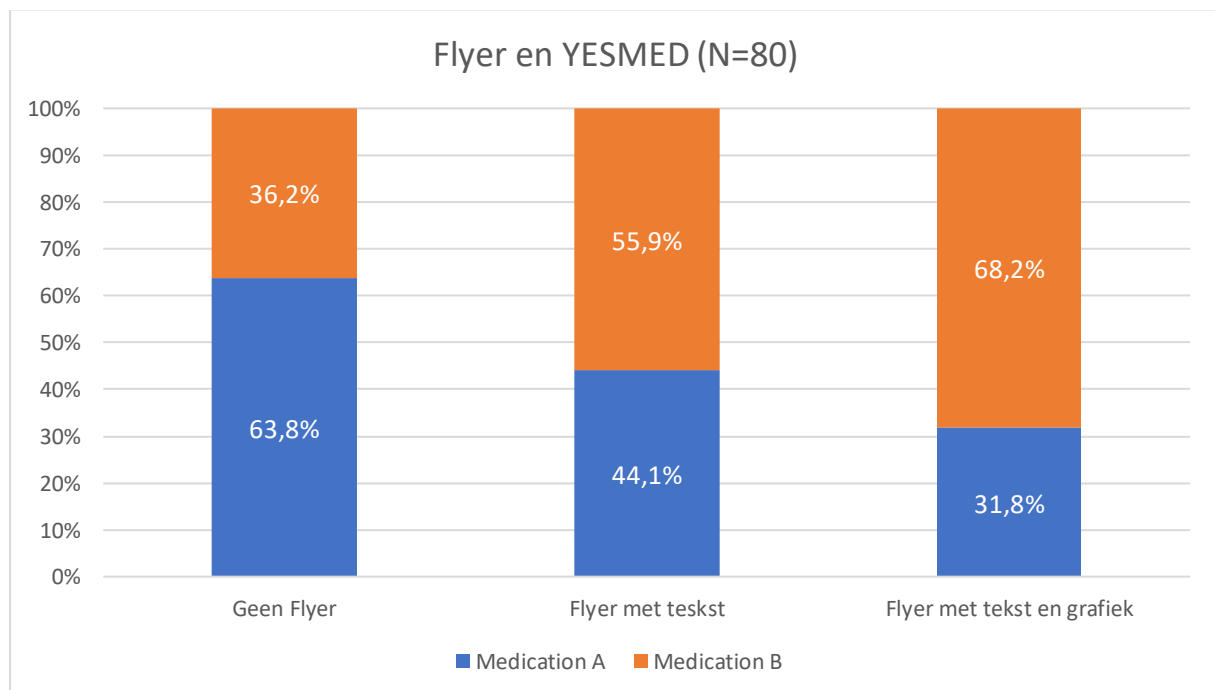


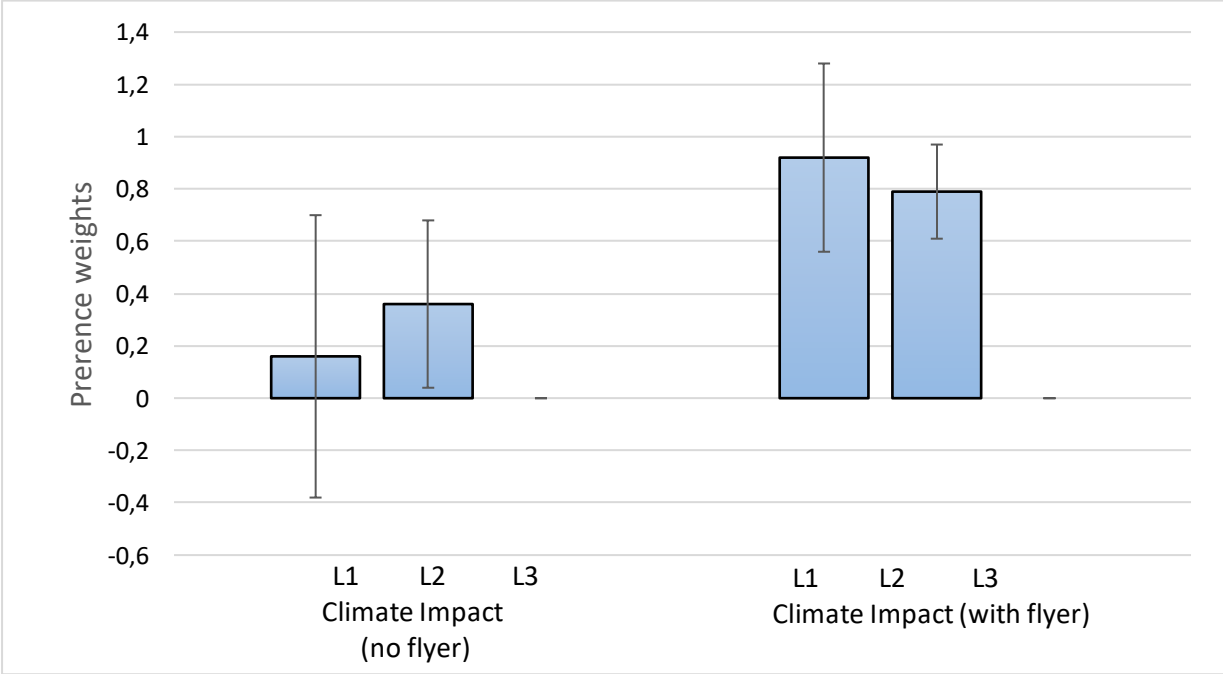
Table 9: Conditional logit model for the attribute Climate impact between people who received a flyer and those who did not

Dummy-variable coding (N=80)					
Attribute	Level	Coefficient	SE	T value	P value
Climate impact (no flyer N=177)	L1	0.16	0.54	0.29	0.773
	L2	0.36	0.32	1.12	0.263
	L3	0	Omitted		
Log-likelihood	-110.6				
Climate impact (with flyer N=378)	L1	0.92	0.36	2.54	0.011*
	L2	0.79	0.18	4.36	0.000***
	L3	0	Omitted		
Log-likelihood	-233.0				

Note: \*P < 0.05 \*\*P < 0.01 \*\*\*P < 0.001

The attribute Climate impact has different levels in which it was shown. The levels for climate impact are how much the emissions are for driving a car for a certain period. Level 1 is one week, level 2 is two weeks and level 3 is four weeks of emissions.

Figure 3: Comparison of the weight of the levels of the attribute Climate impact between people who received a flyer and those who did not.



People that did not receive a flyer to read before they answered the choice sets, put less weight on the attribute climate impact than people who did receive a flyer. By getting a flyer beforehand they learnt about the climate impact Dutch healthcare has. This made them take the climate impact of medication more into account when deciding their preference for medication.

## 5 Discussion

The main aim of this thesis was to find out with what kind of flyer about the impact healthcare has on the climate people are more likely to choose medication that is better for the environment.

In general, Medication B was chosen the most. 44% of the time people had a preference for the most climate-friendly answer. A large group of people are willing to take less effective medication for a more climate-friendly alternative. This was closely followed by medication A, the most effective medication, which was chosen 37% of the time. The remaining 19% of patients' preference was no medication. This is because of any number of reasons like possible side effects, costs or a general aversion to medication. In previous research, it is shown that many people do not know that the healthcare sector is one of the biggest polluters in the Netherlands (NHS, 2021; Verhaar et al., 2022). We see the same result, only 16.4% of the Dutch population knows how much Dutch healthcare emits.

### 5.1 No medication

The most important result for the first sub-question is that some population groups differ from each other when it comes to choosing which treatment they would prefer. The youngest (18 to 25 years old) and the oldest (66+ years old) age groups are less likely to take any medication in comparison to people who are between 26 and 65 years old. The youngest age group chose no medication 26%, and the oldest age group chose it 23% of the time. Whereas only 9% of the people in the two middle age groups chose no medication. This is possible due to the fact that people who are between 26 and 65 years old often have a busier life than younger or older people. It would have a bigger impact on them to not be able to work, study or play sports. Yet in all population groups, there is a preference for medication instead of no medication. Even for the younger and older generations.

### 5.2 Climate-friendly or effective medication

Females tend to choose climate-friendly medication more often in comparison to males. Males chose medication B 48% of the time, whereas for females this number was 62%. This is often referred to as the eco-gender gap (Intel, 2023). Women tend to act stronger towards protecting the environment than men. But it could also have to do with perceiving vulnerability to risk from the environment (Bord & O'Connor, 1997). People who enjoyed education at a university choose medication A, the more effective but less climate-friendly medication, significantly more often than other people. 55% of university-educated people chose medication A. For both high school/MBO and college/HBO-educated people this percentage was around 40. This is a notable result, as most research shows that highly educated people make greener decisions (Meyer, 2015).

The more climate-friendly the medication is, the more weight it has on the decision of a patient. Both level 1 and 2 have a high weight coefficient that is significant. The second level of effectivity is also significant and weighs in patients' decisions when being asked which treatment they prefer. They do not want the least effective medication. However, the most effective, level 1, did not have a big weight either. It might be possible that people find effectivity important but only if the externalities are not too big. They might rather have a more climate-friendly medication than the most effective medication. That people look for a middle road is a famous behavioural phenomenon called the compromise effect. This behavioural principle was introduced by Simonson and Tversky (1992).

Discussing the climate impact of a medication with a patient could be a big step towards making healthcare more sustainable. It is always thought that patients want to get better as soon as possible no matter what. Climate impact as a variable in the decision of a patient can change this. Healthcare decision-making should be transparent, patients should know all the side effects of their treatment. When they know all the side effects of their treatments we can measure which side effect/attribute they find important and we can adapt our system with this knowledge.

### 5.3 Receiving a flyer causes a shift in what people find important in medication.

In Figure 2 we can see that receiving a flyer or not does make a difference when respondents were asked which medication they would prefer in the hypothetical scenarios they were described. We cannot be certain that the flyer is the variable that makes respondents choose a more climate-friendly treatment. But when controlling for age, gender, education, whether people know the climate impact of healthcare and the questions that were asked, we can see a significant difference between the groups of people that were randomized into three groups, one control group and two treatment groups. The control group, the group that did not receive a flyer, preferred medication B, the more climate-friendly medication, 36% of the time. In comparison, the first treatment group that received a flyer with text preferred medication B 56% of the time. The second treatment group also received a graph as a visual aid in their flyer, they preferred medication B 68% of the time.

Furthermore, in Figure 3 we can see how important the climate impact was for people when answering the questions in the hypothetical scenarios. The weight of the attribute was measured and shows us that respondents who did not receive a flyer put a lot less weight on whether treatment was better or worse for the climate. The respondents who received a flyer however took the climate impact of the treatment more into consideration when choosing which type of hypothetical treatment they preferred.

Previous research already showed that people were willing to choose a more climate-friendly alternative when it comes to medication. In a questionnaire from the NHS (2021), people mentioned that they were open to the idea of taking a more climate-friendly medication. In other research, people chose climate-friendly medication in hypothetical situations (Verhaar, 2022). The importance of this result is that it shows that a combination of facts and visual aid shifts patients to the climate-friendly alternative. It shows the direct effect of the flyer on the weight respondents put on climate impact.

#### 5.4 Limitations

However, there are some limitations to this study. First of all, the sample size was not big enough to put all the attributes in one conditional logit model. Only eight levels could be measured at the same time. This is why the decision was made to only test for the two most important attributes. Furthermore, not all results are significant. For example, in Table 9 the p-values of the attribute climate impact without a flyer are both large. This is the same for Level 1 of Effectivity in Table 8. The sample size was not perfectly representative of the Dutch population. The youngest age group is overrepresented and the 41 to 65 years old age group is underrepresented. The sample also had more higher-educated people than lower-educated people. In the general Dutch population more people are lower-educated. Although stated preferences are an ideal way to test patient preferences when you cannot get observational data, the results would be more valid if the research is repeated with revealed preferences. Furthermore, the responses are received from hypothetical and not real scenarios.

#### 5.5 Validity

By controlling for age, gender, education and whether people have experience with strong headaches the internal validity is high. Tests were conducted for correlation between variables. People were also randomly assigned to one of three groups, the control group and two treatment groups. Although some population variables were not representative of the Dutch population, the results should not be neglected. People from all different backgrounds answered the questionnaire. A big group of the Dutch population is represented.

#### 5.6 Recommendations

My results support the recommendations that the Gezondheidsraad gave to the government. The climate impact of medication should be taken into account when deciding which medication would be best for a certain situation (Gezondheidsraad, 2022). However, not only healthcare workers should take the climate impact of medication into account, but patients should also be told what the climate impact is. This would allow them to decide with more information on the table. The more information patients have, the more their decision represents their preference.



I also recommend that flyers be distributed about the climate impact of healthcare so that more people are informed. This will lead people to different choices. As a patient, but it will also raise awareness in general about the climate. Further research could try and avoid the limitations that were found in this paper. Furthermore, it is important to replicate this research in a hospital or in a general practitioner's office to have a look if patients act according to their stated preferences.

## 6 Conclusion

This thesis aimed to find out which flyer, about the climate impact of healthcare, will encourage patients to choose climate-friendly medication the most. The hypothesis was that the most effective way of informing the patients would be through a flyer with facts and a visual aid. Based on quantitative research, which was conducted through a questionnaire and analysed with descriptive statistics, probit models and conditional logit models, it can be concluded that a flyer with facts and a visual aid is most effective in the tested situation. The results indicate that people who did not receive a flyer chose medication B, the climate-friendly medication, only 36% of the time. In comparison, respondents who got a flyer with just text chose medication B 56% of the time. People who also received visual aid with the flyer chose medication B the most, almost 70% of the time. The climate impact of the medication weighed more in the decision-making of people who saw a flyer. This confirms the hypothesis that was set at the beginning of the thesis. A flyer about the climate impact of healthcare with facts and a visual aid will encourage patients to choose a climate-friendly treatment even though it would mean a less effective treatment.

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## Appendix 1: The flyer with information and with the visual aid

This is the flyer about the climate impact of the healthcare system that one treatment group was shown. The flyer includes an explanation of the effects of climate change, a comparison with other big polluters, a visual aid and the vicious circle of care that is bad for the environment.




### Climate impact of healthcare

Healthcare is a major climate polluter. This is mainly due to the high CO<sub>2</sub> emissions from healthcare. If there is too much CO<sub>2</sub> in the air, this will cause climate change. Climate change leads to major problems, such as sea level rise, extreme weather, and health problems.

In the Netherlands, healthcare causes 7% of total CO<sub>2</sub> emissions, namely 11 megatons. This is more than the individual CO<sub>2</sub> emissions of companies such as KLM (8.6 megatons), Shell (6.7 megatons), Tata Steel (5.8 megatons), and Chemelot (4.7 megatons) in the Netherlands. In the whole of the Netherlands, 168 megatons of CO<sub>2</sub> were emitted in 2021.

**CO<sub>2</sub> emissions per year in megatons**



Entity	CO <sub>2</sub> Emissions (Megatons)
Health Care	11
KLM	8,6
Shell	6,7
TATA Steel	5,8
Chemelot	4,7

At the front door, health care makes many patients better again, but the polluting treatments make many people sick through "the back door of the health care system". The choice of a different medication can be more climate-friendly.



## Appendix 2: Flyer with information but without the visual aid

This is the flyer about the climate impact of the healthcare system that one treatment group was shown. The flyer includes an explanation of the effects of climate change, a comparison with other big polluters and the vicious circle of care that is bad for the environment.



### **Climate impact of healthcare**

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At the front door, health care makes many patients better again, but the polluting treatments make many people sick through "the back door of the health care system". The choice of a different medication can be more climate-friendly.






## Appendix 3: Choice set

This is one of the seven choice sets participants of the survey had to fill in. This will give you an image of how the survey was conducted. This was the fourth choice set

Q9. The information for the question is now repeated if you forgot it.

For the questions, imagine that you have a strong headache that will require you to stay at home. You cannot perform activities in your daily life such as work, study, or sports.

You go to the GP for help and you are offered medication A and B. The GP also gives you the option not to take any medication. Which option do you prefer?

	Medication A (climate-unfriendly)	Medication B (climate-friendly)	No medication																																																																																				
How long will you keep a headache after the first medication?																																																																																							
How long should you not drive a car to compensate for the climate impact of your medication?	<table border="1"> <thead> <tr> <th>Sun</th><th>Mon</th><th>Tue</th><th>Wed</th><th>Thu</th><th>Fri</th><th>Sat</th> </tr> </thead> <tbody> <tr><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td></tr> <tr><td>8</td><td>9</td><td>10</td><td>11</td><td>12</td><td>13</td><td>14</td></tr> <tr><td>15</td><td>16</td><td>17</td><td>18</td><td>19</td><td>20</td><td>21</td></tr> <tr><td>22</td><td>23</td><td>24</td><td>25</td><td>26</td><td>27</td><td>28</td></tr> <tr><td>29</td><td>30</td><td>31</td><td></td><td></td><td></td><td></td></tr> </tbody> </table>	Sun	Mon	Tue	Wed	Thu	Fri	Sat	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31					<table border="1"> <thead> <tr> <th>Sun</th><th>Mon</th><th>Tue</th><th>Wed</th><th>Thu</th><th>Fri</th><th>Sat</th> </tr> </thead> <tbody> <tr><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td></tr> <tr><td>8</td><td>9</td><td>10</td><td>11</td><td>12</td><td>13</td><td>14</td></tr> <tr><td>15</td><td>16</td><td>17</td><td>18</td><td>19</td><td>20</td><td>21</td></tr> <tr><td>22</td><td>23</td><td>24</td><td>25</td><td>26</td><td>27</td><td>28</td></tr> <tr><td>29</td><td>30</td><td>31</td><td></td><td></td><td></td><td></td></tr> </tbody> </table>	Sun	Mon	Tue	Wed	Thu	Fri	Sat	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31					No impact
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Could you feel nauseous after taking the medication for the first time?	Yes	No	No																																																																																				
How often should you take the medication?	4x, 8 hours between medication	Once	Never																																																																																				
Costs of the medication?	Free	Free	Free																																																																																				

Which option do you prefer?

- Medication A
- Medication B
- No medication