Work Project prepared for the Master Thesis of Master Degree in International Management at the NOVA School of Business and Economics.

Subject: AI advice vs. patients’ advice vs. no advice: choosing a doctor.

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Abstract

Due to the development of information technologies and Artificial Intelligence (henceforth AI) solutions, hospitals can match patients’ to doctors more efficiently and effectively. In this research, I investigate trust in advice generated by AI over advice from other people, when a patient selects a doctor for a medical appointment. Data related to trust, likelihood to follow the received recommendation, likelihood to select a doctor, and demographics were collected via an online questionnaire to investigate whether people accept or refuse advice to choose a doctor based on AI advice (vs. other patients’ advice or no advice). The experiment revealed that patients are more likely to select a doctor following advice from AI, as compared to when they receive advice from other people or no advice at all. Moreover, patients trusted more AI advice than advice from other people. These results have important practical implication: they suggest that hospitals should inform patients about benefits and dispel doubts of using AI in matching-system through educational programs and leaflets. Finally, they also suggest developing AI recommender-systems that can share AI consultations with a selected physician.

Keywords: AI advice, doctor, patient, trust, algorithms.
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Introduction

In the past two decades, technology has expanded to support people’s decisions in different fields, including healthcare. The importance of AI-driven decisions has significantly increased in the medical sector. For instance, AI advice can enhance the quality of health service and reduce shortages of doctors in rural areas, (Spänig et al. 2019). Algorithms are also increasingly used to choose appropriate healthcare plans (Silverman, 2015). Another example of AI application in healthcare is Baidu Doctor, which is the most widespread AI tool that allows communicating with patients through a chatbot (Khan, Zardar & Bhatti, 2017).

Of note, by implementing digital solutions, hospitals can match patients’ to doctors more efficiently and effectively. Indeed, patients can select a doctor with the help of Artificial Intelligence (henceforth AI). For instance, K Health worked on a new solution to enable patients to share the AI-driven health consultations directly with selected physicians. Using AI to match patients and doctors has several advantages. For instance, older (vs. younger) adults struggle more with comprehension of healthcare information available online (e.g. treatment plans, annual costs, insurance choice; Hibbard et al., 2002). AI matching tools might minimize the cognitive burden of older patients when they choose a doctor. Moreover, there are several online platforms combining Big Data techniques with information on patient preferences, provider, clinical expertise and availability, in order to identify healthcare providers who best match patients’ needs (e.g., Armada Health, ZocDoc, and Ayasdi). Head of Spinal Surgery in Cleveland Clinic, Kalfas MD said: “Getting the right patient to the right doctor the first time is a critical aspect of healthcare today” (Armada Health website). It seems that hospitals and clinics need tools that can modify a relation between patients and doctors. Therefore, new AI systems for matching patients with doctors are currently being developed and are expected to link patients with doctors more effectively and increase patients’ satisfaction as well as the length of the patient-doctor relationship (Qiwei Han et al., 2019). Even though AI can be
beneficial to the healthcare sector, especially in providing patients with a good recommendation for a doctor, it is unclear how patients will react to this AI-based match-making advice. Hence, the main problem is to understand whether people would trust the recommendation of AI regarding the selection of a doctor compared to other types of recommendations.

Research shows that algorithmic methods still have opponents (Promberger and Baron, 2006): some believe that people tend to distrust advice from AI. However, other studies suggest that in fact, people trust algorithms (Logg, 2019). The examples presented above underline how diversified and controversial is a topic of AI advice. In this study, I will try to ascertain whether, in the specific context of selecting a doctor, people prefer advice from AI or other types of advice.

By collecting data regarding reactions of patients to AI recommendations of doctors (vs. no advice, other patients’ advice) in a study questionnaire, this paper will contribute to research on advice taking, in particular with a preference for AI. Moreover, this research will have a practical value, because it can develop guidelines for hospitals using AI to match a patient with a physician.

**Literature Review**

The literature is divided in two opposite attitudes regarding AI-based decision-making process that can support a selection of a doctor in the healthcare sector: algorithm appreciation (a preference for algorithmic vs. human advice) and algorithm aversion (a preference for human vs. algorithmic advice).

**Assertions in favor of algorithms advice**

Plenty of studies demonstrated that algorithmic techniques outperformed human predictions (e.g., Sawyer, 1966; Dawes, Faust, & Meehl, 1989; Morera & Dawes, 2006). Meehl
(1954) formulated the first study of a psychological judgment of algorithms, including two different methods of evaluating the evidence: clinical method and actuarial method. Clinical method refers to a holistic human judgment, while actuarial method includes a statistical formula. His paper demonstrated that algorithms outperform clinical methods and consequently computers may replace human thinking in the future. Furthermore, review of literature on clinical versus actuarial judgment has shown the superiority of the latter to support individuals with decision-making (Grove, Zald, Lebow, Beth & Nelson, 2000; Hogarth, 1989 & Kleinmuntz, 1990). Not only people entrust their lives to computer systems (e.g. autopilots in aircrafts), but also, they tend to follow advice coming from an expert AI system more than advice based on human appraisal (Haak, 2017; Dijkstra, Liebrand, & Timminga, 1998). This algorithm appreciation has been shown across several experiments in recent research, including predicting an individual’s weight from photographs, forecasting the popularity of songs on Billboard Magazine Hot 100 Music Chart, and matching potential romantic partners (Logg, 2019).

**Assertions against algorithms advice**

On the other hand, algorithm aversion was demonstrated in several studies (Bazerman, 1985; Dawes, 1979; Dawes et al., 1989; Kleinmuntz, 1990). The idea that human thinking and decision making could be replaced by algorithms was opposed by many: “From the very outset, clinical psychologists responded to Meehl’s ideas with hostility and disbelief” (Kahneman, 2013). Clinical studies showed that people distrusted computer predictions (Prahl and Van Swol, 2017). Moreover, in the case of prediction errors, people judged more negatively errors made by algorithms than humans (Dietvorst et al., 2015). In the healthcare sector, patients valued more a recommendation for surgery from a doctor than from a computer system (Promberger & Baron, 2006). An important concern refers to a responsibility issue. Following a doctor’s recommendation makes individuals less accountable for advice than referring to
computer advice. Indeed, people preferred to share responsibility with their doctor concerning selecting a treatment (Promberger & Baron, 2006). Moreover, people seem to trust less advice given by other people than their own choice or AI advice. For instance, even the developer of a diagnosis system, Dombal, was hesitant to apply its algorithmic advice, especially in case of life-threatening diseases (Kleinmutz, 1990). Lastly, 18% of doctors are estimated to be against the help of computer systems (Grundmeier and Johnson, 1999; Pezzo, 2006).

This work’s project

The current literature (reviewed above) indicates that there is no consensus on whether people will follow advice from algorithms. Therefore, it might seem unclear whether patients will trust AI when it comes to selecting a physician. In developing my hypotheses, I took into account the role of increasing digitalization, which affects the ways in which younger generations select their physicians. For instance, 64% of patients made online appointments in 2019 compared to only 34% in 2016 (WP Amelia Staff, 2018). Moreover, young people deal with a selection of a healthcare plan easily (Hibbard et al., 2002) and they are more familiar with new technologies and online appointments with doctors (WP Amelia Staff, 2018). Moreover, in general, people seem to be changing attitudes toward AI recommendations, especially in the healthcare sector (Silverman, 2015).

Predictions

Taking into consideration the literature review and recent trends concerning digitalization, I predict the following. I foresee that people are going to trust algorithms (AI advice vs. other patients’ advice) to match the patient’s preference with a physician (HYPOTHESIS 1). I also anticipate that as a consequence, the AI recommendation to select a doctor (vs. no advice, other patients’ advice) will be more likely to be followed by patients
(HYPOTHESIS 2). I predict this because recent studies showed that people altered their attitude toward AI application in medicine. For instance, individuals prefer to follow algorithms to choose healthcare plans (Silverman, 2015). Furthermore, I predict that the AI recommendation to pick a doctor (vs. no advice, other patients’ advice) will be more likely to be followed by younger people (vs. older people; HYPOTHESIS 3). I predict this because young people select healthcare plan easily (Hibbard et al., 2002) and they know more about new technologies (WP Amelia Staff, 2018). Moreover, in the view of the growing online appointments (WP Amelia Staff, 2018), I hypothesize that the AI recommendation to select a doctor (vs. no advice, other patients’ advice) will be more likely to be followed by people who typically make medical appointments on the Internet (e.g. via an online form) as compared to offline appointments; (HYPOTHESIS 4).

Methodology

Study description

I designed an experiment to analyze the (dis)trust of algorithmic advice among patients. The purpose of the study is to define the extent to which people choose a physician in three different conditions: on 1) AI advice, 2) other patients’ advice, and 3) no advice. In all conditions, participants saw a list of doctors on a hospital website. In the AI advice condition, AI recommends one of these doctors as the best physician for them. In the other patients’ advice condition, participants receive other patients’ advice for the best doctor. In the no advice condition, participants do not receive any advice. In all conditions, patients rate their likelihood to select a doctor from the list and also pick a doctor. The experiment was administered by means of a questionnaire prepared in Qualtrics.
Study design

One hundred fifty-five adults who are users of public or private healthcare participated in an online study. Fifty-eight participants were subsequently excluded due to incomplete answers. Ninety-seven participants completed the whole experiment (M_{age} = 29.732; SD_{age} = 10.17607; male = 32% (full demographics in appendix 1 and 2). Participants first completed an informed consent form. Next, all participants saw a mock hospital website with a list of four doctors and were randomly assigned to one of three conditions (AI advice, other patients’ advice, no advice). In the AI advice condition, participants saw a recommendation for one of the doctors, selected by AI. In the other patients’ advice condition, participants saw a recommendation from other patients. In both conditions, the recommended doctor was, in fact, random. In the no advice condition, participants did not receive any advice. Subsequently, all participants rated the extent to which they would be likely to pick a doctor (e.g., “How likely would you be to choose the recommended doctor?”, 1 = extremely likely, 7 = extremely unlikely), and finally were asked to pick one.

Moreover, respondents answered exploratory questions regarding the recommended doctor (only in the AI and other patients’ advice; e.g., “The recommended doctor seems to have a relevant specialization” or “The recommended doctor seems to have a lot of professional experience”, 1 = strongly disagree, 7 = strongly agree) as well as the received recommendation (e.g., “To what extent do you trust the advice you received?”, 1 = strongly agree, 7 = strongly disagree). Then, all participants completed a trust measure concerning general questions related to trust in other patients’ opinions (e.g., “In general, to what extent do you trust advice from other patients?”, 1 = strongly agree, 7 = strongly disagree; exploratory open-ended question: “Why do(n)ot you trust advice from other patients?”) an exploratory customer satisfaction measure (e.g., “I am satisfied with my current GP”, 1 = strongly satisfied, 7 = strongly dissatisfied, plus “does not apply”), and frequency of medical check-ups (also exploratory, e.g.,
“How often are you going for a medical check-up?”, 1 = really low frequency, 5 = really high frequency). Moreover, participants answered questions about communication channels (e.g., “In general, how do you make medical appointments?”, visit in hospital/clinic, phone call, email, form on the website), usage of AI solutions (exploratory open-ended question: “Why do(not) you use AI solutions or AI devices?”), and attitude toward technology (exploratory, e.g., Please specify the extent to which you agree with the following statements: “New technologies are reliable”, 1 = strongly agree 7 = strongly disagree). Finally, participants filled out their demographic data. Stimuli and questionnaire can be found in Appendix 3.

Results and discussion

Trust in advice (AI advice vs. other patients’ advice)

A t-test (AI advice condition vs. other patients’ advice) with trust in the received advice (“To what extent do you trust the advice you received?”, 1- strongly agree, 7 - strongly disagree) as the test variable revealed that participants trusted AI advice more (M = 2.94, SD = 1.205) than other patients’ advice (M = 3.77, SD = 1.818; t(58) = -2.119, p =.038). This result support hypothesis 1.

Likelihood to pick a doctor in general

I ran a one-way ANOVA test with condition (AI advice, other patients’ advice, no advice) as factor and the likelihood to follow the received recommendation to pick a doctor as dependent variable (“How likely would you be to choose a doctor immediately based on this information?”, 1- extremely likely, 7 - extremely unlikely). There were significant differences between conditions F (2,96) = 13.061, p =.000 < .001. The Post Hoc LSD test revealed that participants were more likely to select a doctor in case of AI advice (M = 2.265, SD = 1.13642) than with other patients’ advice (M = 4.154, SD = 1.93271; p < .001) and without advice (M = 3.676, SD = 1.51023, p < .001). The difference between other patients’ and no advice condition was not significant (p = .44). These results support hypothesis 2.
Mediation effect

I conducted the bootstrap tests (Hayes 2013) to identify the indirect effect of trust in a survey (“To what extent do you trust the advice you received?”, 1- strongly agree, 7 - strongly disagree). The indirect effect test is not significant, because the 95% confidence limits include zero (BootLLCI = -.0118 and BootULCI = .7296). The mediation effect of trust between the likelihood to select a doctor and condition variable (AI advice, other patients’ advice, no advice) does not exist.

Likelihood to pick a doctor by age

I computed the median age (X = 25) then split the data into younger (i.e., <= 25) and older (> 25). A two-way ANOVA with condition (AI advice, other patients’ advice, no advice) and age as factors, and the likelihood to follow the received recommendation to pick a doctor as dependent variable (“How likely would you be to choose a doctor immediately based on this information?”, 1- extremely likely, 7 - extremely unlikely) revealed differences between conditions (F (5,96) = 6.63, p = .000 < .001). Younger in AI condition (M = 2.61, SD= .97853) were more likely to select a doctor than younger in other conditions (patients’ advice M = 3.69 SD = 1.81265, no advice M = 3.37 SD = 1.88788; see also figure 1 and table 1) but less willing to select a doctor than older in AI advice condition (M = 1.88, SD = 1.20416). The interaction between age and condition was marginally significant (p = .067). The Post Hoc LSD test showed that people were more likely to select a doctor in case of AI (M = 2.2647, SD = 1.13642) advice as compared to both other patients’ advice (M = 4.1538, SD = 1.93271, p < .001) and no advice (M = 3.6757, SD = 1.51023, p < .001). These result does not support hypothesis 3.
Figure 1: Means for likelihood to follow the received recommendation to pick a doctor

<table>
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<tr>
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<th>Older</th>
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<tbody>
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<td>.97853</td>
<td>1.20416</td>
<td></td>
</tr>
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<td>Patient advice</td>
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<td>1.93815</td>
</tr>
<tr>
<td>No advice</td>
<td>1.88788</td>
<td>1.71499</td>
</tr>
</tbody>
</table>

Table 1: Standard deviation for likelihood to follow the received recommendation to pick a doctor

Likelihood to pick a doctor based on different method of making appointments

A two-way ANOVA test with condition (AI advice, other patients’ advice, no advice) and making-appointment category (“In general, how do you make medical appointments?”, 1 – Visit in hospital/clinic, 2 – phone call, 3 – email, 4 – form on the website) as fixed factors and the likelihood to follow the received recommendation to pick a doctor (“How likely would you be to choose a doctor immediately based on this information?”, 1- extremely likely, 7 - extremely unlikely) as the dependent variable showed some differences between study conditions (F (8,96) = 4.492, p = .000 < .001; see also figure 2 and figure 3). The Post Hoc LSD test revealed that the average likelihood to select a doctor immediately was higher in the AI
advice condition (M = 2.381, SD = .293) as compared to both the other patients’ advice (M = 3.933, SD = .328) and no advice conditions (M = 3.609, SD = .256; pv as already shown; see page 10), The interaction between appointment category and condition category was not significant. This result does not support hypothesis 4.

![Figure 2: Means for likelihood to follow the received recommendation to pick a doctor](image1)

![Figure 3: SD for likelihood to follow the received recommendation to pick a doctor](image2)

**Exploratory analyses**

I also tested the effect of condition on perceptions of doctor’s expertise and perceived relevance of his/her specialization, on general trust in advice from other patients, on satisfaction with current GP, and on the expected satisfaction with the recommended doctor: I also
examined the interaction between satisfaction with current GP and condition on likelihood to choose a doctor and the interaction between usage of AI and condition on likelihood to choose a doctor. Finally, I tested the effects of frequency of medical check-ups, usage of AI, and attitudes toward technology on trust in new technologies, on perceived reliability of new technologies, and importance of new technologies, and on positive opinions about new technologies. For the sake of brevity, I report only significant results. Moreover, I described main reasons of trust/distrust in advice from other patients and reasons of usage of AI (qualitative data).

Satisfaction with a new doctor from the received recommendation

I ran a one-way ANOVA test with condition (AI advice, other patients’ advice, no advice) as factor and the satisfaction with a new doctor as the dependent variable (e.g., Please specify the extent to which you agree with the following statement: “I am satisfied with a new doctor given in the recommendation”, (1 - strongly satisfy 7 - strongly dissatisfy, does not apply), F (2,96) = 1.329, p = .270. These results depicted the differences between groups were not significant.

Usage of AI

I ran a two-way ANOVA test with condition (AI advice, other patients’ advice, no advice) and usage of AI (e.g., “Do you normally use AI solutions or AI devices (for instance Alexa, Echo, Cortana, Siri, Google Home, Google Assistant)?”, no, yes) as factors and the likelihood to follow the received recommendation to pick a doctor as dependent variable (“How likely would you be to choose a doctor immediately based on this information?”, 1- extremely likely, 7 - extremely unlikely), F (5,96) = 5.145, p < .001. People were more likely to follow AI advice (M = 2.275, SD = .291) than other patients’ advice (M = 4.019, SD = .384) and no advice (M
= 3.664, SD = .278; see also figure 4 and figure 5). The Post Hoc LSD test presented significant differences in the level of trust in patients’ advice for selected groups: No advice – AI advice (p < .001) and AI advice – Patient advice (p < .001). These results also showed that the usage of AI and the interaction between condition variable and usage of AI variable were not significant.

![Means](image)

**Figure 4:** Means for likelihood to follow the received recommendation to pick a doctor

![Standard Deviation](image)

**Figure 5:** SD for likelihood to follow the received recommendation to pick a doctor

**Trust in advice from other patients**

The one-way ANOVA test with condition (AI advice, other patients’ advice, no advice) as a fixed factor and the level of trust in the recommendation received from patients (“In
In general, to what extent do you trust advice from other patients?”, 1- strongly agree, 7 - strongly disagree”) as the dependent variable demonstrated some significant differences between study conditions. In AI condition (M = 4.03, SD = 1.642) people trust advice from other patients less than in condition with other patients’ advice (M = 2.23, SD = .951) and in condition without advice (M = 2.95, SD = 1.29), , F (2,96) = 13.644, p = .001). The Post Hoc LSD test presented significant differences in the level of trust in patients’ advice for selected groups: No advice – AI advice (p = .003), No advice – Patient advice (p = .041) and AI advice – Patient advice (p < .001).

Qualitative data – general reasons of trust in advice from other patients

In general, it is important to understand what people think about trusting in patients’ opinions regarding physicians. A questionnaire asked about a reason of trust/distrust in advice from other patients (e.g. “Why do(not) you trust advice from other patients?”). The findings demonstrated that people believe in recommendations from other patients mainly because of patient’s experience, similar expectations and sincere opinions (e.g., “I trust advice from other patients because they are based on their experience and feelings after doctor appointment”, “Because they already had an experience with that doctor and can tell me their full experience and opinion”, “Patients visited a doctor and they have relevant and reliable opinions”). Another important factor refers to a relationship with a doctor and practical skills (e.g. “Advice on relationship with doctor rather than on competencies”, “University diploma is not the only thing required from a good doctor” ) and responsibility issue (e.g. “They took the risk, so I do not have to”). On the other hand, some participants were more skeptical about the trust in advice from other patients (e.g. “If I trust a patient”, “It depends if they are strangers or people who I know”, “I check opinions of patients on different web portals”). Last but not least group was against patient’s opinions, because of multiple interpretations of patient’s problems or subjective and emotional character of judgments (e.g. “Their opinion are based on their specific
case, which is rarely the same as mine - therefore I value opinion of other doctors over patient opinion about other doctors”). Moreover, some people have a limited trust (e.g. “I trust in opinions of patients when I see many similar good opinions”, “The opinions on the internet are shared by hired people or generated by bots, sometimes they look really genuine “, “I do not trust advices from other patients I need an expert “, “I do not trust any advices”).

Qualitative data – general reasons of usage of AI

For the purpose of this study, it is also vital to answer a question: “Why do(not) people use AI solutions or AI devices?”. The study indicated that 26 out of 97 participants use AI tools such as of Alexa, Echo, Cortana, Siri, Google Home, Google Assistant. The main reason of using AI in daily basis is to make things easier and faster (e.g. “They are fast and reliable”, “It may be very helpful in many fields and make a lot of processes more effective”). Moreover, people can save time and money because AI improves a quality of service (e.g. “They make my life easier and I use them because I do not pay for them”, “Saves time and money: for example the new slide design assistant from Office 365”). Participants also think that “Another source of information is always useful”. The study also identified respondents who do not use AI tools at the moment, but they will consider using them for more complex tasks and everyday activities (e.g. “I am not called a pioneer so until someone strongly recommends it, I tend to wait”, “I do not feel the need at the moment, maybe I will start using them for more complex tasks and not normal everyday routines, or when I will realize that by using AI solutions/devices I am using my time more efficiently”). However, many participants of the survey declared that they do not benefit from AI tools due to a lack of need, trust, personal touch, price and privacy issue (e.g. “They are not useful to me”, “I have never used them and I do not know what I miss by not using them”, “Because it affects my privacy”, “Not efficient enough there is no certainty about what happens to the data collected”). Moreover, people do not have a knowledge about
AI technologies, or there is a poor integration of AI with other systems (e.g. “I do not have to use AI and I have a limited knowledge about AI”, “Alexa is not that well integrated with its services in Portugal, limiting its usage. To a lesser extent, I don't like how extensive the data collecting and cross platform data matching is”). It seems that a good understanding of AI tools supported by the development of practical and beneficial solutions for users can change opinion about using AI.

General discussion

An experimental study with in three between-subjects condition (AI advice, other patients’ advice, no advice), tested participants’ level of trust in AI and probability to follow the received recommendation as well as the likelihood to choose a doctor. Results suggest that patients’ trust more advice coming from AI than from other patients. Moreover, patients also self-reported to be more likely to pick a doctor in the AI condition, as compared to all other conditions. These results seem to be in line with prior research suggesting that patients prefer to share responsibility with algorithms, instead of relying on personal choice or subjective choice of other people. The above-mentioned results support some of the initial hypotheses. AI advice and other patients’ advice influence match-making systems between patients and doctors. Thus, findings can support the initial research conducted to develop a mechanism to link patients with family doctors in primary care (Qiwei Han et al., 2019).

I also had hypothesized that patients’ age would play a role. In fact, there was an interaction between age (younger vs. older) and condition (AI advice, other patients’ advice, no advice). However, in contrast to my initial hypothesis, older (vs. younger) people were more likely to select a doctor in AI condition. Moreover, the likelihood of picking a doctor in the different conditions does not change for patients who make online appointment or traditional
appointments (e.g. visit in hospital/clinic, make a phone call, send email, or complete form on the website).

As expected, participants demonstrated a lower level of trust in opinions of other patients in AI condition than in other conditions. In this case, people might be also less likely to follow AI advice. Patients presented differences in the likelihood to select the recommended doctor across conditions, when they were user of AI. It might be explained by different understanding of AI. Qualitative research confirmed that people are interested in AI, but they do see a practical implication, or they have the data privacy concerns. However, people were equally satisfied about the new doctor from the received recommendation. Therefore, patients can achieve the same level of satisfaction from AI recommender-system as from other types of advice.

As previously mentioned, the study showed some positive signs in terms of using AI advice for choosing a doctor (e.g. a higher level of trust in AI advice than other patient’s advice, a higher likelihood to follow advice from AI than other advice, the same level of satisfaction of recommended doctor from AI advice as from other advice). Indeed, the first important implication for hospitals is to prepare educational programs and leaflets to inform people about positive aspects of using algorithms (e.g. trust, satisfaction, matching preferences, saving time, and availability of doctors) and dispel doubts (e.g. distrust, personal touch, price and privacy issue). Due to these programs patients will be aware of subjective character of patients’ options over a coherent advice from AI. Another recommendation for hospitals is to launch AI recommender-system that can share AI consultations from a chatbot conversation with a recommended physician.

Limitations and suggestions

This research has several limitations that can be applied for following studies. Firstly, a questionnaire was distributed on the Internet and thus younger people participated. Participants
were divided into younger and older group by median age (X= 25), consequently creating a relatively young sample of older group overall (M = 38). A limitation can be explained by a sample selection bias: the experiment was conducted online, therefore the sample is likely people who are used to dealing with technologies. However, older people might have limited knowledge about AI concept and thus they do not know how algorithms work. The differences in understanding of algorithms application might be another limitation. Further research should include a wider age range via online and traditional channels of communication, in particular with a focus on older patients. Namely, it would be interesting to explore how old people react to AI advice, especially among people who do not use online technologies frequently. Furthermore, it is vital to analyze also doctors’ and hospital managers’ attitudes to match-making systems between patients and physicians.

AI match-making systems to select physicians are at their early stage of development (new applications, e.g. Armada Health, ZocDoc, and Ayasdi). Due to this, there is not much research about the interaction between the waiting time for the medical appointment and the trust in AI or gender and the trust in AI. It might help to define why people want to choose AI advice over other advice. Thus, further research might check how people are likely to follow a recommendation given by AI (vs. other patients’ advice and no advice) across gender (e.g. female/male/other) and waiting categories (e.g. a shorter waiting time for a random specialist/a longer waiting time for own GP).

**Theoretical and practical implications**

To conclude, this research contributes to the controversial topic of AI application in the medical sector, in particular with the analysis of patient’s trust and likelihood to follow different recommendations (e.g. AI advice, other patients’ advice, no advice) from match-making systems between doctors and patients. Patients trust more in advice given by AI than advice from other people. Patients seem to be more likely to choose a doctor when recommended by
AI, than they are when the doctor is recommended by other patients’, or when they do not receive any advice at all. It is vital to show how algorithms can support AI recommender-systems. I suggest that hospitals should inform patients about benefits and dissipate concerns of using AI in matching-system through educational programs and leaflets. Finally, I also suggest developing AI recommender-systems that can share AI consultations with a selected physician AI.

References


Qiwei Han et al. (2019). A Hybrid Recommender System for Patient-Doctor Matchmaking in Primary Care. Universidade Nova de Lisboa, School of Business and Economics, University of California, Davis, Department of Agricultural and Resource Economics, Wright State University


“Zocdoc appointment booking app now verifies insurance with AI”. Retrieved June 30, 2019, from https://www.mobihealthnews.com/content/zocdoc-appointment-booking-app-now-verifies-insurance-ai

References for profiles of doctors in a questionnaire:

Dr Joseph Lee. Retrieved July 10, 2019, from https://www.phc.ox.ac.uk/team/joseph-lee


Dr Janet Huang Fitzpatrick. Retrieved July 10, 2019, from https://drexel.edu/medicine/faculty/profiles/janet-fitpatrick/

Dr Steven Russel. Retrieved July 10, 2019, from https://drexel.edu/medicine/faculty/profiles/steven-russell/

Appendixes

Appendix 1 Descriptive Statistics and Frequencies from SPSS

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<th>Std. Deviation</th>
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## Frequency Table

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<td>Other</td>
<td>1</td>
<td>1,0</td>
<td>100,0</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>97</td>
<td>100,0</td>
<td>100,0</td>
</tr>
</tbody>
</table>

### Do you have children?

<table>
<thead>
<tr>
<th>Response</th>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valid</td>
<td>Yes</td>
<td>15</td>
<td>15,5</td>
<td>15,5</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>82</td>
<td>84,5</td>
<td>100,0</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>97</td>
<td>100,0</td>
<td>100,0</td>
</tr>
</tbody>
</table>

### Please select your highest level of education:

<table>
<thead>
<tr>
<th>Education Level</th>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valid</td>
<td>high school</td>
<td>12</td>
<td>12,4</td>
<td>12,4</td>
</tr>
<tr>
<td></td>
<td>university</td>
<td>55</td>
<td>56,7</td>
<td>69,1</td>
</tr>
<tr>
<td></td>
<td>postgraduate</td>
<td>30</td>
<td>30,9</td>
<td>100,0</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>97</td>
<td>100,0</td>
<td>100,0</td>
</tr>
</tbody>
</table>

### Are you currently working?

<table>
<thead>
<tr>
<th>Working Status</th>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valid</td>
<td>Yes</td>
<td>72</td>
<td>74,2</td>
<td>74,2</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>25</td>
<td>25,8</td>
<td>100,0</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>97</td>
<td>100,0</td>
<td>100,0</td>
</tr>
</tbody>
</table>

### Please indicate your monthly net income in EUR:

<table>
<thead>
<tr>
<th>Income Range</th>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valid</td>
<td>&lt;500 EUR</td>
<td>5</td>
<td>5,2</td>
<td>6,9</td>
</tr>
<tr>
<td></td>
<td>500–1000 EUR</td>
<td>25</td>
<td>25,8</td>
<td>41,7</td>
</tr>
<tr>
<td></td>
<td>1000–1500 EUR</td>
<td>18</td>
<td>18,6</td>
<td>66,7</td>
</tr>
<tr>
<td></td>
<td>1500–2000 EUR</td>
<td>7</td>
<td>7,2</td>
<td>76,4</td>
</tr>
<tr>
<td></td>
<td>&gt; 2000 EUR</td>
<td>14</td>
<td>14,4</td>
<td>95,8</td>
</tr>
<tr>
<td></td>
<td>not applicable</td>
<td>3</td>
<td>3,1</td>
<td>100,0</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>72</td>
<td>74,2</td>
<td>100,0</td>
</tr>
<tr>
<td>Missing System</td>
<td></td>
<td>25</td>
<td>25,8</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>97</td>
<td>100,0</td>
<td></td>
</tr>
</tbody>
</table>

### As a patient, do you mostly go?

<table>
<thead>
<tr>
<th>Healthcare Type</th>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valid</td>
<td>public healthcare</td>
<td>38</td>
<td>39,2</td>
<td>39,2</td>
</tr>
<tr>
<td></td>
<td>private healthcare</td>
<td>59</td>
<td>60,8</td>
<td>100,0</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>97</td>
<td>100,0</td>
<td>100,0</td>
</tr>
</tbody>
</table>
### Appendix 2 Pivot table per nationality

<table>
<thead>
<tr>
<th>Nationality</th>
<th>Sum of Nationality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Polish</td>
<td>49</td>
</tr>
<tr>
<td>Portuguese</td>
<td>15</td>
</tr>
<tr>
<td>Italian</td>
<td>7</td>
</tr>
<tr>
<td>Russian</td>
<td>6</td>
</tr>
<tr>
<td>British</td>
<td>4</td>
</tr>
<tr>
<td>French</td>
<td>3</td>
</tr>
<tr>
<td>Brazilian</td>
<td>2</td>
</tr>
<tr>
<td>Spanish</td>
<td>2</td>
</tr>
<tr>
<td>Colombian</td>
<td>1</td>
</tr>
<tr>
<td>Japanese</td>
<td>1</td>
</tr>
<tr>
<td>Austrian</td>
<td>1</td>
</tr>
<tr>
<td>Asian</td>
<td>1</td>
</tr>
<tr>
<td>South Korean</td>
<td>1</td>
</tr>
<tr>
<td>Belgian</td>
<td>1</td>
</tr>
<tr>
<td>Taiwanese</td>
<td>1</td>
</tr>
<tr>
<td>German</td>
<td>1</td>
</tr>
<tr>
<td>Greek</td>
<td>1</td>
</tr>
<tr>
<td><strong>Grand total</strong></td>
<td><strong>97</strong></td>
</tr>
</tbody>
</table>
Appendix 3 Online questionnaire

Consent form:

Hello,

My name is Anna Kaliszewska and I am a Master student in Management at Nova School of Business and Economics. I am writing my Master Thesis about patients’ choices in the medical and hospital sector. This survey has been prepared to help hospitals and clinics to understand the preferences of patients regarding picking up a doctor. Filling out a questionnaire (around 20 questions) will only take approximately 10-15 minutes.

By taking part in this research you will help me to graduate soon! Thank you for sharing your opinions.
Please note that the survey is confidential and only a summary of the results will be published in the Master Thesis.

Clicking on the "Yes, I consent" button below confirm that:
• you have read the above information
• you voluntarily agree to participate in survey
• you are at least 18 years old

If you do not wish to participate in the research study, please decline participation by clicking on the "No, I do not consent" button.

1. Insertion for other patients’ advice condition:

Below you can see a part of the website of a hospital. Imagine as vividly as possible the following scenario:

This is your local hospital where you have just been registered as a patient. The hospital has selected four profiles of the best doctors according to patients’ ratings.
Welcome on the website of The St. Joseph hospital!

Please, find beneath four profiles of the best physicians with diversified professional experience and specialization:

1. **Dr Joseph Lee** (male; GP with special interest in cardiology; Education: BSc Biological Sciences (Warwick, 2000), BMBCh (Oxford, 2007), MSc Epidemiology (LSHTM, 2011); Hospital or clinic: National Health Service)

2. **Dr Gina Dahel** (female; GP with specialty in Children's Health, Pediatric Cardiology; Education: Birmingham Medical School (2005); Hospital or clinic: International Medical Clinic)
3. **Dr Janet Huang Fitzpatrick** (female; GP specialized in Primary Care, General Internal Medicine, Internal Medicine; Education: MD - MCP Hahnemann University; Hospital or clinic: Drexel Internal Medicine)

4. **Dr Steven Russel** (male; GP with interest in Primary care and Internal medicine; Education: MD - University of Medicine and Dentistry of New Jersey; Hospital or clinic: Drexel Internal Medicine)
1. How likely would you be to choose a doctor immediately based on this information? (1 - extremely likely, 7 - extremely unlikely)

II. Insertion for AI advice condition:
Below you can see a part of the website of a hospital. Imagine as vividly as possible the following scenario:

This is your local hospital where you have just been registered as a patient. The hospital has selected four profiles of the best doctors according to patients’ ratings.

Welcome on the website of The St. Joseph hospital!
The St. Joseph hospital is supported by AI tool, which helps to recommend the best physician for a patient. The doctor will be picked from the list:

1. **Dr Joseph Lee** (male; GP with special interest in cardiology; Education: BSc Biological Sciences (Warwick, 2000), BMBCh (Oxford, 2007), MSc Epidemiology (LSHTM, 2011); Hospital or clinic: National Health Service)

2. **Dr Gina Dahel** (female; GP with specialty in Children's Health, Pediatric Cardiology; Education: Birmingham Medical School (2005); Hospital or clinic: International Medical Clinic)

3. **Dr Janet Huang Fitzpatrick** (female; GP specialized in Primary Care, General Internal...
4. **Dr Steven Russel** (male; GP with interest in Primary care and Internal medicine; Education: MD - University of Medicine and Dentistry of New Jersey; Hospital or clinic: Drexel Internal Medicine)

**AI system selected for you the doctor number: $\{\text{rand://int/1:4}\}$**

1. How likely would you be to choose a doctor immediately based on this information?

   (1- extremely likely, 7 - extremely unlikely)
III. **Insertion for no advice condition:**

Below you can see a part of the website of a hospital. Imagine as vividly as possible the following scenario:

This is your local hospital where you have just been registered as a patient. The hospital has selected four profiles of the best doctors according to patients´ ratings.

---

**Welcome on the website of The St. Joseph hospital!**

Please, find beneath four profiles of the best physicians with diversified professional experience and specialization:

1. **Dr Joseph Lee** (male; GP with special interest in cardiology; Education: BSc Biological Sciences (Warwick, 2000), BMBCh (Oxford, 2007), MSc Epidemiology (LSHTM, 2011); Hospital or clinic: National Health Service)
2. **Dr Gina Dahel** (female; GP with specialty in Children's Health, Pediatric Cardiology; Education: Birmingham Medical School (2005); Hospital or clinic: International Medical Clinic)

3. **Dr Janet Huang Fitzpatrick** (female; GP specialized in Primary Care, General Internal Medicine, Internal Medicine; Education: MD - MCP Hahnemann University; Hospital or clinic: Drexel Internal Medicine)
4. **Dr Steven Russel** (male; GP with interest in Primary care and Internal medicine; Education: MD - University of Medicine and Dentistry of New Jersey; Hospital or clinic: Drexel Internal Medicine)

Based on our patients' ratings, we recommend picking doctor number: ${rand://int/1:4}

1. How likely would you be to choose a doctor immediately based on this information?
   
   (1- extremely likely, 7 - extremely unlikely)
Welcome on the website of The St. Joseph hospital!

Please, find beneath four profiles of the best physicians with diversified professional experience and specialization:

1. **Dr Joseph Lee** (male; GP with special interest in cardiology; Education: BSc Biological Sciences (Warwick, 2000), BMBCh (Oxford, 2007), MSc Epidemiology (LSHTM, 2011); Hospital or clinic: National Health Service)

   ![Dr Joseph Lee](image)

2. Dr Gina Dahel (female; GP with specialty in Children's Health, Pediatric Cardiology; Education: Birmingham Medical School (2005); Hospital or clinic: International Medical Clinic)
3. Dr Janet Huang Fitzpatrick (female; GP specialized in Primary Care, General Internal Medicine, Internal Medicine; Education: MD - MCP Hahnemann University; Hospital or clinic: Drexel Internal Medicine)

4. Dr Steven Russel (male; GP with interest in Primary care and Internal medicine; Education: MD - University of Medicine and Dentistry of New Jersey; Hospital or clinic: Drexel Internal Medicine)
2. Which doctor are you willing to select for making an appointment?

- Dr Joseph Lee
- Dr Janet Huang Fitzpatrick
- Dr Steven Russel
- Dr Gina Dahel
- postpone choosing a doctor
- none of these doctors

Questions

Block - Scenario questions (only for AI advice condition and other patients’s advice condition)

1. To what extent do you trust the advice you received? (1- strongly agree, 7 - strongly disagree)

2. If I already had a GP (general practitioner), I would consider switching to the recommended doctor. (1- strongly agree, 7 - strongly disagree)

3. Please indicate the extent to which you agree with the following statements:
a. The recommended doctor seems to have a relevant specialization (1- strongly agree, 7 - strongly disagree)

b. The recommended doctor seems to have a lot of professional experience (1- strongly agree, 7 - strongly disagree)

**Block - General questions (for all conditions)**

4. In general, to what extent do you trust advice from other patients? (1- strongly agree, 7 - strongly disagree)

5. Why do (not) you trust advice from other patients? (open question)

6. Please indicate the extent to which you agree with the following statement:
   In general, I tend to trust new technologies (1- strongly agree, 7 - strongly disagree)

7. Please specify the extent to which you agree with the following statements
   New technologies are reliable (1 - strongly agree 7 - strongly disagree)
   New technologies are vital in my daily life (1 - strongly agree 7 - strongly disagree)
   I have a positive opinion concerning new technologies (1 - strongly agree 7 - strongly disagree)

8. Do you normally use AI solutions or AI devices (for instance Alexa, Echo, Cortana, Siri, Google Home, Google Assistant)? (no, yes)

9. Why do (not) use AI solutions or AI devices? (open question)

10. Please specify the extent to which you agree with the following statement:
    a. I am satisfied with my current GP (1 - strongly satisfy 7 - strongly dissatisfy, does not apply)
    b. I am satisfied with a new doctor given in the recommendation (1 - strongly satisfy 7 - strongly dissatisfy, does not apply)
11. In general, how do you make medical appointments? (visit in hospital/clinic, phone call, email, form on the website)

12. How often are you going for a medical check-up? (1 - really low frequency, 5 - really good frequency)

**Block - Demographic questions (for all conditions)**

1. Please indicate your gender: male/female/other
2. Please indicate your age:
3. Please indicate your nationality:
4. Do you have children? yes/no
5. Please select your highest level of education: less than high school, high school, university, postgraduate, none of these categories
6. Are you currently working? yes/no
7. If Q6 equals “Yes” then a question: “Please indicate your monthly net income in EUR: <500 EUR, 500-1000 EUR, 1000-1500 EUR, 1500-2000 EUR, > 2000 EUR, not applicable
8. As a patient, are you signed up and go to? (public healthcare, private healthcare)