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Contents

Digital Maturity Assesment Models for Health Systems

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ABSTRACT

With the rapid development of technology in recent years, it is observed that there are agile changes in many sectors. With these changes, technology comes to the focus of our lives and helps us to take more solid steps by facilitating processes everywhere. With the evolution of the sectors in this direction, concepts such as e-commerce, e-health, and data mining have come to the fore, and many studies have been put forward within the framework of these terms. It has been observed that the digital transformation that has begun to take place in the field of healthcare has led to significant changes in this field. The effects of technological advances, which have begun to integrate into health services, such as increasing work efficiency, increasing service quality, and creating a safe service environment have been determined. In this review study, various digitalization studies carried out in the field of health between 2012-2022 were examined and summarized, also, the prominent concepts in the studies were

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discussed. The study is divided into two main headings: (1) Digitalization in Health, and (2) Digital Maturity Assessment Models in Health Systems. As a result of the study, it was aimed to contribute to the existing literature by observing the deficiencies in the literature.

Keywords: Healthcare, Digital Maturity, Digital Health, Maturity Assessment, Maturity Models

INTRODUCTION

In recent years, it has been observed that there have been significant changes in the health sector with the developing technology. Technological developments worldwide have also affected existing health technologies, thus facilitating the processes by bringing new health technologies to the sector (Karadayı et al., 2020). With the development of technology in health systems, concepts such as predicting the risk of loss of life, drug need estimation, estimating disease epidemics, early diagnosis studies according to disease symptoms, reducing the operating costs of hospital managers, helping the government in health policies and improving health quality are the effects of digitalized processes. To keep up with the transformations with an agile approach, being innovative in health services has become an important skill. As an effect of this, the processes of developing maturity models have started to be measured digitality in health systems and witness innovations. Maturity models, when viewed broadly, are based on the premise that people, organizations, and processes evolve towards a higher maturity that completes several stages throughout the development and growth process. Maturity models in health services, on the other hand, come to the fore in the health service process, based on many important points such as service improvement and quality improvement in hospital operations. In this context, the digitalization studies carried out in the field of health are summarized in the compilation study based on the relevant terms. By going from general to specific, it is aimed to determine and examine the maturity models applied by researchers for digitalization in health and to make a summary presentation. Using the existing literature, digital maturity assessment models in health systems were examined.

LITERATURE REVIEW

Along with the literature review, it is expected to make a summary presenta-

tion of the studies on digitalization in healthcare. In addition, it is aimed to determine the popular methods that researchers include in their studies within the scope of the relevant subject and to examine the tools that support the application while performing the application. Google Academic, Web of Science, PubMed, Science Direct, and Istanbul Medipol University Library-Electronic Information Resources were scanned with the help of keywords related to digitalization in health presented in appendix A. Keyword cloud has been created as it is aimed to summarize the studies on digitalization in health. This created word cloud was searched with AND, OR logic in a way that the scanning databases can understand. In order not to miss any information about maturation in health, it has been created to define these concepts and with synonymous terms of the defined concepts. While reviewing the articles, the scope has been narrowed down with keywords based on different perspectives and methods concerning the relevant topic for appropriate literature selection. Due to the increasing popularity of the subject in recent years, the literature study was carried out between 2012 and 2022. As a result, the articles published during this time were included in the study. At this point, the study is divided into two main headings: (1) Digitalization in Healthcare, and (2) Digital Maturity Assessment Models in Health Systems.

Digitalization in Healthcare

With the development of technology, it is observed that there are opportunities for the sectors to develop themselves and increase their quality. These changes have paved the way for the birth of a new digital age. Digital transformation tools that play an important role in the realization of digital transformation can be listed as virtualized networks, data analysis, multi-layered security, and virtual storage technologies. Thanks to these tools, issues such as e-commerce, e-health, data mining, and cyber security have emerged. Digital transformation has also led to significant changes in the field of health. With this transformation, it is expected to save time by using digital systems in health, increase the time allocated to patients, standardize patient care, improve the efficiency of care, analysis ability, patient safety, prevention of medical errors and quality of care, and to increase the quality of these topics (Figure 1). The digital change and transformation in the field of healthcare have been the focus of attention of researchers, in this context, the current situation has

been examined by focusing on the topic, based on this, interpretations for the future have been made.
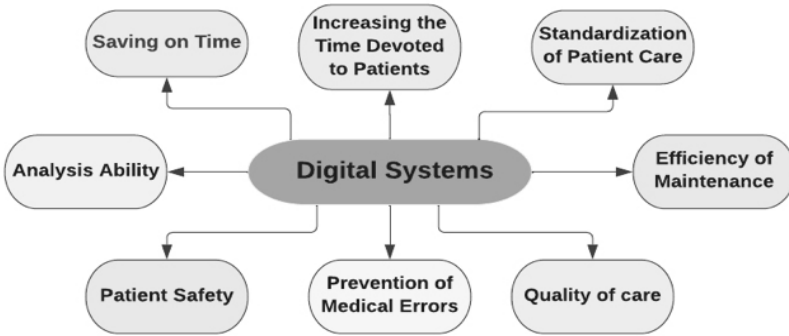
Figure 1: Digital Systems in Healthcare.

With a study published in 2022, Zimmermannova et al., focusing on the Czech Republic case study aimed to identify the benefits of digitizing medical devices in hospitals during the COVID-19 process. As a result, it has been observed that various types of savings, especially economic benefits, and optimization of both processes and employees are realized with digitalization.

With a study published in 2022, Tortorella et al., investigated the effects of digital applications on health during the COVID-19 pandemic on resilience. Data were collected through interviews and analyzed through content analysis. As a result, it has been seen that the applications for patient diagnosis and supply chain support all resilience abilities.

With a study published in 2022, Denizli & Demirtaş, aimed to evaluate the technology readiness of healthcare workers in the digital hospital transformation process. Descriptive analyses, t-tests, and ANOVA analyzes were performed with data from 340 healthcare professionals. As a result, it has been determined that the technology readiness of healthcare workers is higher than the average.

With a study published in 2021, Doğan, aimed to reveal the classification of hospitals certified with Electronic Health Record Adoption (EMRAM) 6th and 7th levels following digital hospital standards in the world and Turkey, according to regions. As a result of the research, it has been analyzed that the number

of certified hospitals in Turkey is higher than the other countries in the region, except for North America. It suggested that this advantage of Turkey in terms of location should be used to serve more foreign patients.

With a study published in 2021, Yaneva, in the study conducted, the main points related to the integration of digital technologies into processes in health institutions were discussed. As a result, it has been emphasized that although some disadvantages occur, the concept of digitalization can minimize the total amount of critical events that endanger patient safety.

With a study published in 2021, Zhao & Canales, examined the formation of information strategies in the digitalization process of health institutions. The results revealed four phases in which interactions between professional groups shape knowledge strategies.

With a study published in 2019, Eden et al., focused on digital transformation in health and compared two approaches: operationalizing effective use by using effective use theory and context-oriented operationalization in terms of workarounds designed by users to achieve their goals. Data were collected from a multi-hospital digital transformation, and as a result, the theory-based approach has come to the fore.

With a study published in 2019, Akinsanya et al., approached from a different perspective and explored the effective evaluation of healthcare cybersecurity maturity models for healthcare organizations that actively use cloud computing. As a result, security concerns specific to the respective healthcare cloud have been presented.

With a study published in 2018, Mettler & Pinto, discussed the term 'digital maturity with the help of statistical analysis based on the evidence emerging from an extensive longitudinal survey. In conclusion, they presented evidence on the evolutionary pathways, influencing factors, and improvement potentials in hospitals.

As a result, it was determined that the researchers focused on the benefits of digitalization in health and commonly observed the disadvantages of new processes. It has been observed that there are many studies in the literature that support digitalization studies in the field of health with the benefits it brings. However, it has been emphasized that while this digitalization brings benefits, it also brings many disadvantages, and it is necessary to focus on these points

to establish robust process frameworks. In addition, it has been determined that most of the researchers have turned their focus to the maturity model in digitalization in health to see the digital level of health organizations by looking at different perspectives.

Digital Maturity Assessment Models in Health Systems

The maturity model is a set of structured levels that define organizational practices, processes, and behaviors that sustainably and reliably produce the required results. It measures an organization's ability to continually improve in certain dimensions until it reaches the desired level of maturity (Liaw et al., 2021). Since digitalization in health is a prominent and spreading concept in recent years, it has been the focus of attention by researchers. Different maturity models have been used in the literature to measure the level of maturity of health institutions that have adopted this system.

With a study published in 2021, Liaw et al., the purpose is to develop a digital health profile and maturity assessment Toolkit to help them leverage digital tools to support their national health priorities. The result shows, that a comprehensive list of indicators describing country digital health profiles and a digital health maturity assessment tool was introduced, using criteria developed with country stakeholders to assess key digital health foundations and quality improvement.

With a study published in 2021, Nyangena et al., aimed to determine the readiness of the Health Information Systems interoperability capacity of hospitals in Kenya to this maturity. None of the domains has claimed a higher level of maturity than the developing level. The sub-domains of governance structures for HIS, the national enterprise architecture defined for HIS, the defined technical standards for data exchange, nationwide network infrastructure, and capacity for hardware operations and maintenance have reached higher levels of maturity.

With a study published in 2021, Lee & Park, targeted to reveal a technology-based practical blockchain system audit maturity model. Ultimately, practical audit items that can contribute to the stabilization of blockchains are proposed.

With a study published in 2019, Carvalho et al., presents the maturity model of information systems in the health field. Information systems were analyzed

using data from Portuguese hospitals to validate Hospital Information System Maturity Model (HISMM). It has been encouraging in demonstrating that it has a high level of acceptance among the data obtained. This early adoption pushes the development of a new model phase focused on the development of an automated HIS maturity assessment tool.

With a study published in 2019, Carvalho, Rocha, Vasconcelos, et al., aimed to analyze the complexity of healthcare services using clinical and financial datasets. For this analysis, they presented a proposal to measure the patients' information systems. By addressing the complexity of this model hospital information system, they proposed and developed useful scales for the mixed management of HIS management.

With a study published in 2019, Carvalho, Rocha, Vasconcelos, et al., examined the inpatient admission process using data from a public hospital in Greece. They aimed to present a digital system for this process and to improve the process by developing a maturity model. As a result, it has been determined that the digital services used in Health services have higher operability maturity than other sectors in Greece.

With a study published in 2016, Pak & Song, systematically created a health capacity maturity model using personal health record data. They suggested ways to improve these records. They have integrated some key processes and concepts from the Talent Maturity Model Integration (CMMI) and Trans-theoretical Model (TTM) into HCMM, which assesses an individual's competence and awareness to manage health and well-being and proposes customized improvement goals.

With a study published in 2012, Guédria et al., access to high quality and safe services, eHealth interoperability is a fundamental prerequisite. A mature interoperability between health systems will support health services organization and delivery, and improve citizens' awareness of how to prevent disease and preserve good health. Within this context, health institutions have to solve interoperability problems or prevent them to appear, and if possible avoid them before they occur by adapting good practices toward interoperability. This paper proposes an evaluation of the potential health interoperability using the MMEI methodology (Maturity Model for Enterprise Interoperabilityaimed to measure e-Health interoperability assessment. They aimed to

carry out an assessment of possible e-health interoperability using the MMEI methodology (Maturity Model for Enterprise Interoperability). It is discussed how the MMEI model can be used to help organizations avoid interoperability issues.

It has been observed that researchers focus on digitalization in health institutions, and in this context, they receive support from different maturity models. While some studies measure the maturity level of existing digitalization, some studies have measured the maturity level by proposing new digital systems. A summary of these studies is presented in Table 1.

Table 1: Summary of the studies about digital maturity assessment models in health systems.

Authors	Purpose	Result	Indicators	Maturity Assessment Model	The focus of the model
Liaw et al., (2021)	Develop a Digital Health Profile and Maturity Assessment Toolkit to help them leverage digital tools to support their national health priorities.	A comprehensive list of indicators describing country digital health profiles and a digital health maturity assessment tool was introduced, using criteria developed with country stakeholders to assess key digital health foundations and quality improvement.	Essential Digital Health Tools, Readiness for Information Sharing, Health System Adoption, Quality Improvement, Measurement, Monitoring, And Evaluation	Information Capability Maturity Model (ICMM)	Digital Health Profile
Nyangena et al., (2021)	To determine whether the interoperability capacity of Kenya's HIS is ready for maturity.	None of the domains has claimed a higher level of maturity than the developing level.	Leadership And Governance, Human Resources, Technology, Network,	Health Information Systems (HIS)	Digital healthcare and maturity level
Carvalho et al., (2019)	A maturity model has been developed for Hospital Information Systems.	Pushes the development of a new model phase focused on the development of an automated HIS maturity assessment tool.	Electronic Medical Records, Systems and IT Infrastructure, Strategy Information Security	Hospital Information System Maturity Model (HISMM)	Hospital Information Systems
Carvalho, Rocha, Vasconcelos, et al., (2019)	To offer a proposal to measure Hospital Information Systems maturity.	HIS is a maturity model that includes six stages of growth and maturity progression.	Clinical And Financial Data	Hospital Information System Maturity Model (HISMM)	hospital Information Systems
Kouroubali et al., (2019)	Developing a digital system, determining improvement priorities with the help of a maturity model	The digital health sector in Greece has been found to have higher operability maturity than other sectors.	Poor Interoperability Opportunistic: Fair Interoperability Essential: Essential Interoperability Sustainable: Good Interoperability Seamless: Seamless Interoperability	Interoperability Maturity Model (IMM)	Digital healthcare and maturity level
Pak & Song, (2016)	To integrate CMMI and TTM processes with HCMM.	By applying HCMM to the PHRs, the PHRs reached the desired level of maturity.	Personal Health Record	Health Capability Maturity Model (HCMM)	Health Management

Using the existing literature, also the tools that are used in digital maturity assessment models were examined. Thus, the tools that were most commonly encountered were classified as Clinical Decision Support Systems (CDSS), Information Technologies, and Technology/ Process Management.

For example, with the studies published in 2022, 2021, and 2020, respectively, Salami et al.; Zhang et al.; Souza-Pereira et al.; Chong et al.and its early detection is crucial for appropriate treatment. To analyse 3D-magnetic resonance imaging (MRI focused on the advantages of CDSS in clinical processes, and as a result, it has emerged as the common idea of researchers that they should be used more actively to reach a sufficient level of maturity.

Also, with the studies conducted in 2022, 2021, and 2020, respectively, Barnes & Daim; Hasic et al.; Zhila et al.; Bah et al.; Gluschkoff et al.; Mertoğlu, and semi-structured interviews with key informants in health policy, information technology and HRH management. It was conducted over two months from May to July 2019. The WHO-HRHIS assessment tool was used during the observational phase. We purposively selected representatives from different organizations and departments involved in managing the HRHIS. In the qualitative phase, purposeful and snowball sampling methods were used, and 20 interviews were conducted that each lasted minimum of 45 minutes. A content analysis was used to discuss findings.\nResults\nHuman Resources (HRaimed to investigate Information Technologies tools during the progress of digitalization in health. It has been determined that the studies gathered under the heading of Information Technology focus on measuring the maturity of the existing technical level and in this context, they put forth maturity models or measure the maturity level with the support of existing maturity models.

In addition, with the studies conducted in 2021, 2017, and 2016, respectively, Chew et al.; Shaygan & Daim; Arshad et al.; Ileri, Technology/Process Management topic was examined. By emphasizing the importance of information flow, the authors underlined the critical importance of sound technology management in the process of increasing the digital maturity level of hospitals.

RESULTS

In recent years, the health sector has undergone a great digital transformation with the changing world, and as a result, they have had to fight possible

risks by adopting an agile structure. In addition, the advantages and benefits brought by technological innovations have become undeniable, and more solid steps have been taken by facilitating processes in different areas of the services offered. For this reason, it has been observed that digital maturity assessment models come to the fore in the literature.

Maturity models in this area perform level measurement of systems that can create action plans promptly by using the information provided from internal and external contexts to create meaningful metrics related to system learning and increased efficiency in results. In this direction, the concept of digital health has been examined from different perspectives, and it has been determined that different maturity assessment models have been included and examined by researchers. Many studies have been brought to the literature to develop and improve digital maturity assessment processes in health. With the literature review carried out, it has been determined that the related concept has been focused on by researchers and has come to the fore in the last ten years.

With the literature review, the concept of a digital hospital was examined, and two main headings were created, namely digitalization in healthcare and digital maturity assessment models in health systems, and the focus was shifted to digital maturity assessment models in health systems, which is the area where most of the research is collected.

DISCUSSION

In recent years, with the emergence of the concept of digitalization in health, researchers have focused on this issue from different perspectives and have produced many studies. The result has been many different models and many different vehicles that have emerged in those models.

Emphasizing the advantages of technological advances in clinical processes has emerged as the common thought of researchers that they should be used more actively to reach a sufficient level of maturity. Although it is emphasized that different tools such as Clinical Decision Support Systems, Information Technologies, and Technology/ Process Management facilitate processes and provide different positive returns, it has been observed that health institutions still do not reach the level of maturity.

As a result of the literature review, it was observed that researchers put forward models and frameworks that guide policymakers in technology management. Emphasizing the importance of information flow, the authors underlined the critical importance of sound technology management in the process of increasing the digital maturity level of hospitals.

It has been observed that health organizations that ideally integrate new technological developments into their systems have great success in the digital transformation process. In this direction, it is thought that the literature review will contribute to the literature by guiding future studies for researchers focusing especially on digital maturity assessment processes in health systems. In addition, it is recommended that decision makers and policymakers in health systems should receive support from these techniques by improving the relevant models and methods summarized in this research at the stages of process development, improvement, and productivity increase.
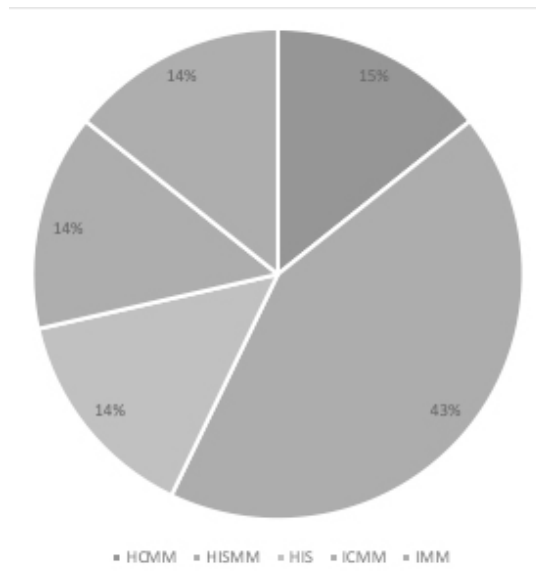
Figure 2: Distribution of Maturity Assessment Model

Some maturity models have been developed to perform digital maturity level measurements in health. According to the literature review, different maturity models were determined. It has been observed that there are HIMMS,

HCMM, HIS, ICMM, and IMM models to develop and improve the process of evaluating digital maturity models in health. As a result of the literature study, it has been observed that the most used model is HIMMS. (Figure 2).

Ethical Approval: Since the article is a literature review, there is no violation of ethical rights, so ethical approval does not require.

Authors' Contributions: All authors analyzed related papers in the literature, collected appropriate studies, and classified them into subtitles of the general research subject. Lastly, the authors wrote the literature review paper.

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APPENDIX A

Keywords: ("health 4.0" OR "health 5.0" OR "e-health" OR "healthcare" OR "HIMSS" OR "health" OR "telemedicine") AND ("digitalization" OR "technology" OR "smart" OR "informatics" OR " artificial intelligence") AND ("maturity" OR "digital maturity") AND ("assessment" OR "data" OR "digital" OR "decision making") AND ("index" OR " models" OR " level" OR "scale") AND ("cybersecurity" OR "interoperability" OR " blockchain") AND ("measurement " OR " system" OR " techniques" OR " evaluation") AND ("standardization" OR "road map" OR "strategy" OR "plan" OR " standard" OR "degree" OR "performance" OR "improvement" OR "development" OR "progress")

The Role of Social Psychology in Acquiring Proenvironmental Patterns of Living

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ABSTRACT

Humans polluted the air, water and land of the planet to such an extent that they are always experiencing large-scale environmental crises. Environmental problems are 'social issues' because they are caused by human behavior. Social psychologists lead the way in helping people to acquire pro-environmental patterns of living. Although both environmental attitudes and behaviors, and their relationship are studied by social psychologists in the field, the emphasis of social psychologists is mostly on changing environment-related behavior in a positive direction and on strategies promoting pro-environmental behavior. In the environmental literature, there are a lot of theoretical and applied studies emphasizing the destructive effects of the environmental problems. The most usual environmental stressors in the literature are noise, climate changes, pollution, and crowd, and the results of environmental stress are generally found physical illnesses, diminished altruism, learned helplessness, and attentional problems. The most studied topics in the literature are litter behavior, energy conservation, recycling, water use, and car use. Furthermore, social psychologists have developed some more theoretical models (e.g., the models developed by Clayton, de Young, Kaplan) to promote pro-environmental behavior. What most social psychologists consider as a necessary step to promote environmentalism is the productive collaboration among different disciplines, i.e., a multi-disciplinary approach.

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The challenge of social psychology is to find ways to transform environmental concern into environmentally responsible behavior. The feeling of responsibility for the future generations is called 'vertical responsibility'. Social psychology has yet much to do in order to benefit the whole world. The scope of the present review is to emphasize the role of social psychology in helping to solve environmental problems. For this purpose, the most prominent and recent research, and theories in the field were examined.

Keywords: Pro-environmental Behavior, Social Psychology, Environmental Attitudes, Vertical Responsibility, Environmental Concern

INTRODUCTION

Humans are continuously harming the environment thus, they are in great danger. They overuse, pollute, destroy the air they breathe, the water they use, and the land that sustains them. The air, water, and land of the planet are polluted to such an extent that humans are always experiencing large-scale environmental crises. Hence, the planet has been abused on an unprecedented scale.

Environmental problems are among the most daunting of social problems that humans face (Zelezny and Schultz, 2000). They are 'social issues' because they are caused by human behavior. Therefore, environmental problems are not only technical problems requiring solutions from the disciplines such as engineering, physics, and chemistry, but also social problems, i.e., social sciences have a crucial role in solving these problems, which can "all be reversed by human behavior" (Oskamp, 2000a, p. 501). Social psychology is one of these social sciences interested in 'reversing' these problems, i.e., in researching and in trying to solve them. İncedayı (2007) emphasized the importance of constructing buildings with natural techniques, less energy consumption, and renewable materials. In the 21st century, ecological architecture has three main aims: harmony with nature and sustainability, construction without discarding ecological principles, and designing taking art and human soul into account (Yılmaz, 2007). For instance, Wyoming University designed the building for Visual Arts after observing the interaction between the sun and interior design (EkoYapı Magazine, 2016); similarly, the Biological Sciences Research Building in Galway, Ireland has a design using a natural air conditioning system and adapted itself to the Irish climate.

The scope of the present review is to emphasize the role of social psychology in helping to solve environmental problems. How do social psychologists lead the way in helping people to acquire pro-environmental patterns of living? To answer this question, the most prominent and recent research, and theories in the field will be examined.

Environmental Concern, Attitudes and Behavior

Social psychologists have a great interest in investigating 'environmental concern' because they consider it as a prerequisite for developing efficient environmental protection and for applying behavior modification programs (van der Pligt, 1996). In addition to the scales (e.g., "New Environmental Paradigm Scale", "New Ecological Paradigm Scale") measuring environmental attitudes, social psychologists examine mostly 'environmental concern' through the study of the attitude-behavior relationship. Social psychological literature pays a lot of attention to attitudes as primary determinants of behavior (Cassidy, 1997; van der Pligt, 1996). However, a lot of psychologists (e.g., Aitken et al., 1994; Kempton et al., 1992; Verplanken et al., 1994) find a gap or a weak relationship between environmental attitudes and behavior. For instance, a person may feel very strong about energy conservation, but unfortunately this attitude may not prevent him/her from wasting energy. So, although people have positive attitudes in behaving towards the environment, "unfortunately [they] do not translate their attitudes into behavior" (Cassidy, 1997, p. 206). Thoreau (2007), who accepted the nature as a kind of 'religion', stated that he learned everything that could be learned from life and besides to live consciously thanks to the nature.

The relationship between attitude and behavior can be strong or weak or modest. The fact that most findings are about modest relationships between environmental attitudes and behavior is not a pessimistic situation according to Cassidy (1997). He argues that there is a "cause for optimism that the behaviors we observe may not reflect attitudes" (p. 212). It means that even though people waste energy and abuse the environment, it is logical to believe that they may not feel positively about damaging the environment. It is about trying to find a positive meaning in the attitude-behavior discrepancy but of course, it would be better to have positive environmental attitudes as predictive of positive environmental behaviors. Positive environmental behaviors may become

the more accepted behaviors and so, related attitudes may change in line with those behaviors (Pandey, 1990) as well.

Although both environmental attitudes and behaviors, and their relationship are studied by social psychologists in the field, when it comes to the applied social psychology field, the emphasis of social psychologists is mostly on changing environment-related behavior and on strategies promoting pro-environmental behavior (ven der Pligt, 1996). It is time to ask the following questions: How do social psychologists help to solve environmental problems? How do they help to change environmental behavior, i.e., stimulate environment-friendly behavior?

Social Psychological Theory and Research: Solution to The Environmental Problems

There is a growing realization around the world that environmental abuse is a serious societal problem. Unfortunately, human beings may overuse natural resources for obtaining their individual or group short-term self-interest and they may discard the long-term common interest. This tendency is named as the 'tragedy of the commons' by Hardin (1968; as cited in Oskamp, 2000a). Since, humans may think only of themselves and their needs, this egoism may lead to great environmental abuse.

The concept of 'environment' covers both natural physical settings and social settings (De Young, 2013). Accordingly, the discipline of social psychology has a great interest in helping to solve environmental problems. This interest is not surprising because social psychology is concerned with humans who live in different environments. What social psychologists do is trying to change environment-related human behavior in the direction of pro-environmental behavior and thus, avoid the 'tragedy of the commons' (Oskamp, 2000a; van der Pligt, 1996). The study and research of social psychologists form a worldwide environmental social psychological movement. Social psychologists both "heighten awareness about environmental problems" and "change human behaviors to improve our sustainability" (Schultz and Zelezny, 1998, p. 541). Therefore, they try to develop successful environment protection and behavior modification programs at both local and global level, and they try to foster environment-friendly behavior (Stern, 1992; van der Pligt, 1996). How do they try to change environmental behavior? What are the studies that they conduct

to solve environmental problems? In the following section, the most prominent research in the literature will be examined.

Research: Changing Environmental Behavior

The most usual environmental stressors in the literature are noise, climate changes, pollution and crowd (Ercan, 2021). Among the results of environmental stress are generally found physical illnesses, diminished altruism, learned helplessness, and attentional problems (Ercan, 2021). In the environmental literature, there are a lot of theoretical and applied studies emphasizing the destructive effects of the environmental problems, which are causing stress. For instance, one of these destructive effects is a concept called 'environmental racism': Generally, the poor strata of the society and the minorities are experiencing environmental problems (Macionis, 2012). This is a problem related to social inequalities.

Since the early 1970s, social psychologists have investigated ways to promote pro-environmental and conservation behavior (van der Pligt, 1996). The most studied topics in the literature are litter behavior, energy conservation, recycling, water use, and car use. Social psychologists have developed some more theoretical models (e.g., the models developed by Clayton, de Young, Kaplan) to promote pro-environmental behavior at its general meaning without focusing on specific topics, such as promoting litter behavior or promoting water use behavior. As a result of the contributions of all the research findings and recently developed models, the field becomes very rich.

The studies investigating how to induce anti-littering behavior (e.g., Bator, 1997; as cited in Bator and Cialdini, 2000; Cialdini et al., 1990; Reno et al., 1993) show that if the norms are manipulated and emphasized, it is possible to change behavior and to induce conformity. For instance, in a research aimed at inducing anti-littering behavior (Cialdini et al., 1990), the researchers manipulated the appearance of a parking lot as clean vs. littered. Their sample consisted of people coming to that parking lot. As a result of the observations, they found that when the parking lot was previously littered with fliers, most drivers followed suit. This social norm is called as 'descriptive norm' which specifies what most others do in a given setting. Another finding of the research- which Aronson (2018) finds very interesting- was that people were much less likely to litter when there was one piece of litter on the ground than when there was no

litter on the ground. The reason of this behavior was that when people saw one piece of litter, they remembered that littering was disapproved in the society. This social norm is called as 'injunctive norm' which specifies what most others approve or disapprove in the society. As it is apparent from this and other studies on littering behavior, the contribution of social psychology to environmental issues is very great: Social psychology demonstrates humans what to do if they want to induce anti-littering behavior.

Similar to the litter behavior, the studies investigating how to induce water consumption behavior, energy-conserving behavior, travel mode choice behavior, and recycling behavior show that the contribution of social psychology to the behavior change is very great. If norms are manipulated, people's positive prior commitments and agreements about an environmental issue are obtained, individuals are provided with incentives for target behavior, and if financial sanctions are applied, it is possible to change behavior in the direction of environment-friendly behavior (see Aronson, 2018).

Theoretical Models: Changing Environmental Behavior

The theoretical models concern with global issues, and they focus on how to promote pro-environmental behavior at a general level. So, these general models do not focus on specific topics such as how to promote anti-litter behavior or how to promote water conservation behavior. They are not applied research models in themselves, but they are developed more on a theoretical level by using social psychological tools. However, they may lead to new application areas.

One of these theoretical models is the 'Reasonable Person Model' suggested by Kaplan (2000). This model integrates evolutionary, cognitive and motivational aspects which concern human life. So, this model offers an evolutionary-cognitive-motivational approach to understand human nature and it uses insights from cognitive science and human evolution. According to this model, it may be easier to promote environmentally responsible behavior if human nature and circumstances that foster motivation are recognized.

De Young (2000) developed another motivational strategy called 'intrinsic satisfaction', which is personal, internal contentment that engaging in pro-environmental behaviors, such as balanced consumption. Another idea was developed by Clayton (2000). She advanced the idea of 'environmental justice',

which covers the responsibility to future generations and the rights of the environment. According to Clayton (2000), this idea emerges as "the most highly rated consideration in resolving environmental conflicts" (p. 459); similarly, Schultz (2000) argues that the 'self-concept' of an individual and the extent to which he/she perceives himself/herself as an integral part of the environment are very important to determine his/her attitudes towards the environment. Cassidy (1997) emphasizes the relevance of social identity in gaining an environmental perspective.

In summary, according to these theoreticians, it should be firstly recognized the nature of humans, and if their cognitive processes, motivations, moral feelings and emotions are stimulated, environment-friendly behavior may be promoted. There is much more to be done if it is thought that humans have abused the planet on an unimaginable scale.

Conclusion: Contributions and Future Directions of Social Psychological Research

Social psychologists concern with the environmental social issues such as litter behavior, water use behavior, energy conservation, car use behavior, and recycling behavior. They try to find some ways to promote environment-friendly behavior. In this way, they emphasize what is necessary to apply for environmentalism. Overall, in the studies included in the present review, they show that social norms and social information, prior commitment (especially public commitment), financial costs and incentives, (vivid) communication, agreements, training programs and education are very effective for promoting pro-environmental behavior. With these findings, it is possible to say that if all these factors are manipulated and applied, behavior may be changed in the direction of a more positive approach to environmental issues.

In addition to these studies, social psychologists developed some theoretical models concerning with global issues and focusing on how to promote pro-environmental behavior at a general level. They dig the origin of human nature and try to understand it in order to promote environmentalism. In further studies, these theoretical models can be applied in promoting pro-environmental behavior.

What most social psychologists (e.g., McKenzie-Mohr, 2000; Stern, 2000) consider as a further and necessary step to promote environmentalism is the

productive collaboration among different disciplines such as social, health, community and clinical psychology, sociology, political science, geography, anthropology, and engineering. This kind of a multi-disciplinary approach, within which social psychology can make a useful contribution, is necessary for a future development in order to fully understand, predict, and change for environment-friendly and responsible behavior. when different disciplines bring their own points of view and when researchers from different disciplines collaborate, the environmental problems can be easily solved (van der Pligt, 1996).

Actively, social psychologists set up scientific agencies and organizations (e.g., the U.S. Environmental Protection Agency, the Environmental Design Research Association) and they publish journals (e.g., Environment and Behavior, the Journal of Environmental Psychology) and handbooks (e.g., the Handbook of Environmental Psychology by Stokols and Altman). These organizations and publications are very effective for changing environmentally destructive behavior. They should also serve to educate lay people for positive environmental behavior. In this way, in addition to psychologists and other scientists, lay people may also gather their emotional, material, and informational forces to form social networks and units of social support to solve and/or avoid environmental problems. In summary, social psychologists should act as 'pro-environmental educators' in order to promote environment-friendly behavior. Oskamp (2000b) is one of these educators and he argues that "to create a sustainable world, we need everybody's participation" (p. 388). Governments and political leaders should also work for these pro-environmental goals; in addition, funding agencies should fund research. McKenzie-Mohr (2000) suggests that psychologists should try to influence funding agencies such as the U.S. Environmental Protection Agency and Environment Canada to support environment-friendly behavior.

Everybody can do a lot of things: buying fuel-efficient cars, recycling thoroughly, using mass transportation, and so on. In this effort, social psychology is the 'moderator': It should moderate and organize the collaboration with other scientists, politicians, and lay people because it understands better the human-environment interaction. Furthermore, it should unite applied research and theory to show the ways leading to pro-environmentalism. So, it should

find further ways to solve environmental problems and then apply them.

In short, the challenge of social psychology is to find ways to transform environmental concern into environmentally responsible behavior. In this challenge, as Winter (2000) argues, it is necessary to gain momentum to avoid a future environmental disaster because humans have abused the Earth to a great degree. The feeling of responsibility for the future generations is called 'vertical responsibility' (Ercan, 2021). Social psychology has yet much to do in order to benefit the whole world, to benefit our children and our grandchildren.

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Detection of Misuse or Illegal Use of Medicines: A Study Example for Tacrolimus Active Ingredient

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ABSTRACT

Corruption and irregularity are situations that we may encounter in every field such as banking, insurance, security and health. Health expenditures are increasing every year all around the world. The amount of corruption and irregularity is parallel to this increase. Corruption and irregularities in the health sector both threaten human health and cause financial losses. With the help of methods for detecting corruption and irregularities, malpractices can be avoided and also financial losses can be prevented, thus contributing to the improvement of health service delivery. The aim of this study is to identify risky individuals who may be involved in drugs, which constitute an important part of health expenditures, and who may cause corruption and irregularities. Drugs with the Anatomical Therapeutic Chemical (ATC) code with the same active ingredient were examined. Anomaly detection, association analysis and rule-based data mining methods were used for the detection of corruption and irregularity. 24 physicians were identified as with high risk. Those who were found to be risky in the analysis were examined specifically and it was confirmed that all of them abused the drug with the relevant active ingredient, thus it means that the method used is 100% consistent and accurate.

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Keywords: Data mining, Corruption, Irregularity detection, Prescription fraud

INTRODUCTION

Data mining is the process of obtaining information from big data (Karimi, H.A. 2014). Health is a basic human right and access to health services is a fundamental right that every individual has just after birth (United Nations, (2022, June 02)). Health care is a type of service that costs to countries increasingly every year. According to 2020 data, approximately 250 billion Turkish Liras have been spent on health in the Republic of Türkiye (Türkiye Statistics Institution (2022, June 22)).
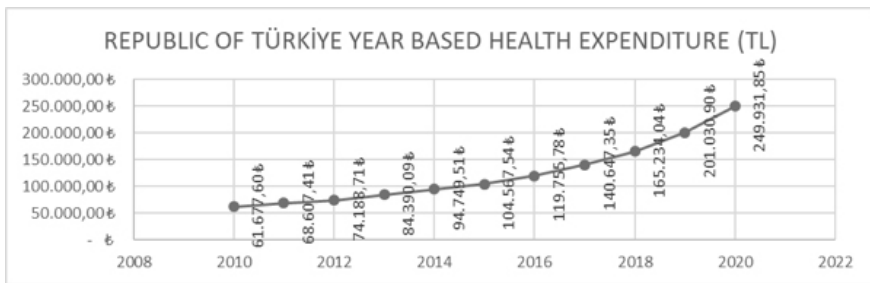
Figure 1: Year based health expenditures (2010-2020) (Türkiye Statistical Institute (TÜIK), 2022).

Drug use constitutes a significant part of health expenditures. Medicines are medical products which are open to abuse due to their financial burden and difficulties access to them. Drug corruption occurs when drugs are made to appear as if they were used while unused, over-prescribed drugs, off-label drugs are prescribed and with the cooperation of physicians with organizations such as companies or pharmacies (Thornton et al, 2013). It is important to detect unnecessary or illegally prescribed drugs, to prevent financial losses, and to prevent situations that may harm human health. The financial resource flowing to corruption and irregularity is an important factor that prevents people from getting a better service. Due to the high number of people receiving health services and the difficulty of detecting individual irregularities, it has become vital to conduct irregularities with data mining methods in the health sector. It has been shown that corruption and irregularity can be found in health

with methods such as outlier detection, association rules among data mining methods (Capelleveen et al, 2016). The aim of this study is to identify risky individuals who may be involved in drug related corruption and irregularities by using data mining methods.

METHODOLOGY

In our literature review, it is observed that data mining methods are generally used in the health sector to detect corruption over insurance systems.

Namrata Ghuse has tried to detect corruption that may occur in health insurances with prediction algorithms and logistic regression models. The difficulties of working with raw big data are mentioned. It has been found to be more efficient than the classical audit approach in detecting corruption (Ghuse et al, 2017).

Verna's study is an experimental study and the purpose of the experimental study is to define and measure health insurance data. Statistical decision rules in two criteria based on abnormal demands and diseases, k-means clustering algorithm are applied on abnormal claims, anomaly detection and association algorithms are used on diseases. The results were found to be effective. 75 cases of corruption have been identified (Verma et al, 2017).

Kareem's study used classification, association (apriori algorithm) and data mining methods of support vector machines. No significant association was detected. The data of the University of Malaysia was used. He concluded that corruption detection methods should be developed (Kareem et al, 2017).

In Yang's study "Gradient Boosting Decision Tree (GBDT) and LHEM" were used as the decision tree model. Pharmaceutical data of health insurers in Jinhua city in 2019 and 2020 are used. Disease diagnosis and gender were evaluated together with medication. When the results of the two models were evaluated together, LHEM was found to be more effective in detecting health corruption (Yang et al, 2021).

The subject of data mining has been examined by following the steps of data selection, data cleaning, data reduction, data integration, data transformation, modelling, model evaluation and information presentation (Han et al, 2012). The study was carried out using the IBM SPSS Modeler software.

Data Selection

Anonymized 9x235162 sized data of the Republic of Türkiye Ministry of Health was used for drugs containing tacrolimus active ingredient covering the years 2019-2020. Within the scope of this study, 16460 physicians and 24671 pharmacies were examined.

Pre-Processing and Cleaning the Data

Data quality was evaluated using the SPSS Modeler Data Audit tool.

Field	Sample Graph	Measurement	Min	Max	Mean	Std. Dev	Skewness	Unique	Valid
doktor_id		Continuous	99877	580864	248808.853	119389.769	0.807	–	460147
hak_sahibi_id		Continuous	7956	1967913696	1307803815.450	323866855.476	-0.679	–	460147
recete_no		Continuous	209294939...	30921967656	26024398341.637	2870222222.814	-0.050	–	460147
recete_tarihi		Continuous	2017-01-0...	2020-12-31 00:00:00	–	–	–	–	460147
eczalinankutuadet		Continuous	1	90	2.404	5.138	12.251	–	460147
brans		Nominal	–	–	–	–	–	85	460147
ecz_kod		Continuous	108060294	112861158	110029992.984	1146160.607	0.243	–	460147
tesis_il		Nominal	–	–	–	–	–	81	460144
tesis_ana_grup		Nominal	–	–	–	–	–	5	460147

* Indicates a multimode result   * Indicates a sampled result

Figure 2: Data Audit result image

Physicians with empty branch data are combined under the "other" heading. The missing data were completed by taking the arithmetic mean of the other non-null physicians for the values with the null number of physician examinations and the total number of physician prescriptions.

Data Reduction and Integration

In order to prevent the effect of a small number of prescribers on the mean and standard deviation, the distribution of the number of prescriptions written by the physicians in their own branches was examined and the quarters were calculated. According to these quarters, physicians with prescription numbers less than the 1st quarter value were excluded from the data set (4 boxes) and analyzes were made with 75% of the physicians. Thus, physicians who write a small number of prescriptions are prevented from being among risky physicians. The data size is reduced to 9x215195.

Transforming Data

Data transformations were carried out within the framework of risk criteria.

Risk 1: Physician prescribing a large number of boxes to patients with similar diseases compared to other physicians in his/her own branch

Indicator 1: Number of Boxes Per Prescription

I1 Calculation: (Number of Risky Boxes i)/(Number of Risky Drug Prescriptions i) , $i=1.N$(Number of physicians in the branch)   (1)

Risk 2: The high share of prescriptions that the physician prescribes drugs with risky active ingredients in total prescriptions

Indicator 2: Risky Prescription Ratio

I2 Calculation: (Number of Risky Drug Prescriptions i)/ (Number of Prescriptions of All Medicines i) , $i=1.N$(Number of physicians in the branch)   (2)

Risk 3: Physician always prescribes risky drugs to the same patients

Indicator 3: Number of Drug Boxes Per Different Patient

I3 Calculation: (Total Number of Boxes of Risky Drug i)/(Number of Different Patients i), $i=11.N$(Number of physicians in the branch)   (3)

Risk 4: Physician prescribes medication for the same patient in a very short time (Note: It includes outpatients who are prescribed in 10 days or less, the medications given to inpatients are excluded.) Physicians who prescribe the same medication to the same patient more than once within 10 days are considered risky.

Indicator 4: Physician - Patient Relationship

I4 Calculation: Date of Prescribing Medication to a Single Patient-Previous Medication Date ≤10   (4)

Risk 5: Physician prescribes too many related drugs on the same day

Indicator 5: Prescribing drugs on the same day above the country's average

I5 Calculation: Number of physician's prescriptions per day≥3*(Number of Prescriptions Per Day)/ (Number of Active Physicians on the Same Day)   (5)

Data Mining (Modeling) Phase

In this step of the process, data mining methods were applied according to the purpose of the study by using the data prepared in the previous steps. Data mining methods used in this study are:

Anomaly Detection:

Outliers, which can have significant effects on further analysis and modeling, occur between continuum situations (Čampulová et al, 2021). Outlier detection methods make an implicit assumption: normal objects are somehow "clustered". In other words, an unsupervised outlier detection method would expect normal objects to follow a pattern much more frequently than outliers. Normal objects do not need to fall into a group that shares high similarities. Instead, they can form multiple groups, where each group has different characteristics. However, an outlier would be expected to occur very far in the feature space from any of these normal object groups (Han et al, 2012). Anomaly Detection is a technique that enables the detection of unexpected situations in data. The detection of unexpected situations is revealed by determining over big data. These unexpected situations are called outliers, exceptions, or anomalies in the literature (Pang et al, 2021).

Association Analysis- Apriori Algorithm:

The Apriori algorithm is an impressive algorithm found by R. Agrawal and R. Srikant in 1994 for logical association relationships (Losarwar ve Joshi, 2012). Association analysis is a data mining and machine learning method that reveals the relationship between variables based on rules.

Each transaction set with the units in this data set, including the D data set and the $I=\{I_1, I_2, \cdots, I_m\}$ unit set (Itemset), is $T \subseteq I$. Each transaction is represented by a TID number. With $A \subseteq I$, $B \subseteq I$, $A \neq \varnothing$, $B \neq A$, and $A \cap B = \varnothing$, the association rule of A and B units is shown as $A \supset B$. The expression to the left of the $\supset$ symbol in the rule notation is called antecedent, and the expression to the right is called the consequent. Association rules shown as antecedent $A \supset$ consequent B among the units in the D data set are defined by support, confidence, and lift values.

Support $(A \Rightarrow B)$ = (Frequency Number (A, B)) / (N Number (Data Set))

Confidence $(A \Rightarrow B)$ = (Frequency Number (A, B)) / (Frequency Number (A))

Lift $(A \Rightarrow B)$ =(Support$(A \Rightarrow B)$)/(Support(A)×Support(B)) (Momeni Kho et al, 2021).

The methods are implemented through the SPSS Modeler data mining product.

Rule Induction:

One of the known classification approaches in data mining is rule extraction. It is a key algorithm for building classification models with simple, yet effective, easy to understand rules. This algorithm was developed in 1987 based on the separation of data samples using existing class labels. Rule inference algorithms generally produce if-then classifiers with predictive performance comparable to other traditional classification approaches such as decision trees and relational classification.

Anomaly detection model was applied for branch and sector (public, private, and university) based evaluations via IBM SPSS Modeler Program for Boxes Per Converted Recipe, Risky Prescription Rate, and Number of Drug Boxes Per Different Patient. In the indicators of Physician-Patient Relationship and prescribing drugs above the country average on the same day, rule-based progress was made, and abnormalities were detected. The mean of frequency (μ) and standard deviation (σ) were calculated, and the risk score was given.

Table 1: Risk Scoring Table

$\mu + 0{,}5\ \sigma \leq$ Indicator Result $< \mu + 0.75$	σ	1 score
$\mu + 0.75\ \sigma \leq$ Indicator Result $< \mu + 1$	σ	2 scores
$\mu + 1\ \sigma \leq$ Indicator Result $< \mu + 1.25$	σ	3 scores
$\mu + 1.25\ \sigma \leq$ Indicator Result $< \mu + 1.5$	σ	4 scores
$\mu + 1.5\ \sigma \leq$ Indicator Result $< \mu + 1.75$	σ	5 scores
$\mu + 1.75\ \sigma \leq$ Indicator Result $< \mu + 2$	σ	6 scores
$\mu + 2\ \sigma \leq$ Indicator Result $< \mu + 2.25$	σ	7 scores
$\mu + 2.25\ \sigma \leq$ Indicator Result $< \mu + 2.5$	σ	8 scores
$\mu + 2.5\ \sigma \leq$ Indicator Result $< \mu + 2.75$	σ	9 scores
$\mu + 2.75\ \sigma \leq$ Indicator Result		10 scores

In addition, the apriori algorithm for the patient-patient relationship was used to observe the relationship between physicians and pharmacies and block movements between patients (repeated block movements of patients who prescribed the same drug to the same doctor on the same day and bought this drug from the same pharmacy).

RESULTS

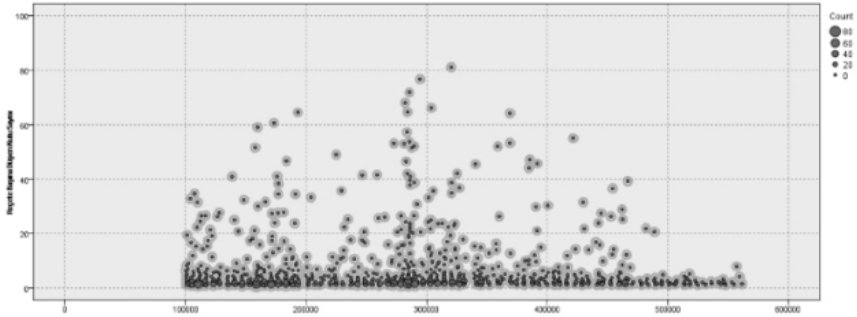### Calculation and Findings

Finding 1: Number of Boxes Per Recipe

Figure 3: Boxes Per Prescription Ratio Scatter Chart

Table 2: Number of Boxes Per Prescription Data Characteristics

|	
Count	3,327
Mean	2.07
Min	1.00
Max	76.67
Range	75.67
Variance	5.54
Standard Deviation	2.35
Standard Error of Mean	0.04

In the Number of Boxes Per Prescription indicator, the overall average was 2.073, and physicians who deviated from the general average were scored according to their standard deviation. From Indicator 1, out of 2354 physicians, 16 physicians attained the high-risk physician status by obtaining a risk score of 9-10, 5 physicians attaining the status of risky physician with a risk score of 7-8, 5 physicians attaining the status of medium-risk physician with a risk score of 5-6 and 2328 physicians attaining the status of low risk-no risk physician with a risk score of 1-4 were identified. 1.1% of physicians were identified as risky.

Finding 2: Risky Prescription Ratio
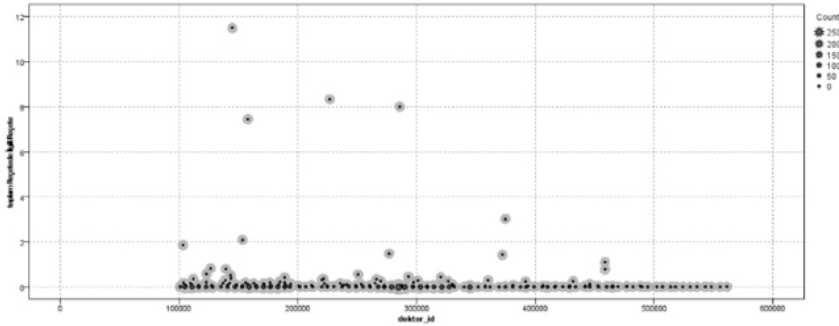
Figure 4: Relevant Prescription Ratio in the Whole Prescriptions Scatter Chart

Table 3: Relevant Prescription Ratio in Whole Prescriptions Data Attributes

Count	3,327
Mean	0.006
Min	0.000
Max	0.149
Range	0.149
Variance	0.000
Standard Deviation	0.010
Standard Error of Mean	0.000

In the indicator of Relevant Prescription Ratio in the whole prescriptions, the general average was 0.006, and the physicians who deviated from the general average were scored according to their standard deviation. From Indicator 2, out of 2354 physicians, 66 physicians entered the high-risk physician status by obtaining a risk score of 9-10, 29 physicians attained the status of risky physician with a risk score of 7-8, 51 physicians attaining the status of medium-risk physician with a risk score of 5-6 and 2208 physicians attaining the status of low risk-no risk physician with a risk score of 1-4 were identified. 6% of physicians were identified as risky.

Finding 3: Number of Drug Boxes Per Different Patient
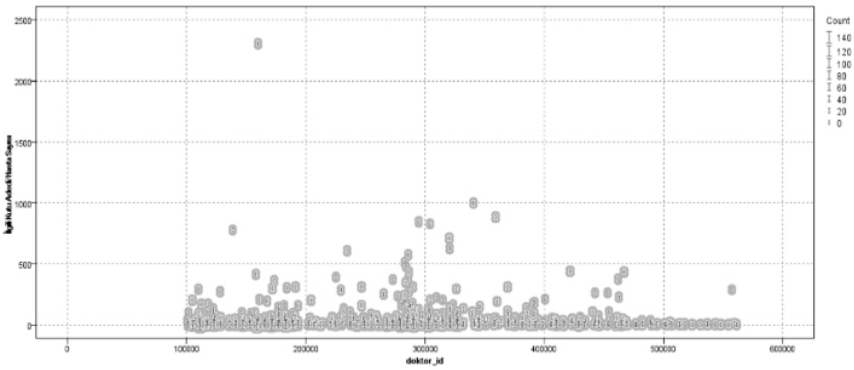
Figure 5: Number of Boxes Per Different Patient Ratio Scatter Chart

Table 4: Number of Boxes Per Different Patient Ratio Data Attributes

Count	3,327
Mean	4.34
Min	1.00
Max	161.00
Range	160.00
Variance	54.62
Standard Deviation	7.40
Standard Error of Mean	0.13

In the indicator of number of boxes per different patient, the overall average is 4.336, and physicians who deviate from the general average are scored according to their standard deviation. From Indicator 3, out of 2354 physicians, 29 physicians entered the high-risk physician status by obtaining a risk score of 9-10, 10 physicians attained the status of risky physician with a risk score of 7-8, 10 physicians who attained the status of medium-risk physician with a risk score of 5-6, and 2305 physicians attaining the status of low risk-no risk physician with a risk score of 1-4 were identified. 2.08% of the physicians were identified as risky.

Finding 4: Physician Patient Relationship

Table 5: Physician Patient Relationship Results

patient id	physician id	Number of drug prescription for less than 10 days
1401592710	924780	4
344468574	2589444	4
1300046880	1895838	4
762594054	960120	4
1438197570	1644612	3
1763156016	1872726	3
9806514	1895838	3
1807953708	1895838	3
1468176342	1488270	3
1130521644	1895838	3
1052406702	3214986	3

Among the physicians who prescribed this drug group for less than 10 days to the same patient, the first physician, who was considered the riskiest, prescribed the drug to 87 different patients in less than 10 days. The 2nd physician prescribed drugs to 47 different patients, the 3rd physician to 21 different patients, the 4th physician to 14 different patients, the 5th physician to 12 different patients, and the 6th physician to 10 different patients. In this way, 46 physicians were considered to be risky.

Finding 5: Prescribing drugs above more than 3 times of the country average on the same day

Table 6: Physician Average Number of Exceeded Days

physician id	Exceeded Days
945744	249
1514028	224
1895838	150
1146864	129
1636224	87
996204	85
898710	81
712596	67
834468	64
894642	63
1580226	61

The number of days of the physicians who prescribed the drug more than 3 times of the average of the number of prescriptions per day was determined. It was found that 4 high-risk physicians wrote prescriptions for more than 100 days above the national average and 7 physicians wrote prescriptions for more than 50 days above the national average.

Finding 6: Physician-Pharmacist-Patient Association Analysis

Table 7: Physician-Pharmacist Association Analysis Results

pharmacy id	physician id	Support	Confidence	Lift
109864290	1895838	0.006	100%	17804%
108068646	651744	0.002	91%	63387%
110118972	1278096	0.002	70%	54370%
112385400	2368296	0.001	87%	84035%
112385400	2573940	0.002	62%	64902%
110079612	698370	0.001	63%	70778%
110094816	2154708	0.001	98%	112168%
109864896	2807646	0.001	97%	114407%
109864548	2294304	0.001	99%	124032%
109864350	605796	0.001	100%	171991%
109862982	1836270	0.001	100%	174906%
109267548	2275428	0.001	100%	179782%
108970476	1065024	0.001	86%	170852%
111660474	657732	0.001	94%	189696%
109864548	2949792	0.000	90%	246878%
109864350	686850	0.000	100%	286652%
112385400	2642670	0.000	100%	291511%

Physicians with higher than 50% confidence in the association analysis and prescribing more than 100 boxes were included in the risky category. No block movement of patient was observed.

DISCUSSIONS and CONCLUSIONS

Similar studies were examined. Aral et al., in their study "A fraud detection model", developed a model using data mining methods to detect prescription irregularities. Data titles are market price of the prescribed drug, prescription number, age, sex and diagnosis. The work is coded in MATLAB. 26,419 prescriptions were analyzed. Classification models are used. The established model showed high success with 77.4% true positive rate and 6% false positive rate for counterfeit prescriptions (Aral et al, 2012).

In the study "The evaluation of trustworthiness to identify health insurance fraud in dentistry" by Wang et al., rule-based data mining methods were used to detect this situation due to the fact that dentists harm health insurance companies due to false statements. The model works according to the reliability score of a dentist, the amount of procedure and the type of procedure. The treatment practices of dentists with patients through their social networks were evaluated. It has been evaluated that the model is capable of reducing insurance fraud (Wang et al, 2017).

In their study, Kirlidog and Asuk "A fraud detection approach with data mining in health insurance" aimed to detect situations that may cause fraud and corruption by making false statements in order to gain benefit from health insurance companies, by using data mining methods. By examining the historical data, anomaly detection and support vector machine models and possible corruption and irregularities have been determined. The study was carried out through Oracle. As a result of the study, it has been evaluated that anomaly detection methods and situations with the possibility of corruption and irregularity can be separated in big data and come to a conclusion in detailed analysis and examinations (Kirlioglu and Asuk, 2012)

The relationship between risk criteria such as physicians' risk score averages, high risk criteria, number of prescription drugs, clustering in certain healthcare facilities and provinces, physician/pharmacy relationship, and of block patient movements were evaluated. In addition, a final evaluation was made with experts on the subject and suggestions were made.

In our study, scenarios suitable for drug corruption were applied using data mining algorithms. 16460 physicians and 24671 pharmacies were examined and 26 physicians were selected from the Number of Boxes Per Prescription criteria,

146 physicians from the Rate of Related Prescription in All Prescriptions criteria, 49 physicians from the Ratio of the Number of Boxes per Different Patient, 46 physicians from the criteria of prescription drugs in less than 10 days, and 11 physicians from prescribing the drugs more than 3 times of the average number of prescriptions per day criteria were found to be high risk. It was also evaluated the pharmacy-physician relationship. As a result of the association analysis, physicians who prescribed more than 100 boxes of drugs with confidence above 0.50 were filtered out. As a result, 38 physicians and 29 pharmacies were evaluated as high risk.

When all the results were evaluated together, a total of 24 physicians were found to be at high risk and were ranked according to their risk levels. Each physician and pharmacy found to be at risk in the analysis was examined by the inspector, and it was confirmed that all of them abused the drug with the relevant active ingredient. For this reason, it has been observed that the method used is 100% consistent and accurate.

Due to the fact that unsupervised methods are generally used in the detection of corruption and irregularity with data mining methods, an inspector examination is needed after the risk focus is determined in the studies. The accuracy of the studies can only be revealed as a result of the inspection of the inspector.

In this study, unlike other corruption and irregularity detection studies, association algorithms and anomaly detection methods are used as a hybrid model. In addition, the criteria created for corruption and irregularity scenarios were evaluated together and achieved high success.

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Conflict of Interest Statement: The authors declare that there is no conflict of interest for this study.

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