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CASE REPORT / OLGU RAPORU

Effect of Immunosupressive Medication Adherence Using a SystemCHANGE™ Intervention: Case Study of a Turkish Kidney Transplant Recipient

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ABSTRACT

In kidney transplant recipients, non-adherence to immunosuppressive medications leads to rejection, which negatively affects the function of the transplanted organ and increases mortality rates and healthcare costs. The purpose of this paper is to report a case from the parent study which is designed to test the efficacy of the SystemCHANGE™ intervention compared to an attention-control intervention on medication adherence at 6 and 12 months in non-adherent Turkish adult kidney transplant recipients. This is a case report from the Turkish parent study which mirrored the methods of the Medication Adherence Given Individual Change (MAGIC) studies conducted with adult kidney transplant recipients that have been previously published. This study reports a case study of an adult kidney transplant recipient with poor medication adherence enrolled in an innovative six-month SystemCHANGE™ intervention. Medication adherence increased immediately and was sustained throughout the intervention and maintenance phases. The SystemCHANGE™ intervention resulted in immediate and sustained improvements in medication adherence. The patient experienced a clinically meaningful increase in MA (23%) by improving the timing of doses by linking them to a regularly occurring behavior. This is the first case study conducted in different culture, and the second case study on this topic in the international literature. The SystemCHANGE™ intervention was effective in increasing medication adherence and quality of life in this individual.

Keywords: Medication adherence, kidney transplantation, SystemChange.

SistemDeğişimi™ Müdahalesinin İmmünosupresif İlaç Uyumunun Etkisi: Türk Bir Böbrek Nakli Alıcısının Olgu Çalışması

ÖZET

Böbrek nakli alıcılarında immünosupresif ilaçlara uyumsuzluk, nakledilen organın işlevini olumsuz etkileyen rejeksiyona yol açmakta ve ölüm oranları ile sağlık bakım maliyetlerini artırmaktadır. Bu makalenin amacı, SistemDeğişimi™ müdahalesinin uyumsuz Türk yetişkin böbrek nakli alıcılarında 6. ve 12. aylarda ilaç uyumu üzerinde bir dikkat kontrol müdahalesine kıyasla etkinliğini test etmek için tasarlanan ana çalışmadan bir vakayı bildirmektir. Bu çalışma, daha önce yayınlanmış olan yetişkin böbrek nakli alıcıları ile yürütülen *Medication Adherence Given Individual Change* (MAGIC) çalışmalarının yöntemlerini yansıtan Türk ebeveyn çalışmasından bir vaka raporudur. Bu çalışma, altı aylık yenilikçi bir SistemDeğişimi™ müdahalesine kaydolan, ilaç uyumu zayıf yetişkin bir böbrek nakli alıcısının vaka çalışmasını rapor etmektedir. İlaçlara bağlılık hemen artmış ve müdahale ve idame aşamaları boyunca sürdürülmüştür. SistemDeğişimi™ müdahalesi, ilaç uyumunda anında ve sürekli iyileşmelerle sonuçlanmıştır. Hasta, dozların zamanlamasını düzenli olarak gerçekleşen bir davranışa bağlayarak iyileştirerek ilaç uyumunda klinik olarak anlamlı bir artış (%23) yaşamıştır. Bu çalışma, farklı bir kültürde gerçekleştirilen ilk vaka çalışması ve uluslararası literatürde bu konuda yapılan ikinci vaka çalışmasıdır. SistemDeğişimi™ müdahalesi bu bireyde ilaç uyumunu ve yaşam kalitesini artırmada etkili olmuştur.

Anahtar kelimeler: İlaç uyumu, böbrek nakli, SistemDeğişimi.

1. Introduction

Immunosuppressive medication nonadherence in kidney transplant recipients leads to rejection which adversely affect the function of the transplanted organ, and increases mortality rates and health care costs. Health care cost due to medication non-adherence in the first three years after organ transplantation exceed $33,000 per patient (1,2). Even though it is a preventable behavior, in a meta-analysis, the rate of medication non-adherence in adult kidney transplant patients was reported as 35.6 case per 100 kidney transplant patients per year (3). A systematic review found factors leading to increased medication non-adherence in kidney transplant recipients were male sex, ≥50 years of age, taking ≥2 medicines per day, and having an organ transplanted from a living donor (4).

To increase medication adherence (MA) in adult kidney transplant recipients, interventions have focused on cognition (knowledge, attitudes, beliefs) and a variety of behavioral skills; however, effects of these studies are limited (5,6,7,8,9,10). Many of these studies focus on individual motivation and intention to improve MA. A novel approach, called SystemCHANGE™, which moves beyond motivation and intention, focuses on the redesign of a patient's interpersonal system and daily routines linked to

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the targeted health behavior (11). The SystemCHANGE™ intervention has been studied in Human Immunodeficiency Virus (HIV)-positive patients (12), stroke patients (13), low-income adolescents with overweight and obesity (14), and kidney transplant recipients (15,16). The SystemCHANGE™ intervention, with foundations in Bronfenbrenner`s Socio-Ecological model and Deming`s Plan-Do-Check-Act model, focuses on the individual's systems, including social relations and environmental factors that affect MA at home, at work and in the social environment (11). Using a four-pronged, patient-centered approach, the SystemCHANGE™ intervention involves assessing 1) individual systems (including important others who shape medication taking), how they influence medication taking and solutions for improving medication adherence, 2) implementing the proposed individual systems solutions for improving adherence, 3) tracking adherence data, and 4) evaluating adherence data through these small experiments (16). The purpose of this paper is to report a case from the parent study which is designed to test the efficacy of the SystemCHANGE™ intervention compared to an attention-control intervention on MA at 6 and 12 months in non-adherent Turkish adult kidney transplant recipients. The patient in this case study received the SystemCHANGE™ intervention.

2. Materials and Methods

2.1. Purpose of the study

The purpose of this paper is to report a case from the parent study which is designed to test the efficacy of the SystemCHANGE™ intervention compared to an attention-control intervention on MA at 6 and 12 months in non-adherent Turkish adult kidney transplant recipients.

Location of the Research

The present study was conducted in a university hospital in Izmir, a province located in the west of Türkiye.

2.2. Ethical Aspect of the Research

Dokuz Eylul University Non-Invasive Research Ethical Committee (number: 3636-GOA 2018/04-34) approved the study protocol. Written informed consent was obtained from the participant.

2.3. Application of Research

Before the study was conducted, ethics committee approval (number: 3636-GOA 2018/04-34), and institutional permission were obtained.

This is a case report from the Turkish parent study which mirrored the methods of the Medication Adherence Given Individual Change (MAGIC) studies conducted with adult kidney transplant recipients that have been previously published (16,17,18). Briefly, the study has a 3-month screening phase where patients are screened for medication nonadherence, a 6-month intervention phase where those who are medication nonadherent are randomized into the SystemCHANGE™ intervention or the attention-control education intervention, and a 6-month maintenance phase where both interventions are withdrawn and MA continues to be monitored. Medication adherence scores are obtained at the end of screening, at 6 months and at 12 months.

The patient included in this case study was selected because he met inclusion criteria for the main study. He was a >50-year-old man, took ≥2 medicines per day, had living donor transplant, and had a low MA score.

3. Case Study

Mr. K., was a 33-year-old married man, had a child, was a university graduate, received a living donor transplant from his father 6 years prior to the study, and worked at home. Data were collected between January 2021 and April 2022. The study includes the following three phases: screening, intervention, and maintenance.

3.1. Screening Phase

After the cognitive level of the patient was assessed by the researcher using the Mini Mental Exam, he was given detailed information about the study and his written consent was obtained (19). The Medication Event Monitoring System (MEMS) (AARDEX Company, 2018) was then introduced. This electronic medication monitoring system consists of two parts: a medicine bottle with cap and a reader. Every time the medicine bottle is opened, a chip within the cap records the date and time the cap is opened. The reader allows the date and time data from the cap to be electronically transferred by an internet connection to a database called MedAmigoTM (AARDEX Company, 2018). The MedAmigo™ program uses predefined algorithms to develop a MEMS report which includes a numerical value of MA and graphic display of the patient's MA score according to the days of the week. The patient was also provided with a diary where he could record the date, time and reason he opened the medication bottle but did not take a medication (e.g. opened it accidentally, opened it to refill the bottle but did not take a medication, or opened it to take a medication out early to be taken later). The diary was used to make any corrections to the MEMS cap data to increase the validity of the data. To determine the immunosuppressive medication to be placed in the medication bottle, the researcher listed all of Mr. K's immunosuppressive medications and randomly selected one (mycophenolate mofetil) for him to place in the bottle.

The researcher contacted the patient by phone one week and eight weeks after he started using the medication bottle, cap, and diary to confirm protocol adherence. These questions focused on describing how he was using the bottle, cap, and diary, whether he was taking his medications directly from the medication bottle for each dose, whether he was making a note in the diary if he opened the cap but did not take a medication, and whether he was having any problems with taking his medications related to using the bottle and cap. At the end of the 3-month screening phase, the patient was again called, questioned about the use of the bottle, cap and diary, asked to terminate the use of the bottle, cap and diary and asked to send the cap and diary to the researcher by pre-paid postal service.

The monthly MA score was calculated by averaging the daily MA scores while the 6-month and 12-month MA scores were calculated by averaging the previous 6 months. For example, the 6-month MA score is calculated by adding the month 1, 2, 3, 4, 5 and 6 MA scores and dividing by 6. Because there is a period of adaption to electronic medication monitoring with an early period of higher than normal MA, usually about 30 days (11,15,20,21), the first 30 days of screening phase medication taking data were not included in the calculation of the MA score. To calculate the screening period MA score, the patient's medication data from the second and third months were used.

According to the parent study protocol, the patient is considered medication nonadherent if the MA score is less than 85% (18,19). Mr. K.'s MA score was determined by medAmigo as 62% so he was medication nonadherent and was eligible for the next phase of the study, the intervention phase (AARDEX Company, 2018). After the MA score was shared and discussed with the patient by the researcher, the patient agreed to take part in the intervention phase.

3.2. Intervention Phase

The researcher and patient met via teleconferencing system to complete the baseline measure described below and begin conducting the SystemCHANGE™ intervention phase. The intervention delivery moved to teleconferencing delivery due to

the COVID-19 pandemic. All forms were mailed to the patient prior to the meeting.

First, the patient completed the baseline measure Short Form (SF)-36 Quality of Life Scale, a valid and reliable instrument widely used in the literatüre (22,23,24). The SF-36 has the following eight sub-dimensions: physical functioning, role physical, general health, vitality, social functioning, role emotional, physical health, and mental health. By summing the weighted scores obtained from the questions included in the sub-scales of the SF-36 Quality of Life Scale, physical health component summary scale and mental health component summary scale values are obtained. The purpose of obtaining summary values is to facilitate interpretation and comparison. The summary values obtained are expressed as a continuous variable ranging from 0 to 100. While "0" indicates poor health, "100" indicates good health (22,23).

The intervention phase began next with the researcher introducing Mr. K. to SystemCHANGE™. The key concepts of the SystemCHANGE™ approach were reviewed by the researcher using slides (Table 1).

Table 1. Introduction of key concept of SystemCHANGE™

Introduction to SystemCHANGE™
Everyone has challenges with taking their medications on time every day.
We'd be surprised if you took your medications on time every day.
The SystemCHANGE intervention is meant to:
• Help you focus on changing your medication taking routines
• Make medication taking an effortless habit by trying "small experiments"
There are 4 steps to SystemCHANGE™:
1. Explore your habits around medication taking time and ask:
• How does a habit help or hinder your medication taking?
• How can we arrange your medications within your habits so the medications are in the right place at the right time for you to take?
2. Try a small experiment that changes your medication taking habits.
3. Track your medication taking with the medication event monitoring system (MEMS) cap.
4. Evaluate how the change is working with the MEMS report.
• Improving medication taking works best when you can see a picture or report of how you are taking your medicines.
• Each month we will look over your medication taking report together over the phone to see if the changes are working.
Additional Key Concepts:
• Improving how you take medications takes time.
• Challenges with medication taking are not your fault – it is because your habits and routines don't help you.
• You shouldn't have to try harder or try to remember to take your medications.
• They should be in the right place at the right time.
• Habits and routines are key to success.
I'm going to guide you through this process of:
1. Exploring your habits,
2. Trying a small experiment arranging your medications within your habits so the medications are in the right place at the right time for you to take,
3. Tracking your medication taking with the MEMS cap, and
4. Evaluating how the change is working with the monthly MEMS report.

Next the researcher reviewed the MEMS report from the screening phase with the Mr. K. (Figure 1). Details of these steps are provided elsewhere, but will be briefly reviewed here (11,16,17). The researcher pointed out that mycophenolate mofetil was the monitored medication which was prescribed to be taken two times per day at 8:00 a.m. and 8:00 p.m. and that the "medication taking window" was from 6:30 to 9:30 in the morning and evening. There are three sections to the report, the calendar, the graph with dots, and the bar graph. The researcher reviewed the calendar where the blue days indicated that the medication was taken, and the gray days indicated that the dose was lower than it should be or the medication was not taken at all. There was a number on each day, which showed how many times the medication was taken that day. For instance, if the number was `2`, it indicated that the medication was taken twice that day. In the graph with dots, the x-axis shows the dates, and the y-axis shows the hours. The blue area in the graph shows the time range during which the medication should be taken; the "medication taking window". For instance, since the time range is ±1.5 hours, for the medication that should be taken at 8 o'clock, the blue area covers the time ranging between 6:30 a.m. and 9:30 a.m. The blue dots on the graph show at what time the patient took that medicine on those days. At the top of the graph, the blue bars show the days when the medication is taken, the gray bars show the days when the medication is not taken. The bar graph lists Mr. K's MA scores for each day of the week. Mr. K. was shown that he missed 14 evenings doses and 10 morning doses. Four days both morning and evening doses were missed. He was late with 1 morning dose and 2 evening doses and he never took medications early. Mr. K. also had problems taking medication on Wednesdays, Thursdays and Saturdays of the week. The researcher then informed Mr. K. of his MA score and then asked what his MA score goal was. He set his goal at 100%

Next MA process owners, significant others who were important in his medication taking processes, were identified using the Significant Others Identification Form (18). The form consists of seven yes-no questions where Mr. K. was asked to identify significant others likely to affect his medication taking behavior. The questions are as follows: (1) Is there anyone you live with at home? (2) Does the person you live with consider when you have to take medicine? (3) Does the person you live with help you with your activities of daily living such as bathing, feeding, etc.? (4) Does the person you live with pay attention to the time when you have to take your medicines or support you meeting the cost of the medicine? (5) Does the person you live with pay attention to the way you take medicines? (6) Do you interact with this person every day? (7) Is the person you live with interested in how and when you interact with others socially? Mr. K. answered no to all of the seven questions indicating that he did not have a significant other who had a direct effect on his medication taking behavior, but that instead, he was independently managing his medications.

Next, Mr. K.'s life routines were identified using the Life Routines Form (Table 2). This form was used to collect data on his daily routines such as waking up, eating, going to work, going to sleep; weekly routines such as on-line meetings and coffee breaks on Wednesdays and Thursdays. He had no monthly routines such as paying bills or picking up or refilling medicine from the pharmacy. The discussion indicated that Mr. K. wakes up around 7:30 a.m., stays in bed, takes his stomach protectant medication which is at his bedside. Between 7:45 and 9:45 a.m. he stays in bed and goes to sleep again. During this time, he tries to wake up and remember to go to the kitchen and take his immunosuppressive medication and eat a light breakfast. Between 9:45 a.m. and 10;00 a.m. he wakes up again, goes to bathroom, brushes his teeth, and washes his face. At 10:00 a.m. he goes to kitchen to drink water and then to living room to turn on the computer and starts working. He works in his home office from 10:00 a.m. to 12:00 p.m. Mr. K. has dinner around 6:00 p.m. to 7:00 p.m. Between 7:00 p.m. and 10.00 p.m. he watches television and tries to remember to take his medication which is located in the kitchen. At 10:00 p.m. he goes to kitchen to drink water and goes to bathroom. Between 10:00 p.m. and 10:30 p.m. he goes to the bedroom to sleep. Mr. K.'s other activities from

12:00 a.m. to 6:00 p.m. were also reviewed, but not emphasized because they were not closely associated with his medication taking times. Mr. K.'s weekly routine included having online meetings between 08:00 am and 12:00 am each Wednesday and Thursday. The researcher also asked Mr. K. to describe where he kept his medications because medication location is crucial to consider when using SystemCHANGE^{TM} for successful medication taking. It was discovered that Mr. K. kept his medications on the kitchen countertop near the water.

Table 2. Mr. K.'s life routines forms

Daily Routines	
Morning routines	
7:30 a.m.-7:45 a.m.	- wakes up, stays in bed, takes stomach protectant medication at bedside
07:45 a.m.-09:45 a.m.	- stays in bed and goes to sleep again; tries toremember to take immunosuppressive medication and eat light breakfast
09:45 a.m.-10:00 a.m.	- wakes up again, goes to bathroom and brushes teeth, washes face
10:00 a.m.	- goes to kitchen to drink water and then to living room to turn on the computer and starts working
10:00 a.m.-12:00 p.m.	- works in home office
Evening routines	
6:00 p.m.-7:00 p.m.	- eats dinner
7:00 p.m.-10.00 p.m.	- watches TV in living room; tries to remember to go to kitchen at 08:00 p.m. to take medications.
10:00 p.m.	- goes to kitchen to drink water and goes to bathroom
10:00 p.m.-10:30 p.m.	- goes to the bedroom to sleep
Weekly Routines	
Wednesday:	-08.00-12.00 a.m. has online meeting 10.00 a.m. has coffee break in the meeting
Thursday:	-08.00-12.00 a.m. has online meeting 10.00 a.m. has coffee break in the meeting
Monthly Routines	
	Mr. K.'s did not have any monthly routines related to immunosuppressive medication taking.

Next, the linkages between the life routines around medication taking time and life cycles were identified using the Life Cycles Form (Figure 2). Behaviors the patient displayed before and after taking his morning medicine dose, and before and after taking the evening medication dose were recorded on this form. This form provides information on which daily activities should be taken into consideration in determining solution suggestions that may affect his medication intake. This form is intended to help the researcher and Mr. K. visualize how his routines are linked one to the other and provides insight on ways in which his medication taking could be made more effortless by connecting it to some of these daily routines.

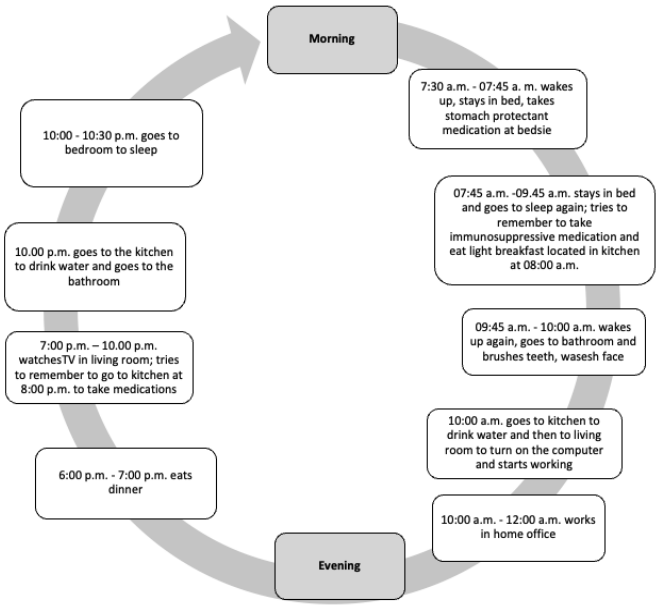

Figure 2. Mr. K.'s life cycles form

Finally, the Possible Solutions Form (Table 3) was completed with Mr. K. Possible solutions likely to increase MA that might affect his medication taking behavior were listed in the first part of this form.

Table 3. Mr K.'s possible solutions form

Possible Solution: Change medication taking time to 10:00 am and 10:00 pm		
Patient answered these questions about the possible solution.	Yes	No
Focuses on events that happen before taking my medications on time.	X	
Does not rely on my motivation or commitment.	X	
Changes my environment		X
Once done, stays done. No need to make the change again.	X	
If it fails to improve medication taking, it is no one's fault.	X	
If the solution doesn't work to improve medication taking, there is no reason to try harder to make it work.	X	
Will increase the time between medication taking failures.	X	
Does not rely on my memory to take medications.		X
Indirectly improves medication taking and timing.	X	
Is a change in a recurring life routine.	X	
Requires more than one person to bring it about.		X
If solution is done today, it will improve medication taking in the future, maybe not today.	X	
Leads to timely medication taking as part of another task	X	
Involves a physical change.		X
Provides resources (time, equipment) for timely medication taking.	X	
Changes who I spend time with.		X
Affects others who live with me.		X
Changes what I do for fun and social gatherings.		X
Leaves no choice but to take medication on time.	X	
Changes a group activity.		X
If it fails to work, it gives me new insights about what to do next.	X	
Rearranges the sequence of my daily living activities		X

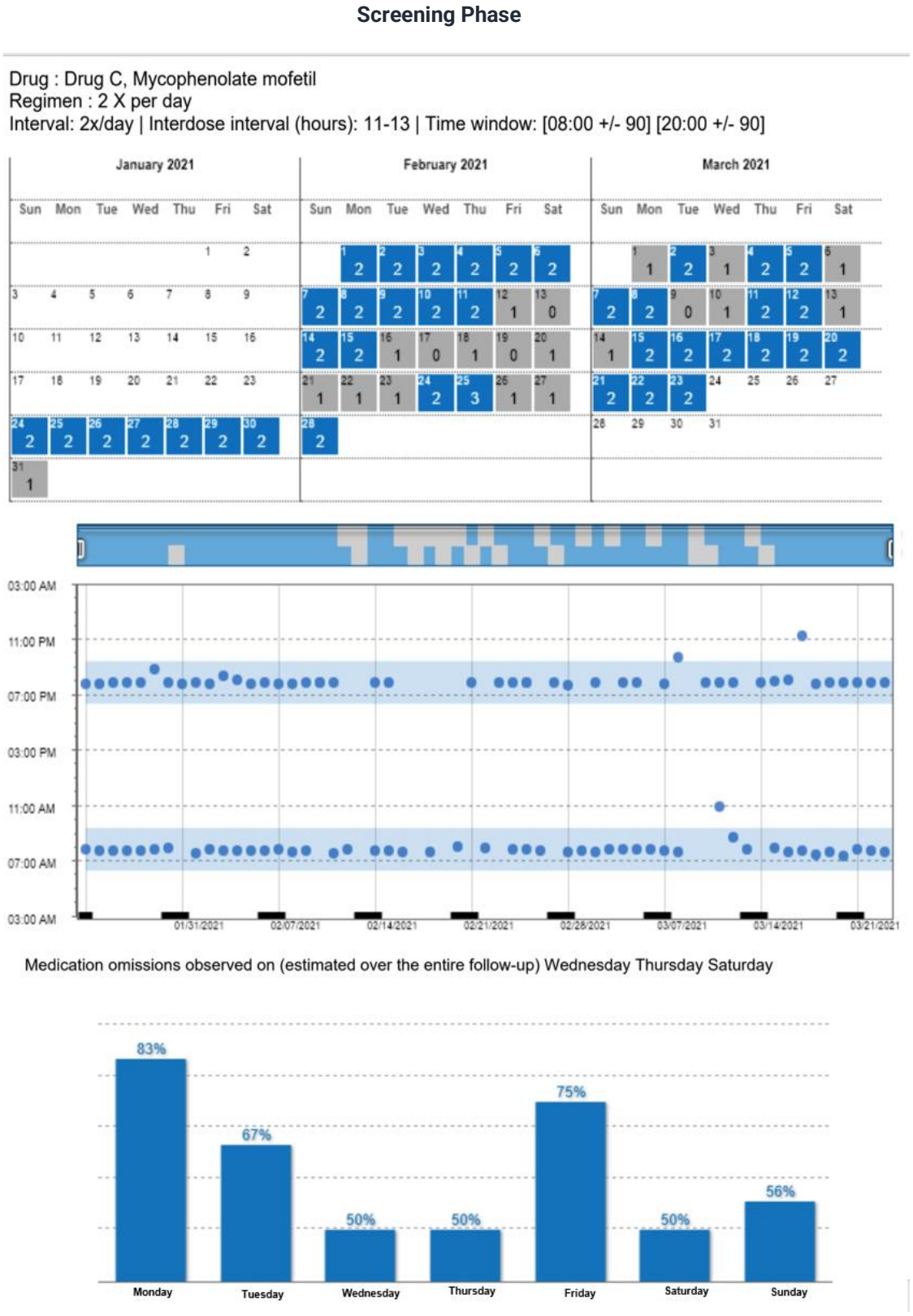

Figure 1. Mr. K.'s MEMS reports- screening phase

In determining these possible solutions, information on his daily routines was utilized. In line with this information, emphasis was placed on which solution could be associated with which daily life routine, and how he could place his medication intake within his daily routine. Finally, the YSO evaluated the possible solution of taking his immunosuppressive medication at 10:00 a.m. and 10.00 p.m. Mr. K. answered "yes" to 59% (13 of 22) of the questions which indicated that this possible solution was a strong SystemCHANGE™ solution and did not rely on memory or trying harder, therefore Mr. K. decided to implement to the solution.

The researcher guided Mr. K. to implement the prioritized the SystemCHANGE™ solution or small experiment of changing his medication taking time to 10:00 a.m. and 10:00 p.m. instead of 8:00 am and 8:00 pm.

The researcher next encouraged Mr. K. to continuing to use the MEMS cap for the next six months of the intervention phase. Throughout the six-month intervention phase, the researchers called Mr. K monthly and asked him to download his data using the MEMS reader. The researcher then mailed Mr. K. a copy of the MEMS report, along with a monthly gift card. The following week, the researcher called Mr. K. at a previously scheduled time to review the MEMS report, address any MEMS diary entries, and assess the MA score and if any additional solutions needed to be considered.

3.3. Results

Mr. K.'s MA score was 62 % in the screening phase which was below the 85% MA limit, therefore he was eligible to be randomized into the intervention phase of the study. His 3-month screening, 6-month intervention and 6-month maintenance phase MA scores are provided in Figure 3. His mean MA score was 97 % at 6- months and 85 % at 12-months.

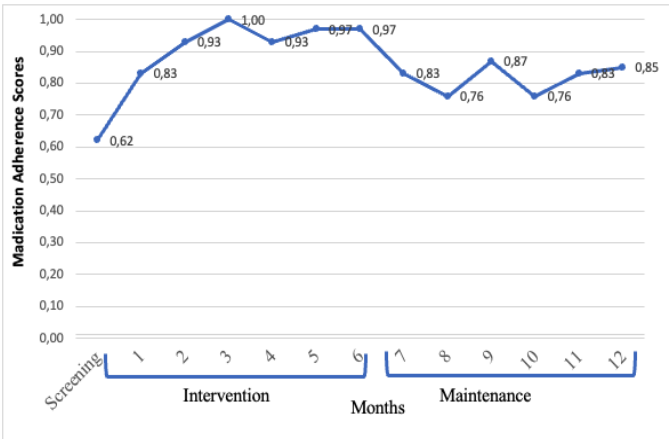

Figure 3. Mr. K's medication adherence scores by month

His life cycles are shown in Figure 2 One of the important issues in Mr. K.'s life routines was that the time to start work was always set at 10:00 but the time to end worked was not set because he worked from home. However, he stated that he always had dinner between 6:00 p.m. and 7:00 p.m. Additionally, Mr. K.'s weekly routines included two days of long online meetings when affected his medication taking time. No changes were determined in his weekend and monthly routines regarding his wake-up and medication intake times.

After reviewing all the data, Mr. K. and the researcher together identified that he could go to the kitchen to take mycophenolate mofetil with water before going to sit in front of the computer in the morning and going to the bathroom in the evening. He kept his immunosuppressive medications in the kitchen, and in the solution proposal, it was decided that they should remain in the kitchen. With this solution proposal, his medication intake was combined with his current daily routine, rather than creating an extra routine for medication intake.

The analysis of Mr. K.'s pre- and post-intervention Quality of Life Scale summary scores demonstrated that his physical health component summary scale mean score increased from 53.18 to 57.61 and his mental health component summary scale mean score increased from 49.16 to 53.15.

4. Discussion

This case study is the first study in which the effect of the SystemCHANGE™ intervention on the medication intake behavior of a Turkish kidney transplant recipient was investigated. Mr. K.'s MA level at baseline was 62%. After analysis of Mr. K.'s daily routines and life cycles, he collaboratively worked with the researcher to implement the solution of changing his medication taking times so that he took his morning dose when he was in the kitchen right before he began work in the morning and he took the evening dose when he was in the kitchen right before he goes to bed. After this change, his MA level immediately increased by 23 % in the first month. At the end of the intervention, his MA was 97 % at the 6th month and 85 % at the 12th month. This result indicates us that the SystemCHANGE™ intervention was effective in increasing MA in this individual. This finding is consistent with Russell et al.'s studies (16,18).

An increase in his MA score from 67 % to 97 % means that the many missed medication doses were almost completely corrected. This also means that Mr. K.'s peak and trough levels of his mycophenolate mofetil were more stable which could reduce the risk of rejection.

In the literature, there are various opinions about the factors that increase the risk of medication non-adherence in kidney transplant recipients. In several studies it is stated that advanced age, being a woman, being single/divorced, having low socioeconomic level (18), being young, being a man, and being married increase the risk of medication non-adherence (4,25). Russell et al.'s (2018) case study whose design is similar to that of our study was conducted with a female individual of advanced age and low education level (18). In our study, the participant was a man, and he was married, highly educated and working. In Turkish culture, it is stated that one of the major risk factors affecting patients' adherence to treatment is male gender (26).

This can be explained by the fact that many men thought that they had lost their role because of cultural reasons and that these roles were fulfilled by other family members. This loss of autonomy may discourage men from perceiving themselves as the "head of the household" which is an important role in the Turkish culture. Another risk factor affecting MA is receiving a transplant from a living donor (4,27). Türkiye ranks first in the world in terms of the number of transplants (per million population=pmp) from living donors (28). In several studies, it has been reported that MA level is low in living-donor transplant patients. In our case, the transplant was from a living donor (his father). Although the participant in Russell et al.'s and our study were completely different from each other in terms of both cultural and risk factors, their MA levels increased after the SystemCHANGE™ intervention. This result indicates that the SystemCHANGE™ intervention is not affected by unchangeable risk factors such as age, sex, culture, and that it is an effective and applicable method even in different geographies and lifestyles. This result is thought to be due to the behavior change paradigm of the SystemCHANGE™ initiative, based on the daily routines and habits of the person. When behaviors are repeated consistently, they become habits (29). Habits have an important place in people's lives and constitute 40% of human life. For this reason, it is thought that in the SystemCHANGE™ initiative, the behavior of patients taking medicines consistently turns into a

habit, and in this way, the habit of taking medicines is formed (30).

Medication non-adherence is a complex and ongoing problem in kidney transplant patients (31). The SystemCHANGE™ moves beyond motivation and intention where interventions have traditionally focused, to instead focus on the redesign of a patient's interpersonal system and daily routines linked to the targeted health behaviors (11). It is important to note that in the maintenance phase, MA remained much higher than at baseline. The SystemCHANGE™ intervention appears to improve behavior and hold the change likely due to the embedding of the change within other routines and habits. In the literature, an intervention targeting individualized behavioral risk factors or a combination of behavioral, educational and emotional changes is stated to improve MA (32,33). The result of our case study, in which the SystemCHANGE™ model was used, is consistent with results in the literature.

Mr. K.'s 12th-month scores for the physical and mental health component summary scales of the SF-36 Quality of Life Scale were clinically significantly higher than were those obtained at the baseline measurement. In the literature, it is emphasized that organ transplant recipients' quality of life is poor, and thus interventional studies should be conducted to improve their quality of life (34,35). Our findings are consistent with other interventional studies that improved quality of life in kidney transplant recipients (36). In a study conducted with liver transplant recipients, individualized educational interventions were determined to increase the patients' quality of life (37).

5. Conclusion and Recommendations

The SystemCHANGE™ intervention was effective in increasing MA and quality of life in this individual. The SystemCHANGE™ intervention resulted in immediate and sustained improvements in MA. The patient experienced a clinically meaningful increase in MA (23%) by improving the timing of doses by linking them to a regularly occurring behavior. This study was conducted with only one person, and the results obtained cannot be generalized. In addition, these findings may be related to individual characteristics, and different results may occur in different individuals.

6. Contribution to the Field

Our case study in which the effect of SystemCHANGE™ intervention on the medication intake behavior of a kidney transplant recipient was investigated is the first study conducted in Turkish culture, and the second case study on this topic in the world literature.

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None

Conflict of interest
The authors declare that there are no conflicts of interest associated with this study.

Authorship Contribution

Concept: YSO, CLR; Design: YSO, CLR; Supervision: YSO, CLR; Funding: YSO; Materials: YSO; Data Collection/Processing: YSO, SY, EAK, BÇ; Analysis/Interpretation: YSO, SY, EAK, BÇ, ÖK, CLR; Literature Review: YSO, SY, EAK, BÇ, ÖK, CLR; Manuscript Writing: YSO, SY, EAK, BÇ, ÖK, CLR; Critical Review: YSO, CLR

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References

1. Pinsky BW, Takemoto SK, Lentine KL, Burroughs TE, Schnitzler MA, Salvalaggio PR. Transplant outcomes and economic costs associated with patient noncompliance to immunosuppression. Am J Transplant. 2009 Nov;9(11):2597-606. doi: 10.1111/j.1600-6143.2009.02798.x.
2. Weng FL, Chandwani S, Kurtyka KM, Zacker C, Chisholm-Burns MA, Demissie K. Prevalence and correlates of medication non-adherence among kidney transplant recipients more than 6 months post-transplant: a cross-sectional study. BMC Nephrol. 2013 Dec 1;14:261. doi: 10.1186/1471-2369-14-261.
3. Dew MA, DiMartini AF, De Vito Dabbs A, Myaskovsky L, Steel J, Unruh M, Switzer GE, Zomak R, Kormos RL, Greenhouse JB. Rates and risk factors for nonadherence to the medical regimen after adult solid organ transplantation. Transplantation. 2007 Apr 15;83(7):858-73. doi: 10.1097/01.tp.0000258599.65257.a6.
4. Belaiche S, Décaudin B, Dharancy S, Noel C, Odou P, Hazzan M. Factors relevant to medication non-adherence in kidney transplant: a systematic review. Int J Clin Pharm. 2017 Jun;39(3):582-593. doi: 10.1007/s11096-017-0436-4.
5. Breu-Dejean N, Driot D, Dupouy J, Lapeyre-Mestre M, Rostaing L. Efficacy of Psychoeducational Intervention on Allograft Function in Kidney Transplant Patients: 10-Year Results of a Prospective Randomized Study. Exp Clin Transplant. 2016 Feb;14(1):38-44.
6. De Bleser L, Matteson M, Dobbels F, Russell C, De Geest S. Interventions to improve medication-adherence after transplantation: a systematic review. Transpl Int. 2009 Aug;22(8):780-97. doi: 10.1111/j.1432-2277.2009.00881.x.
7. Reese PP, Bloom RD, Trofe-Clark J, Mussell A, Leidy D, Levsky S, Zhu J, Yang L, Wang W, Troxel A, Feldman HI, Volpp K. Automated Reminders and Physician Notification to Promote Immunosuppression Adherence Among Kidney Transplant Recipients: A Randomized Trial. Am J Kidney Dis. 2017 Mar;69(3):400-409. doi: 10.1053/j.ajkd.2016.10.017.
8. Easthall C, Song F, Bhattacharya D. A meta-analysis of cognitive-based behaviour change techniques as interventions to improve medication adherence. BMJ Open. 2013 Aug 9;3(8):e002749. doi: 10.1136/bmjopen-2013-002749. Erratum in: BMJ Open. 2014;4(7). doi: 10.1136/bmjopen-2013-002749corr1.
9. Nevins TE, Nickerson PW, Dew MA. Understanding Medication Nonadherence after Kidney Transplant. J Am Soc Nephrol. 2017 Aug;28(8):2290-2301. doi: 10.1681/ASN.2017020216.
10. Nieuwlaat R, Wilczynski N, Navarro T, Hobson N, Jeffery R, Keepanasseril A, Agoritsas T, Mistry N, Iorio A, Jack S, Sivaramalingam B, Iserman E, Mustafa RA, Jedraszewski D, Cotoi C, Haynes RB. Interventions for enhancing medication adherence. Cochrane Database Syst Rev. 2014 Nov 20;2014(11):CD000011. doi: 10.1002/14651858.CD000011.pub4.
11. Russell CL, Ruppar TM, Matteson M. Improving medication adherence: moving from intention and motivation to a personal systems approach. Nurs Clin North Am. 2011 Sep;46(3):271-81, v. doi: 10.1016/j.cnur.2011.05.004. PMID: 21791262.
12. Webel AR, Moore SM, Longenecker CT, Currie J, Horvat Davey C, Perazzo J, Sattar A, Josephson RA. Randomized Controlled Trial of the SystemCHANGE Intervention on Behaviors Related to Cardiovascular Risk in HIV+ Adults. J Acquir Immune Defic Syndr. 2018 May 1;78(1):23-33. doi: 10.1097/QAI.0000000000001635.
13. Wessol JL, Russell CL, Olds KE. A Pilot Randomized Controlled Trial Testing the Feasibility and Acceptability of a SystemCHANGE Intervention to Improve Medication Adherence in Older Adult Stroke Survivors. J Neurosci Nurs. 2019 Oct;51(5):259-265. doi: 10.1097/JNN.0000000000000455. PMID: 31356426.
14. Moore SM, Charvat JM, Andrisin S, Lissemore F, Primm T, Salami I, Farrokh A, SystemCHANGE: Using system improvement for health behavior change. Annals of Behavioral Medicine. 2009 ;37:2078.
15. Russell C, Conn V, Ashbaugh C, Madsen R, Wakefield M, Webb A, Coffey D, Peace L. Taking immunosuppressive medications effectively (TIMELink): a pilot randomized controlled trial in adult

kidney transplant recipients. Clin Transplant. 2011 Nov-Dec;25(6):864-70. doi: 10.1111/j.1399-0012.2010.01358.x.

16. Russell CL, Hathaway D, Remy LM, Aholt D, Clark D, Miller C, Ashbaugh C, Wakefield M, Ye S, Staggs VS, Ellis RJ, Goggin K. Improving medication adherence and outcomes in adult kidney transplant patients using a personal systems approach: SystemCHANGE™ results of the MAGIC randomized clinical trial. Am J Transplant. 2020 Jan;20(1):125-136. doi: 10.1111/ajt.15528.
17. Russell CL, Moore S, Hathaway D, Cheng AL, Chen G, Goggin K. MAGIC Study: Aims, Design and Methods using SystemCHANGE™ to Improve Immunosuppressive Medication Adherence in Adult Kidney Transplant Recipients. BMC Nephrol. 2016 Jul 16;17(1):84. doi: 10.1186/s12882-016-0285-8. PMID: 27421884; PMCID: PMC4947243.
18. Russell CL, Miller C, Remy LM, Wessol JL, Andrews AM, Aholt D, Clark D, Hardinger K, O'Brien T, Hathaway D, Goggin K. Improvement of Immunosuppressive Medication Adherence Using a SystemCHANGE Intervention: Case Study of an Older Adult Kidney Transplant Recipient. Nephrol Nurs J. 2018 Mar-Apr;45(2):171-223.
19. Folstein MF, Folstein SE, McHugh PR. "Mini-mental state". A practical method for grading the cognitive state of patients for the clinician. J Psychiatr Res. 1975 Nov;12(3):189-98. doi: 10.1016/0022-3956(75)90026-6. PMID: 1202204.
20. Wagner GJ, Ghosh-Dastidar B. Electronic monitoring: adherence assessment or intervention? HIV Clin Trials. 2002 Jan-Feb;3(1):45-51. doi: 10.1310/XGXU-FUDK-A9QT-MPTF. PMID: 11819185.
21. Schäfer-Keller P, Steiger J, Bock A, Denhaerynck K, De Geest S. Diagnostic accuracy of measurement methods to assess non-adherence to immunosuppressive drugs in kidney transplant recipients. Am J Transplant. 2008 Mar;8(3):616-26. doi: 10.1111/j.1600-6143.2007.02127.x.
22. Ware JE Jr, Sherbourne CD. The MOS 36-item short-form health survey (SF-36). I. Conceptual framework and item selection. Med Care. 1992 Jun;30(6):473-83. PMID: 1593914.
23. Kocyigit, H. Reliability and validity of the Turkish version of short form-36 (SF-36): a study in a group of patients will rheumatic diseases. Turkish Journal of Drugs and Therapy. 1999;12: 102-106.
24. Ware JE. SF-36 health survey update. Spine. 2000;25(24):3130–3139. https://doi.org/10.1097/00007632-200012150-00008
25. Boucquemont J, Pai ALH, Dharnidharka VR, Hebert D, Zelikovsky N, Amaral S, Furth SL, Foster BJ. Association between day of the week and medication adherence among adolescent and young adult kidney transplant recipients. Am J Transplant. 2020 Jan;20(1):274-281. doi: 10.1111/ajt.15590.
26. Ozen N, Cinar FI, Askin D, Mut D, Turker T. Nonadherence in Hemodialysis Patients and Related Factors: A Multicenter Study. J Nurs Res. 2019 Aug;27(4):e36. doi: 10.1097/jnr.0000000000000309. PMID: 30720548; PMCID: PMC6641098.
27. Griva K, Davenport A, Harrison M, Newman SP. Non-adherence to immunosuppressive medications in kidney transplantation: intent vs. forgetfulness and clinical markers of medication intake. Ann Behav Med. 2012 Aug;44(1):85-93. doi: 10.1007/s12160-012-9359-4.
28. International Registiry of Organ Donation and Transplantation (IRODaT), 2019 https://www.irodat.org/?p=publications
29. Valenzuela-Beltrán M, Andrade ÁG, Stawarz K, Rodríguez MD. A Participatory Sensing Study to Understand the Problems Older Adults Faced in Developing Medication-Taking Habits. Healthcare (Basel). 2022 Jul 2;10(7):1238. doi: 10.3390/healthcare10071238.
30. Duhigg, C. The power of habit: Why we do what we do in life and business. 2012; 34(10): Random House.
31. Scheel JF, Schieber K, Reber S, Stoessel L, Waldmann E, Jank S, Eckardt KU, Grundmann F, Vitinius F, de Zwaan M, Bertram A, Erim Y. Psychosocial Variables Associated with Immunosuppressive Medication Non-Adherence after Renal Transplantation. Front Psychiatry. 2018 Feb 15;9:23. doi: 10.3389/fpsyt.2018.00023.
32. Low JK, Williams A, Manias E, Crawford K. Interventions to improve medication adherence in adult kidney transplant recipients: a systematic review. Nephrol Dial Transplant. 2015 May;30(5):752-61. doi: 10.1093/ndt/gfu204.
33. Mathes T, Großpietsch K, Neugebauer EAM, Pieper D. Interventions to increase adherence in patients taking immunosuppressive drugs after kidney transplantation: a systematic review of controlled trials. Syst Rev. 2017 Nov 29;6(1):236. doi: 10.1186/s13643-017-0633-1.
34. Muduma G, Shupo FC, Dam S, Hawken NA, Aballéa S, Odeyemi I, Toumi M. Patient survey to identify reasons for non-adherence and elicitation of quality of life concepts associated with immunosuppressant therapy in kidney transplant recipients. Patient Prefer Adherence. 2016 Jan 12;10:27-36. doi: 10.2147/PPA.S96086.
35. Zhao SM, Dong FF, Qiu HZ, Li D. Quality of Life, Adherence Behavior, and Social Support Among Renal Transplant Recipients in China: A Descriptive Correlational Study. Transplant Proc. 2018 Dec;50(10):3329-3337. doi: 10.1016/j.transproceed.2018.05.026.
36. Mansouri P, Sayari R, Dehghani Z, Naimi Hosseini F. Comparison of the Effect of Multimedia and Booklet Methods on Quality of Life of Kidney Transplant Patients: A Randomized Clinical Trial Study. Int J Community Based Nurs Midwifery. 2020 Jan;8(1):12-22. doi: 10.30476/IJCBNM.2019.73958.0.
37. Iseri Ö, Karayurt O, Yilmaz S. The Effects of Individualized Education on Depression, Anxiety, Quality of Life in Liver Transplant Recipients. International Journal of Caring Sciences.2021; 14(3):1917-1930.
38. Moradi O, Karimzadeh I, Davani-Davari D, Shafiekhani M, Sagheb MM. Pattern and associated factors of adherence to immunosuppressive medications in kidney transplant recipients at a referral center in Iran. Patient Prefer Adherence. 2019 May 8;13:729-738. doi: 10.2147/PPA.S198967.