


# Telemedicine in monitoring pediatric LT patients before and during COVID-19 pandemic

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## Abstract

**Background:** The delivery of healthcare services by telemedicine decreases costs of traveling for patients, is less time-consuming, and most importantly permits the connection between highly skilled specialists and patients. However, whether the use of telemedicine (text messaging) for LT patients was affected by the COVID-19 pandemic is unknown.

**Methods:** We collected data (following consent from patients and parents) from 57 patients (33 male/24 female) with a median age of 47 (IQR: 9–91) months, whom we followed up with text messaging between September 2019 and September 2020, spanning the 6 months prior to COVID-19 and during this period.

**Results:** In total, 723 text message mediated consultations occurred during this period, henceforth simply referred to as “messages.” Three hundred and twenty-eight (45%) messages occurred during the 6 months up to the start of the pandemic. Following the COVID-19 outbreak, the number of messages increased to 395 (55%). The three most common reasons of messaging were post-liver-LT follow-up messages ( $n = 215/723$ , 29.7%), consultations for drug use ( $n = 157/723$ , 21.7%), and medication prescriptions ( $n = 113/723$ , 15.6%). Protocol biopsy discussions ( $n = 33/723$ , 4.6%) and fever ( $n = 27/723$ , 3.7%) were among others (vaccination, rash, diarrhea, cough, fatigue, acne). During the COVID-19 outbreak, only post-LT follow-up messages increased significantly to 132/395 (33%) from 83/328 (25%) ( $p$ -value: .02).

**Conclusions:** We found that the pandemic resulted in an increase in the total number of text message mediated consultations and specifically for the use of post-LT follow-up. Messaging was effective for post-LT follow-ups and all patients were at least satisfied.

## KEYWORDS

children, immunosuppression, SARS-CoV-2, solid-organ transplantation, telehealth, telemedicine

## 1 | INTRODUCTION

LT is a major intervention rendering a life-long follow-up incumbent. However, due to the patients living at distant places and outbreaks we are currently experiencing, the follow-ups of transplantation

patients are delayed. COVID-19 outbreak was declared as a pandemic by the WHO on March 11, 2020.<sup>1</sup> The Turkish Ministry of Health reported the first case on the same day that the WHO confirmed COVID-19 as a pandemic.<sup>2</sup> For several months, the government implemented the cessation of all elective healthcare visits and

surgeries. However, later on, COVID-19 and other diseases were managed in parallel. Yet, patients are reluctant to go to a hospital due to the high risk of infection.

The global outbreak caused by SARS-CoV-2 infection has challenged the healthcare system globally affecting (suspended or reduced) LT clinic visits and transplantations.<sup>3-6</sup> The overwhelmed healthcare system has tried to replace in-person visits with telemedicine applications like video-conferencing, voice calls, and messages to prevent the spread of infection among patients and healthcare workers.<sup>7,8</sup> This strategy of telehealth has also been applied in solid-organ transplantation clinics.<sup>4,5,9-11</sup> In a study done in Europe, 40% of the 18 pediatric transplantation centers had chosen to use telemedicine for outpatient visits during the pandemic.<sup>4</sup> In the United States, 61 of 83 solid-organ transplantation centers had changed their in-person visits to telemedicine visits due to COVID-19.<sup>5</sup> Another study reported the rise in the number of liver and intestinal transplantation centers implementing telemedicine, active in the United Network for Organ Sharing from February 2019 to April 2020.<sup>9</sup>

There are several steps in LT in which telemedicine could be implemented in such as triage of patients, management of patients with chronic liver disease, post-transplantation care, and follow-ups of patients.<sup>12</sup> Although organ transplant patients are not considered as a confirmed high-risk population for the development of severe Coronavirus disease,<sup>13</sup> the healthcare providers<sup>5</sup> and immunosuppressed patients are afraid to attend in-person visits.<sup>14</sup> Therefore, telemedicine rises in popularity for post-transplantation care visits. Firstly, this study aimed to explore whether the COVID-19 pandemic has changed the frequency of telemedicine (solely via text messages in this study) as it was already in place prior to the pandemic. Secondly, we investigated whether the use of telemedicine in a LT clinic has changed the post-transplantation care of patients owing to the COVID-19 pandemic. To clarify, the term telemedicine in our study refers only to consultations taking place via text messages. To that end, the words "text messages" or "text messaging" are employed to specifically denote this type of telemedicine to undertake the consultations.

## 2 | METHODOLOGY

At Koç University Hospital, telemedicine has been used for pediatric gastroenterology and LT patient clinic prior to the outbreak of the pandemic as the patient population is rather diverse with provenances reaching the far corners of the country and beyond. The clinic has been implementing telemedicine applications like video and voice calls or text messages for patients that could not come to the hospital, before the COVID-19 era. These applications were mostly offered to patients that reside in different cities and countries. The consultations have been carried out by mobile phone, either personal or assigned to the clinic, via text messages or calls.

The study was approved by Koç University Committee for Human Research (2020.381.IRB2.105). The signed informed consent forms were collected in two ways. The patients that visited the clinics or were hospitalized during the recruitment process of

the study were given both a verbal explanation of the study and a written informed consent form. Other patients that did not have an appointment at the time of recruitment were reached and informed by phone call, and the consent form was sent by texting platforms and signed copies were returned likewise. In our clinic, a total of 264 patients are being followed for post-LT care. Out of the 264 patients, 156 (59%) patients were using telemedicine (phone call, video call, texts messages). All 156 patients provided consent and were included. Ninety-two patients opted to have a phone/video call as the main consultation method. Therefore, text messaging was rather an exception in this group. These patients were excluded because of a mixture of telemedicine (text and video call) used and because the personal phone of the physician was used in which conversations were not recorded. To that end, the total number of patients solely followed with text messages and had LT was 64 (24%). However, 7 patients were excluded due to the death ( $n = 4$ ) of the patient during the time of the observation or records of the patients could not be achieved ( $n = 3$ ) because the messages were erroneously deleted. The data on the use of text messaging was collected, from hard copy records of text message consultations, retrospectively starting from November 2, 2020. The text messages conveyed between September 13, 2019, and September 6, 2020, were analyzed and categorized into two groups for comparison. Eleven March was accepted as the first day of the COVID-19 period since the declaration of the pandemic and the first case in Turkey was reported on this day. The management plan for the complaints was also categorized into three groups as outpatient, inpatient, or telemedicine care via text messaging. Specifically, outpatient care indicates that the patient is referred to an emergency department or a specialty outpatient clinic such as our transplantation clinic, dermatology, etc. The text-messaging category includes complaints handled without seeking any healthcare center admission, and the inpatient category implies patients that were hospitalized. The text-messaging satisfaction was evaluated, throughout the study period as per standard, by 2 questions using 5-point Likert scale responses (Table 3).

## 2.1 | Statistical analysis

### 2.1.1 | Statistics

Demographic and clinical characteristics of the patients were summarized using frequency and percentage for categorical variables, and median (IQR) for continuous variables, in case of non-normality. All analyses were performed using GraphPad 5. Categorical values were compared using Fisher's exact test. Alpha was set as 0.05 for statistical significance.

## 3 | RESULTS

After exclusions, 57 patients (33 male) were eligible for the study with a median age of 47 months (IQR: 9-91) as depicted in (Table 1).

The primary reason for LT was cholestatic liver disease followed by metabolic disorders and idiopathic hepatitis (Table 1). The total number of consultations taking place via text messages was 723, and 328 (45%) of these occurred during the pre-COVID-19 era. The most common reasons of messaging (encounters/consultations) were follow-up discussion ( $n = 215$ , 29.7%), consultation on drug use ( $n = 157$ , 21.7%), medicine prescription ( $n = 113$ , 15.6%), protocol biopsy discussions ( $n = 33$ , 4.6%), fever ( $n = 27$ , 3.7%), consultation on vaccination schedule ( $n = 19$ , 2.6%), and nausea/vomiting ( $n = 15$ , 2.1%). The other reasons included surgical site complication, abdominal pain, rash, diarrhea, gastrointestinal bleeding, cough, rhinorrhea, sore throat, fatigue, acne, consultation on complementary food, swelling of the eye, jaundice, loss of appetite, and failure to thrive.

The number of consultations via text messaging increased during COVID-19 pandemic from 328 to 395. When considering the reasons for text messaging, we found that almost all demonstrated non-significant changes. Only the ratio of text messaging for follow-up discussion increased, during the COVID-19 period, significantly from 25.30% to 33.42% ( $p = .02$ ) of all messaging shown in Table 2. There was also a trend of a decrease in the ratio of text messages for rhinorrhea, from 1.52% to 0.25%, and surgical site complications, from 2.74% to 1.01% ( $p = .09$  for both).

The complaints of patients were mostly manageable without hospital admissions. Of all complaints, 77.2% ( $n = 558$ ) were resolved by text messages. The resolution of the complaints by text messaging included digital prescriptions, advice on medication use, nutrition, vaccination schedule, and reassurance. The rate of cases resolved with text messaging was 81.0% ( $n = 320$ ) during the pandemic, whereas this was only 72.5% ( $n = 238$ ) before the pandemic, which was significantly different ( $p = .007$ ). Thirteen percent ( $n = 94$ ) of the cases required a visit to a healthcare center as an outpatient. The ratio of referrals to an outpatient center was 14.6% ( $n = 48$ ) in pre-pandemic era and 11.7% ( $n = 46$ ) during the pandemic ( $p = .26$ ). Furthermore, the ratio of hospitalizations was 9.8% ( $n = 71$ ) for the

entire period. The ratio of hospitalization before the outbreak was 12.8% ( $n = 42$ ), while it was 7.3% ( $n = 29$ ) ( $p = .02$ ) in the course of the outbreak. When the type of resolution (by text messaging, inpatient or outpatient) was observed per reason of messaging, no changes were observed between the pre- and post-COVID-19 era (data not shown).

Furthermore, throughout the year we also queried how telemedicine was perceived by the patients/parents by two questions with 5-point Likert scale response values (Table 3). All 57 participants were at least satisfied, score 4 or 5, with text-messaging-mediated consultations.

## 4 | DISCUSSION

Telemedicine or telehealth, used interchangeably, means delivery of health services with telecommunication. Telemedicine” is “healing at a distance.” WHO has defined it as “the delivery of healthcare services, where distance is a critical factor.<sup>15</sup> An advantage of telemedicine is that it has been shown to decrease the costs of traveling for patients and is much less time-consuming.<sup>16</sup> Based on our survey, all participants and/or their parents (100%) were satisfied with text-messaging-mediated consultations and conveyed their satisfaction with the fact that all clinical needs were met by the physician through telemedicine. However, telemedicine in our clinic was an initiative taken by the physician long before the pandemic. Hence, this was at the time not a hospital policy and there was no system to charge patients for the teleconsultations. In addition to the professional care, the free-of-charge consultations are likely an important reason why all patients perceived text messaging as at least satisfactory.

Prior to the pandemic, telemedicine was more frequently applied between peripheral primary healthcare providers and specialists located at specialized, academic institutions. Specialties currently using telemedicine are pediatric dermatology, psychiatry and surgery among others.<sup>17,18</sup> Clinical data acquired at the primary institution can be readily examined by specialists. Although the accessibility of telemedicine was conceived to be limited by the lack of regulations and reluctance in replacing current practice, the new outbreak of COVID-19 likely will accelerate its acceptance by healthcare providers, as well as patients.<sup>19</sup> By making it more convenient for patients to obtain care, telemedicine has also increased access for those who might not otherwise be able to receive care or be seen at a practice. Before the COVID-19 pandemic, patients who may have benefited from telemedicine included those who cannot financially afford, elderly, or disabled patients or those who simply lived too far away to travel for an in-person visit. However, after this pandemic, it is conceivable that telemedicine will be used in a much broader patient population. In our cohort, even prior to the pandemic, the use of telemedicine (text/video call) was necessary to take care of patients living afar as specialized LT centers for pediatrics are rare. Following the pandemic, it permitted us not to lose contact with the patients. In this study, our findings

TABLE 1 Demographic data

Parameters	
Number of patients	57
Gender (female/male)	24/33
Age median (IQR)	47 (9–91)
Primary liver disease:	
Autoimmune	1
Cholestatic	22
Metabolic	14
Cryptogenic	13
Malignancy	2
Hydrodynamic problems (Budd Chiari)	1
Acute liver failure	4
PELD/MELD score (IQR)	16.50 (11.75–20.00)

Abbreviations: MELD, model for end-stage liver disease; PELD, pediatric end-stage liver disease.

Parameters	(%) pre-COVID-19	(%) post-COVID-19	p-value
Total messages	328	395	na
Fever	12 (3.66%)	15 (3.80)	1
Drug use	74 (22.56%)	83 (21.01%)	.65
Prescription	53 (16.16%)	60 (15.19%)	.75
Follow-up discussion	83 (25.30%)	132 (33.42%)	.02
Liver biopsy related	13 (3.96%)	20 (5.06%)	.59
Vaccination	6 (1.83%)	13 (3.29%)	.25
Surgical site related	9 (2.74%)	4 (1.01%)	.09
Bleeding	6 (1.83%)	2 (0.51%)	.15
Abdominal pain	6 (1.83%)	5 (1.27%)	.55
Nausea/vomiting	6 (1.83%)	9 (2.28%)	.79
Cough	3 (0.91%)	3 (0.76%)	1
Diarrhea	3 (0.91%)	5 (1.27%)	.73
Sore throat	4 (1.22%)	1 (0.25%)	.18
Rashes	3 (0.91%)	7 (1.77%)	.36
Rhinorrhea	5 (1.52%)	1 (0.25%)	.09
Swelling of the eye	1 (0.30%)	3 (0.76%)	.63
Jaundice	2 (0.61%)	1 (0.25%)	1
Others (MRI scan, referrals, being irritated, itching, loss of appetite, failure to thrive, fatigue, complementary food, acne, anuria, bone pain, headache, confusion, knee pain, earache, disease report, exercise, oral aphthae, sneezing, unusual stool, constipation, and diet)	39 (9.45%)	31 (4.81%)	.07

TABLE 2 Number, proportion and reason of messaging

Abbreviation: MRI: magnetic resonance imaging.

TABLE 3 Questionnaire for satisfaction

	1 Very un satisfying	2 Un satisfying	3 Moderately satisfying	4 Satisfying	5 Very satisfying
My physician was able to address all my clinical needs to my satisfaction					
I was satisfied with my telehealth visit					

demonstrated an increase in the use of text messaging during the pandemic. Also, we demonstrated that owing to the pandemic the total number of resolutions based on text messaging (without requiring the patient to go to a hospital) was increased. This could be explained potentially by the fact the pandemic-related travel restrictions made the healthcare provider less accessible but more likely the patients/parents realized that going to the hospital is not necessary to receive appropriate care. However, more importantly, the frequency and total numbers of actual hospitalizations decreased significantly, during the pandemic. Firstly, the fact that patients were further down in the post-LT period likely explains why fewer hospitalizations were required. This decrease would be then independent of the use of text messaging. What potentially could be linked with the use of text messaging is that LT patients

were not required to travel to the hospital, necessitating telecommunication. The number of messages for the listed reasons did not change significantly during the pandemic apart from the follow-up messaging.

Unequivocally, the pandemic changed the behavior of patients; they are less-inclined to see a physician at a hospital. As this may not always be appropriate for the patient, it poses a financial burden for private-sector healthcare providers. Right up to the pandemic but also thereafter, telemedicine was merely controlled, not a standard hospital policy and foremost not charged by the institution. Now, telemedicine consultations via phone calls are logged in into the appointment system and patients are charged for this care. The future will demonstrate as to whether the frequency and or satisfaction of charged telemedicine will alter.

Another limitation is the fact that our survey of satisfaction did not include information about the validation/reliability. Even more, as the survey was done by a member of the same care team, the patients/parents may have been reluctant to be more critical. In future, satisfaction surveys could be performed by institutions independent from healthcare providers.

Lastly, the language could be a barrier between care provider and receiver. By hospital policy, multilingual personnel is present to help when required. If not, there are interpreters who can assist; however, this needs to be organized and is not free-of-charge.

In summary, this type of study might help in the establishment of novel and appropriate regulatory policies and investments in telemedicine applications as it benefits patients living remote to specialized healthcare providers, reducing (i) the necessity of traveling long distances and (ii) travel expenses. Equally, healthcare providers may benefit, as well as they can perform more consultations as they can see more patients but also because they can follow-up patients more frequently. This may also create an alternative income source for the hospitals. However, telemedicine cannot replace current medical practice as physical examinations and interventions require the patient to be in a hospital.

#### CONFLICT OF INTEREST

All authors declare that there is no conflict of interest.

#### AUTHOR CONTRIBUTION

AC and YM envisaged and designed the project. MMN, YM, and AC wrote the manuscript. MMN, MO, and YM analyzed the data. MMN, MO, and AC recruited patients. All authors critically read and consented with the final version of the manuscript.

#### DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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