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ORIGINAL ARTICLE

Impact of coronavirus disease-2019 on pediatric nephrology practice and education: an ESPN survey

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Abstract

Background Coronavirus disease-2019 (COVID-19) has been challenging for patients and medical staff. Radical changes have been needed to prevent disruptions in patient care and medical education.

Methods A web-based survey was sent to European Society for Pediatric Nephrology (ESPN) members via the ESPN mailing list to evaluate the effects of the COVID-19 pandemic on delivery of pediatric nephrology (PN) care and educational activities. There were ten questions with subheadings.

Results Seventy-six centers from 24 countries completed the survey. The time period was between the beginning of the pandemic and May 30, 2020. The number of patients admitted in PN wards and outpatient clinics were significantly decreased (2.2 and 4.5 times, respectively). Telemedicine tools, electronic prescriptions, online applications for off-label drugs, and remote access to laboratory/imaging results were used in almost half of the centers. Despite staff training and protective measures, 33% of centers reported COVID-19 infected staff, and 29% infected patients. Difficulties in receiving pharmaceuticals were reported in 25% of centers. Sixty percent of centers suspended living-related kidney transplantation, and one-third deceased-donor kidney transplantation. Hands-on education was suspended in 91% of medical schools, and face-to-face teaching was replaced by online systems in 85%. Multidisciplinary training in PN was affected in 54% of the centers.

Conclusions This survey showed a sharp decline in patient admissions and a significant decrease in kidney transplantation. Telemedicine and online teaching became essential tools, requiring integration into the current system. The prolonged and fluctuating course of the pandemic may pose additional challenges necessitating urgent and rational solutions.

Keywords COVID-19 · Children · Pediatric nephrology · Telemedicine · Education

Introduction

Coronavirus disease-2019 (COVID-19), caused by novel severe acute respiratory syndrome coronavirus-2, was first described in Wuhan, China [1]. Following its rapid spread, the World Health Organization announced it as a pandemic on March 11, 2020 [2]. The first case in Europe was reported from France in January [3] and was rapidly followed by cases in other countries. Many restrictions, policies, and information were imposed and announced by governments and health authorities worldwide to decrease transmission [4–6]. This new era forced medical practitioners to work under quarantine and on shifts. Patients and doctors were encouraged to communicate through remote communication tools and medical practice changed with an increasing trend toward telemedicine [7–9]. Telehealth and teleconsultation had already become increasingly popular in some areas of medicine [10–14].

Pediatric patients have comprised approximately 1–2% of all COVID-19 cases and seem to have a milder course. Most children present clinical symptoms ranging from asymptomatic to mild/moderate illness [15–17]. Contrary to adult experience [18], based on limited data, PN patients, i.e., hemodialysis (HD) and kidney transplantation patients, and those on immunosuppressive treatment were reported to have a lower risk. In addition, these children did not have an increased risk compared to healthy pediatric populations [19, 20].

For a full list of collaborators, see the Appendix

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The impact of the COVID-19 pandemic on clinical care and training has not been comprehensively assessed. It affected undergraduate and postgraduate medical training. Face-to-face medical education largely shifted to online education in many settings [7, 21]. While awaiting effective treatment or ideal vaccination coverage, the massive impact of the pandemic on patient care and education required rapid implementation of hybrid care and teaching strategies. This study aimed to determine how pediatric nephrologists were affected by the COVID-19 pandemic regarding medical practice, teaching, learning, and research activities.

Methods

We used a web-based survey to investigate the new adaptation measures of PN centers during the COVID-19 pandemic. The survey link was sent to pediatric nephrologists via the ESPN mailing list, and voluntary participation was requested. Non-European countries on the ESPN mailing list also answered the survey, and they were included in the study. One colleague from each center was asked to answer the survey to prevent duplication, and thus, we were unable to calculate response rates.

The survey had ten questions consisting of diverse topics, including COVID-19-specific structural/organizational changes and work sharing in the unit, screening/protection strategies, changes in patient admission and care, use of telemedicine tools, and changes in medical education, PN training, and research activities. On PN patient care and admission, detailed questions were asked about patient populations postulated to be at risk, i.e., those undergoing dialysis and those with kidney transplantation and requiring immunosuppressive medication. Questions regarding the use of telemedicine tools and alterations in educational and research activities were also included in the survey. The questionnaire accompanies this report as Supplementary Material.

The selected time period for the study was between the beginning of the pandemic (slightly different per country) and May 30, 2020. The number of patients admitted during this period was compared to the same time period in 2019. Permission was obtained from the Ministry of Health in Turkey (No: T13-37–09), and the study was approved by Gazi University Ethical Committee (No: E.60214).

Results

Seventy-six centers from 24 countries were included in this study: Belgium (3 centers), Czech Republic (2 centers), Denmark, France (2 centers), Germany (6 centers), Indonesia, Italy (3 centers), Lithuania, Macedonia, Malta (2 centers), Netherlands (4 centers), Norway, Pakistan, Poland (3 centers), Portugal (5 centers), Romania, Greece (2 centers), Russia (3 centers), Slovenia, South Africa, Spain, Turkey (27 centers), UK (3 centers), and Ukraine.

General organizational changes

The majority (88%) of centers were accepting COVID-19 patients. Screening and protection measures were applied in most of them. Reorganizational measures, particularly in HD centers, and task sharing were other implementations meant to decrease transmission and preserve the workforce (Table 1).

Patient care

A significant decrease was noted in the number of outpatients and hospitalized patients. The average number of patients in the outpatient clinics during the study period decreased by 78% compared to the same time interval of the preceding year (274 vs. 1,235). A less prominent decrease (55%) was seen in hospitalized patients (an average of 41 vs. 90 hospitalizations during the pandemic and at the same time in 2019, respectively) (Fig. 1). Forty-two percent of the centers called all the dialysis and transplant patients and those on immunosuppressants for symptom screening regularly. Home HD was started in one center, and the Claria sharesource system, a remote monitoring system for PD, was implemented in five centers during the pandemic.

Despite all these preventative measures to decrease transmission, 29% of the centers had COVID-19-positive patients on follow-up, including general nephrology, dialysis and post-transplant patients. Most were asymptomatic or mildly symptomatic, and all fully recovered.

None of the centers discontinued ACEI therapy and very few centers (12%) stopped immunosuppressive drugs. Discontinuation of living-related donor kidney transplantation and deceased donor kidney transplantation was reported in 60% and 34% of the centers, respectively (Table 1).

Remote monitoring tools

Transition to telehealth was applied in 55% of centers for monitoring and managing the disease (i.e., patients were asked to measure their blood pressure, body weight, and urine volume and examine themselves if they had edema or other signs). Telephone, e-mail, and telephone + WhatsApp texts were the most preferentially utilized remote monitoring tools and were followed by visual calls (Fig. 2). There were additional means for remote access to facilitate patient care (Table 2).

Table.1 Organization of pediatric nephrology settings during the pandemic

General measures	*n**	%**		*n**	%**
Centers accepting COVID-19 patients	67	88	Staff screening for COVID-19	50	65
Staff training for COVID-19 protection	45	79	Patient screening for COVID-19	56	73
Easy access to personal protective equipment	36	63	Having COVID-19-infected staff	19	33
Pediatric nephrology setting organization					
Decrease in pediatric nephrology bed capacity	28	36	Zero visitors or chaperones, except for infants	12	15
Reorganizing HD units for COVID-19 (different teams/ separate rooms-time slots, etc.)	42	55	Cancelation of appointments by patients	63	83
Private transportation to HD sessions	28	49	Cancelation of appointments by medical staff	57	75
Task sharing					
Removal of senior faculty members from on-call roster	21	27	1/2 decrease in actively working nephrologists	22	38
Consultants worked only in nephrology departments***	39	68	1/3 decrease in actively working nephrologists	10	17
Fellows worked only in nephrology departments***	25	44	One team responsible for all patients (inpatient/ outpatient)	39	51
Patient care					
Phone calls for patients before each HD session for symptom screening	28	37	Discontinuation of conventional/biologic immunosupressives	9	12
Regular calls for specific patient groups (patients on kidney replacement therapy, and those on immunosuppression)	32	42	Discontinuation of living-related kidney transplantation	46	60
Discontinuation of treatment with ACEI	None		Discontinuation of deceased donor kidney transplantation	26	34

*Number of centers, **Percentage of centers, ***Not working in COVID clinics

Changes in educational and research activities

Medical education

Routine medical student training came to a standstill in most of the centers (91%). Hospital teaching opportunities such as elective surgery, clinics, and academic meetings were canceled or restricted in 84% of centers. In 85% of centers, there has been a significant shift to online and video-enabled classes. Clinical courses like clinical skills teaching were moved online in 43% of the centers. In 46% of the centers, faculty members were trained on online teaching. Live e-lectures with active student participation and recorded e-lectures were 46% and 39%, respectively. Forty-two percent of the instructers or faculty staff had no

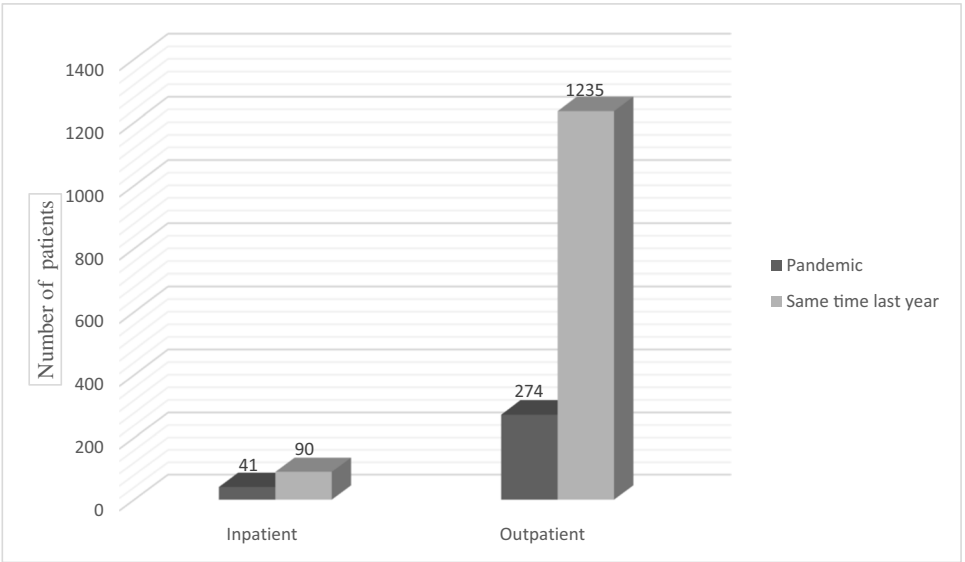

Fig. 1 Changes in the average number of pediatric nephrology patients admitted during the COVID-19 pandemic* and the same time in 2019 (*the time period from the beginning of the pandemic to May 30, 2020)

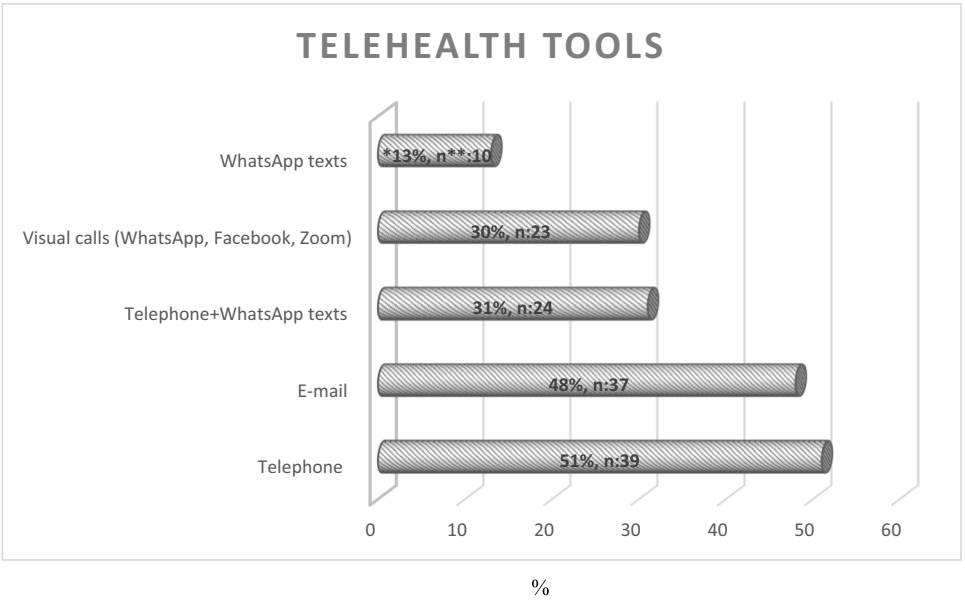

Fig. 2 Telehealth tools used in pediatric nephrology settings during the COVID-19 pandemic. *Percentage of centers, **number of centers

Table.2 Additional settings in healthcare

General measures	*n**	%**
Remote access to sign medical reports, reach laboratory test results, and radiological images outside of the hospital	34	44
Adaptations in medical authorities' and insurance companies' systems to prevent delays in medical supplies (online applications for off-label drugs, drug supplies with e-prescriptions)	37	49
No problems with any drug supplies	53	70
Difficulties in receiving pharmaceuticals and other health-related products	19	25
Patient or parent complaints related to the new health care system	20	26
Physicians received telehealth consultation fee by payer organizations	15	20
Extra payment during the pandemic	39	51

*Number of centers, **Percentage of centers

difficulty giving online lectures, 38% requested technical support, and 35% were not satisfied with online medical education. Only 47% of the centers collected feedback from the students, and it was reported that this novel online education system was well accepted by students 65% of the centers.

Pediatric Nephrology Fellow training

Education of PN fellows was interrupted in 38% of the centers. Fifty-four percent of the centers reported that the PN unit's regular pathology, histology, urology, radiology, and research meetings were canceled, and in 37% of centers, meetings were organized online. However, consultant-led (one-on-one) activities were continued in half (55%) of the centers and clinical visits in all centers with social distancing.

Research activities

Only three centers reported that there was no impact by the pandemic on their research activities, and 38% stated that it was a useful time period for pursuing research activities. Sixty percent of the centers stated that all clinical trials or clinical research activities were suspended, and 43% faced problems in ongoing research activities. One-third of the centers commenced or were involved in new research projects involving COVID-19, and 14% were enrolled in new research projects not related to COVID-19 during this period. Ethical committees were active in 58% of the centers.

Discussion

The online survey demonstrated that the COVID-19 pandemic substantially disrupted patient care, which was more pronounced in kidney transplantation, and medical education in PN centers. However, many centers rapidly took action to find solutions and reorganized their in- and outpatient clinics and staff task sharing to decrease risk and disease transmission. In addition, simple telemedicine tools and

online education were primarily used to prevent disruptions in patient care and educational activities.

Our survey provided a snapshot of early adaptations to the pandemic. Shortage of personal protective equipment was a problem in 37% of the centers at the beginning of the pandemic. In one-third of the centers, there were infected staff, most commonly physicians and nurses, despite staff training. This was an alarming finding in the absence of any effective treatment or vaccine at that time. Working in shifts to decrease healthcare staff burnout and removal of seniors from on-call duties might have caused a shortage of personnel but might also have reduced the risk of transmission among staff.

In order to provide sustained medical care to patients, local medical authorities and insurance companies accepted online applications in half of the centers to prevent delays, while one-quarter of centers reported difficulties in obtaining pharmaceuticals and other health-related products. Almost two-thirds (60%) of the centers suspended living-related kidney transplantation and one-third (34%) deceased kidney transplantation. This result is almost in line with two earlier European surveys; one showed discontinuation of living-related kidney transplantation in 54% and deceased donor kidney transplantation in 15% of the centers [22]; the other reported a 25–75% reduction in usual solid organ transplant (SOT) activities in 67% of the centers [23]. Similarly, a recent paper reported a 29% decrease in pediatric SOT during the pandemic [24]. In the long term, this will definitely lead to longer transplant waiting lists and related complications. When considering continuing or suspending kidney transplantation, there needs to be a balance between the benefit of transplantation for patients, individually, and the risks of nosocomial COVID-19 spread and resource utilization. Massie et al. developed a tool using machine learning to determine the benefit versus harm of SOT and found that, in 72% of simulated scenarios, immediate transplantation provided a survival benefit to deferring transplantation and remaining on the waitlist [25]. This tool may be used by centers to individualize transplantation decisions and to help resume kidney transplantation under strict precautions.

As there is no evidence showing a more severe COVID-19 course in children on immunosuppression [26] and COVID-19-infected transplant patients had a similar course as immunocompetent children [27], there is no reason to postpone lifesaving treatments like transplantation [28]. Therefore, it is suggested that transplant programs should continue their activities during the COVID-19 pandemic with specific case selection and accurate pretransplant screening methods (i.e., PCR or antibody test, or spiral chest CT), while following strict protective protocols [24].

Twenty-nine percent of our PN centers reported having COVID-19-positive children with full recovery, parallel to previous reports that PN patients, even those on kidney replacement therapy or immunosuppressive treatment, experience a milder course than adults [26, 29]. It is also hypothesized that immunosuppression might positively affect the hyper-responsiveness of the immune system, which is pronounced in the COVID-19 course [30]. In line with this, in our study, 12% of the centers advised stopping immunosuppressive treatments. Nevertheless, strict precautions and appropriate screening should be applied [24] and every patient should be evaluated individually.

In-center HD patients may represent a high-risk group because of a lack of private transportation and isolated rooms, and being in close contact with other patients and HD staff [20, 31]. Private transportation was accessible in 49% of the centers in our study. Thus, transitioning patients from in-center HD to home dialysis modalities, such as home HD or PD with a remote control system, can also be considered.

The striking decrease in patient admissions was encouraged by medical staff in many centers, while parents more often canceled their appointments due to their concerns about transmission. Postponing non-urgent appointments at the beginning of the pandemic was an effective method. Instead of face-to-face visits, telemedicine was rapidly introduced into medical practice. Most centers have started using this tool to communicate with patients. We observed outpatient clinics transition to telehealth in more than half of the centers. Telephone, e-mail, and telephone + WhatsApp texts were preferred remote monitoring tools. Remote access to laboratory test results and radiological images, electronic signatures for medical reports or prescriptions, and online applications for off-label drugs were successfully implemented in almost half of the centers. Telemedicine gave a "working from home" opportunity to medical staff, which may also prevent transmission of the virus, preserve personal protective equipment, and quarantine exposed staff. This was a simple rehearsal for future telemedicine utilization with more sophisticated devices or methods, i.e., telephones recording or sending electrocardiograms to practitioners [11], electronic stethoscopes [12], or remote dialysis monitoring systems such as Claria sharesource for PD patients, which increases medical provider oversight and allows early recognition of problems by using online, objective data [13, 14]. We believe that telemedicine will evolve in many ways soon and that the pandemic simply accelerated the invention and implementation of remote monitoring tools or devices in medicine far more quickly than anticipated [9]. Additionally, in this survey, some of the centers reported that payer organizations have already started covering teleconsultation fees which are expected to be a common policy soon.

Medical education changed dramatically during the pandemic. Medical education and fellow education were interrupted in 91% and 38% of the centers and switched online in 85% and 37%, respectively. New arrangements were well-accepted in some centers; however, student and lecturer resistance and dissatisfaction were also noted.

Although medical education requires hands-on education, these extraordinary, tough times require a hybrid teaching system to maintain educational activities safely. It is obvious that online education will rapidly evolve with experience and by using the newest technology. However, it should be enhanced using feedback and suggestions made by students and faculty [32, 33].

In terms of fellow training, regular multidisciplinary team meetings were suspended, postponed, or performed online, which might have been less effective. One of the most critical parts of one-on-one teaching is the exchange of ideas, group discussions, and learning from the experience of seniors, which was partly maintained by clinical visits and online meetings. On the other hand, free access to many national/international online trainings has been one of the most important benefits of the pandemic. Research activities, which may be considered a part of fellow education, were also disappointingly aborted in many centers. However, 38% of the centers considered this period as a useful time for research activities.

There were several limitations of our study. Firstly, it covered a short time interval in which some centers experienced difficulties or changes resulting from the pandemic, while other centers were at the beginning and not yet influenced in significant ways. This may have affected the variability of responses. Secondly, this voluntary survey was sent via the ESPN mailing list and is not delivered to all pediatric nephrologists and may not be fully representative. Twenty-seven centers answered the survey from Turkey, while 1–6 centers from other countries. Therefore, specific country-based results were not given. Thirdly, this survey was deployed early in the pandemic while healthcare systems and medical faculties were trying to adapt to unprecedented challenges. Over a year's time, online methods have become an integral part of medicine both in care delivery and education. Additionally, previously suspended activities like kidney transplantation resumed. Therefore, results should be interpreted time-dependently.

In conclusion, the COVID 19 pandemic is a real challenge to all medical staff. It has opened a brand new window to both medical practice and education. Our results showed that the COVID-19 pandemic had a major impact on PN care delivery, particularly on kidney transplantation activities. The extent of its negative effects on educational activities was broader. While waiting for the vaccine to be available to all, we will further experience the real impact of the pandemic.

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Declarations

Conflict of interest The authors declare no competing interests.

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