



Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Elsevier hereby grants permission to make all its COVID-19-related research that is available on the COVID-19 resource centre - including this research content - immediately available in PubMed Central and other publicly funded repositories, such as the WHO COVID database with rights for unrestricted research re-use and analyses in any form or by any means with acknowledgement of the original source. These permissions are granted for free by Elsevier for as long as the COVID-19 resource centre remains active.



Contents lists available at ScienceDirect

## Journal of Pediatric Surgery

journal homepage: [www.elsevier.com/locate/jped surg.org](http://www.elsevier.com/locate/jped surg.org)

## Both sides of the screen: Provider and patient perspective on telemedicine in pediatric surgery



Maria E. Knaus<sup>a,b</sup>, Kelly Kersey<sup>c</sup>, Hira Ahmad<sup>a</sup>, Laura Weaver<sup>a</sup>, Jessica L. Thomas<sup>a</sup>, Gregory A. Metzger<sup>b</sup>, Richard J. Wood<sup>a</sup>, Alessandra C. Gasior<sup>a,d,\*</sup>

<sup>a</sup> Department of Pediatric Colorectal and Pelvic Reconstructive Surgery, Nationwide Children's Hospital, 700 Children's Drive, Columbus, OH 43205, United States

<sup>b</sup> Center for Surgical Outcomes Research, Abigail Wexner Research Institute, Nationwide Children's Hospital, Columbus, OH, United States

<sup>c</sup> Quality Improvement Services, Nationwide Children's Hospital, Columbus, OH, United States

<sup>d</sup> Department of Colon and Rectal Surgery, The Ohio State University, Columbus, OH, United States

### ARTICLE INFO

#### Article history:

Received 27 May 2021

Revised 24 January 2022

Accepted 17 March 2022

#### Keywords:

Colorectal surgery  
Multidisciplinary care  
Telehealth  
Clinician  
COVID-19

### ABSTRACT

**Background:** There has been increased telemedicine use secondary to the COVID-19 pandemic. The objective of this study was to assess patient/parent satisfaction with their telemedicine experience, gauge provider perspective on telemedicine for the management of pediatric colorectal disease and evaluate the quality of telemedicine care being provided.

**Methods:** A cross sectional study was performed at a single institution from March 2020–February 2021. Patients who completed a patient/parent telemedicine survey after a telemedicine appointment and nurse practitioners/surgeons who completed a provider telemedicine survey were included. Patient and provider characteristics and responses were analyzed using descriptive statistics. Differences between the levels of provider confidence to provide telemedicine care were analyzed using Pearson's chi-square test. **Results:** 118 patients/parents completed the survey. The median age of patients was 7 years. Most patients were male (59%) and White (73%). The most common diagnosis was anorectal malformation (49%). 71% of parents felt the telemedicine visit was as effective or better than an in-person visit and over 70% said they prefer a telemedicine visit to an in-person visit. Ten surgeons and 8 nurse practitioners completed the provider survey. 28% had previous telemedicine experience and 94% planned to continue offering telemedicine appointments. Providers felt significantly more confident performing clinical duties via video telemedicine compared to telephone telemedicine.

**Conclusions:** Telemedicine is a useful adjunct or alternative in pediatric surgery for complex patients who require multidisciplinary care. Providers show confidence with the use of video telemedicine and parents show high satisfaction, with the majority preferring telemedicine visits over in-person visits.

**Level of evidence:** IV.

© 2022 Elsevier Inc. All rights reserved.

### 1. Introduction

With the advent of the COVID-19 pandemic, telemedicine has become an important tool for healthcare providers across the world. Even prior to the onset of the pandemic, telemedicine has played a role in expanding access to healthcare, particularly in areas with geographic disparities to access and in patients who require highly specialized care available at only select institutions. It has the potential to improve costs, efficiency, quality, and out-

comes, and has been increasingly used in both adult and pediatric surgery [1–11].

Many studies have shown the increases in patient satisfaction secondary to ease of use, decreased travel time, decreased wait times, and improved outcomes from telemedicine [1,3,7,9]. However, there is a paucity of literature describing the provider perspective on telemedicine. In order to expand the use of telemedicine in medicine and surgery, the providers themselves must feel comfortable navigating this environment and knowledge of the barriers to providing quality telemedicine visits from the provider side must be investigated. In addition, there has been limited research done to assess telemedicine in highly specialized environments and in complicated patients requiring coordination of care among multidisciplinary teams. Our center is a quaternary center that provides integrated, multidisciplinary care for children with colorectal and pelvic reconstructive conditions. We have pre-

**Abbreviations:** NP, nurse practitioner; EUA, exam under anesthesia; PSARP, posterior sagittal anorectoplasty.

\* Corresponding author at: Department of Pediatric Colorectal and Pelvic Reconstructive Surgery, Nationwide Children's Hospital, 700 Children's Drive, Columbus, OH 43205, United States.

E-mail address: [Alessandra.Gasior@nationwidechildrens.org](mailto:Alessandra.Gasior@nationwidechildrens.org) (A.C. Gasior).

viously provided limited telemedicine visits to patients, but during the COVID-19 pandemic, the majority of our visits were via telemedicine in order to comply with social distancing and stay-at-home orders.

The objectives of this study were to (1) assess patient and parent satisfaction in their telemedicine experience, (2) assess provider perspective by provider type and experience level on telemedicine and its strengths and weaknesses in the medical and surgical management of complicated pediatric colorectal and pelvic reconstructive conditions, and (3) evaluate the perceived quality of care being provided to the patients as a result of increased telemedicine use.

## 2. Methods

### 2.1. Patient/provider selection and data collection

This was a cross-sectional study resulting from a quality improvement project completed at a single institution from March 2020 to February 2021. Patients who participated in a video or telephone (audio without video) telemedicine appointment at our center and completed a patient/parent telemedicine survey were included. Patients were excluded if they did not complete the telemedicine survey despite 3 reminder attempts via e-mail. Additionally, the 8 nurse practitioners (NPs) and 10 surgeons that are a part of our multidisciplinary team were included after completing a provider survey on telemedicine. The multidisciplinary team includes colorectal surgery, urology, and pediatric adolescent gynecology. Telemedicine visits were conducted via Zoom, which was integrated with the patient portal of our electronic medical record. Families were given a handout with detailed instructions on how to set up the portal and prepare for the appointment, and the office staff had been trained to troubleshoot any technical issues. Demographic information and responses of the surveys were recorded in a secure Research Electronic Data Capture database. This study did not require approval by the Institutional Review Board as it qualified as quality improvement.

### 2.2. Patient and provider telemedicine surveys

Two telemedicine satisfaction surveys were created by the quality improvement and multidisciplinary team: one for the patient/parent and one for the provider (Appendices A and B, respectively). The patient/parent survey was a 19-item questionnaire regarding sociodemographic information, technical and satisfaction questions about the visit and prior telemedicine and in-person visits, and post visit outcomes, such as misdiagnosis or unplanned readmissions. The technical and satisfaction questions, as well as those on post visit outcomes, were on either a nominal or ordinal scale. Questions using an ordinal scale were Likert-like, and although not all identical, they all followed the typical rubric of indicating a greater or lesser degree pattern. Dichotomous questions using a nominal scale to measure the patient/parent response regarding post visit outcomes gave respondents the opportunity to provide additional feedback. These surveys were sent to all families via e-mail after their first telemedicine visit. Families who had additional telemedicine visits did not receive the survey again. There were 3 reminder emails sent at 3-day intervals to facilitate response rate, with the goal of receiving responses within 4 weeks post visit to decrease recall bias. No additional reminders were sent after this time in order to limit excessive traffic in the patient's email inbox. The number of appointments (in-person, video, phone, no-show) and number of colorectal surgeries (including minor procedures such as an exam under anesthesia or anal Botox injection through large, reconstructive operations such as a posterior

sagittal anorectal vaginal urethroplasty) from one year prior to administration of the first survey was collected in order to compare the survey responders to the non responders.

The provider survey was a four-part, 29-item questionnaire assessing individual provider characteristics, experiences, and confidence with video and telephone visits, post visit outcomes, and perceived barriers to appropriate care and surgical planning. This was administered to the 18 surgeons and NPs of our team. A 5-point Likert scale was used to evaluate provider confidence with video and telephone telemedicine across 8 clinical tasks: diagnosis, treatment, ordering diagnostic studies, prescribing medical treatment, relaying information to parents, answering parent questions, scheduling surgery, and coordinating with other care teams. We then combined individual provider responses to get an aggregate number for comparison. Providers who selected that they were confident performing the various clinical tasks "always" or "most of the time" were considered to be confident in performing these actions. If they selected "sometimes" or "never," they were considered to be not confident.

### 2.3. Statistical analysis

Patient data were analyzed using descriptive statistics. Both patient and provider characteristics were characterized using frequency (%) for categorical variables and measures of central tendency and relative position including median and interquartile range for continuous variables. In order to ensure that our results could be generalizable to the entire patient population and not only those who responded to the survey, we performed a statistical comparison of the clinical characteristics of the survey responders and non responders. Differences between the levels of provider confidence to provide patient care by video and telephone were analyzed using Pearson's chi-square test. A *p*-value of less than 0.05 was considered statistically significant.

## 3. Results

### 3.1. Patient/parent sociodemographic information

Overall, within the time frame of March 2019 (one year prior to first survey administration) through February 2021 (last survey administration), there were a total of 1557 in-person appointments, 1070 video appointments, 728 phone appointments, and 172 no-show appointments within our center. The survey was sent out to 704 patients and families and 118 responded (15%). Of those who responded, demographic information was available for 105 patients (Table 1). The median age of patients was 7 years (interquartile range: 0–11.1 years; range: 4 months–57 years). The majority of these patients were male (59%, 62/105). Most patients were White (71%, 77/105). Anorectal malformation was the most common diagnosis in this cohort (49%, 51/105), followed by functional constipation (23%, 24/105) and Hirschsprung disease (15%, 16/105). Patients were from 27 different states across the United States, including Hawaii. Sixty-eight percent of parents had a bachelor's degree, master's degree, or doctorate. Family income was variable; 21 families (15%, 21/118) reported a total family income of less than \$50,000 in the previous year before taxes, and 51 families (43%, 51/118) reported earning more than \$100,000.

When comparing characteristics of the survey responders versus non responders, we found that there were no differences between the two populations regarding median age, sex, and race/ethnicity (*p* > 0.05). We did note that the non responder group did have a smaller percentage of patients with anorectal malformation (49% in the responder group versus 38% in the non responder group, *p* = 0.04) and a larger percentage of patients with Hirschsprung disease (15% in the responder group versus 22%

**Table 1**  
Patient demographics.

	n	%
Age in years, median (interquartile range)	7 (0–11.1)	
Sex		
Males	62	59
Females	43	41
Diagnosis		
Anorectal malformation	51	49
Functional constipation	24	23
Hirschsprung's disease	16	15
Neurogenic bowel/bladder	7	7
Cloacal malformation/exstrophy	4	4
Myelomeningocele	1	1
Caudal regression syndrome	1	1
Rectal cyst	1	1
Race/ethnicity		
White	77	73
Asian	16	15
Biracial	4	4
Latino/Hispanic	4	4
Black	4	4
Highest education		
High school/GED	11	9
Some college	13	11
2 years of college (associate degree)	12	10
4 years of college (bachelor's degree)	36	30
Master's degree	32	27
Doctorate	13	11
Decline to answer	1	1
Total family income before taxes (last year)		
Less than \$10,000	3	3
\$20,000–\$50,000	18	15
\$50,000–\$100,000	31	26
\$100,000–\$150,000	31	26
More than \$150,000	20	17
Do not know/prefer not to answer	15	13

in the non responder group,  $p < 0.01$ ). The breakdown of the remainder of diagnoses was similar in the two groups. The average number of in-person appointments (2.2 for the responders versus 2.1 for the non responders), video appointments (1.7 for responders versus 1.4 for non responders), phone appointments (0.7 for responders versus 0.8 for non-responders), and no-show appointments (0.2 for responders and 0.3 for non-responders) within the year prior to each patient being sent a survey were not significantly different between the two groups ( $p > 0.05$  for all). Lastly, the average number of colorectal procedures performed between the two groups within the year prior to each patient being sent a survey were not significantly different (1.3 for responders and 1.2 for non-responders,  $p = 0.39$ ).

### 3.2. Patient/parent survey results

Incomplete responses for each survey question were excluded. The majority of telemedicine interactions in this cohort occurred via video (84%, 87/104). Seventeen patients were evaluated by telephone only. Only 8% (8/105) parents reported technical issues during their telemedicine visit. More than 3 out of 4 parents (77%, 27/35) reported prior experience sending pictures of their child's abdomen or perineal area. The most common routes of day-to-day communication with providers were e-mail (42%, 50/118) or via secure electronic medical record direct messaging to the provider (39%, 46/118). Seventy-six percent (90/118) of parents reported having had at least one in-person visit at our center in the past year and 9% (11/118) had 8 or more in-person appointments during the past year. In comparison, 58% (61/105) of patients had one telemedicine visit in the past year, and 2% (2/118) had 8 or more. Nearly 18% (21/118) of parents said they had lost wages because of time missed for their child's previous in-person visits.

Parents were asked about specific complications that may have occurred because of a missed, incomplete, or inadequate telemedicine appointment. One parent (1/105) reported an incorrect diagnosis and one parent (1/105) reported an adverse outcome. There were no parent-reported unplanned readmissions as a result of the telemedicine visit (0/105).

Ninety-six percent (98/102) of parents felt that the telemedicine appointment was equally or less stressful for their child than an in-person appointment. More than 70% (74/105) of parents felt that their telemedicine visit was as effective or more effective than an in-person appointment. Most families felt more confident using telemedicine for future appointments (93%, 95/102). Ultimately, 30% (35/118) of parents stated they would prefer an in-person visit for their next appointment, and 70% (83/118) of parents stated they would prefer a telemedicine visit. Seventeen parents provided reasons for why they would decline a telemedicine visit in the future. Three parents (3/17) reported they would decline a telemedicine visit because of discomfort from having to video their child's abdomen or perineal area. Fourteen parents (14/17) reported they would decline a telemedicine visit out of concern that their child would not get the right diagnosis or treatment.

### 3.3. Provider survey results

The response rate among providers was 100% (10 surgeons, 8 NPs). Clinical areas of expertise included pediatric colorectal surgery (11), pediatric urology (5), and pediatric adolescent gynecology (2). Three providers had been in practice more than 20 years, 4 providers between 10 and 20 years, and 11 providers less than 10 years. Twenty-eight percent of providers had experience using telemedicine before COVID-19. After the onset of the COVID-19 pandemic, the majority of providers (64%) had more than half of their appointments via telemedicine. All providers felt more confident using telemedicine after the period of expanded use in response to the pandemic.

Both NPs and surgeons felt significantly more confident diagnosing and treating conditions, ordering appropriate diagnostic studies, prescribing the appropriate medical treatment, and communicating with parents using video telemedicine compared to telephone visits only ( $p \leq 0.02$  for all) (Table 2). Surgeons did not feel confident scheduling surgery without an in-person exam—only 30% of surgeons felt they could confidently schedule surgery during a video visit and only 10% of surgeons felt they could confidently schedule surgery during a telephone visit ( $p = 0.45$ ).

Individual provider responses for confidence in the 8 various clinical areas of a video telemedicine visit were aggregated. When confidence performing video telemedicine visits was further examined by level of experience, we found that all providers with less than 10 years of experience were more likely to be “always” confident performing clinical duties via telemedicine compared to their more experienced colleagues (Fig. 1).

When considering surgeon respondents only, those with less than 10 years of experience were more likely to select “always” (11%) when expressing their confidence level in performing the different aspects of a video telemedicine visit, compared to 3% of surgeons with 10 to 20 years of experience and 7% of surgeons with more than 20 years of experience (Supplemental Fig. 1). All but one of the NPs had less than 10 years of experience; the other NP had more than 20 years of experience. The NPs with less than 10 years of experience were more likely to select they were “always” confident than was the NP with more than 20 years of experience (55% versus 0%) (Supplemental Fig. 2). The NPs felt more confident overall compared to surgeons (Supplemental Fig. 3). Almost half (48%) of all NP responses regarding confidence with the various aspects of video telemedicine visits were “always.” The remaining NP responses were “most of the time.” Conversely, when all surgeon

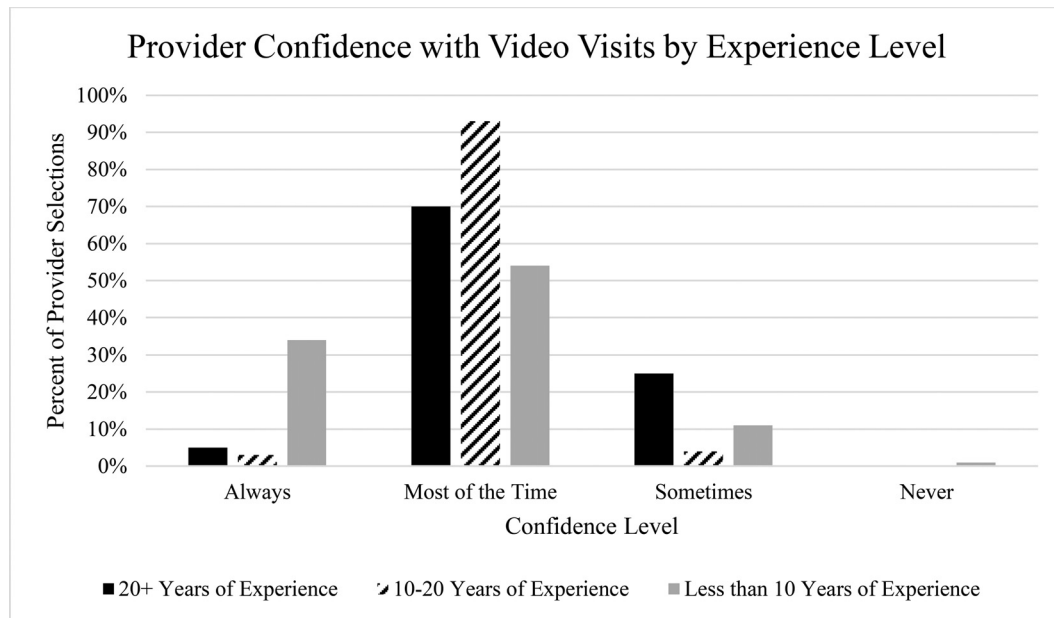
**Table 2**

Provider confidence with clinical care via video or telephone telemedicine visits.

Clinical care	Video*	Telephone*	p-value
Diagnose conditions	94%	28%	<0.001
Treat conditions	89%	33%	<0.001
Order appropriate diagnostic study	94%	56%	0.007
Prescribe appropriate medical treatment	89%	44%	0.005
Relay information to parents	100%	56%	<0.001
Answer parent/patient questions	100%	72%	0.02
Schedule surgery (with no in-person exam)*	30%	10%	0.45

\* :percent of providers who answered they were confident “most of the time” or “always”.

x :among surgeons only (n = 10).



**Fig. 1.** Provider confidence with video visits by level of experience. In this figure, all providers were stratified by experience level (20 or more years, 10–20 years, or less than 10 years) and their confidence responses for performing the various clinical tasks using video telemedicine were aggregated and compared.

responses for confidence with video telemedicine were aggregated together, only 7% of them were “always,” 74% were “most of the time,” 17% were “sometimes,” and 2% were “never.”

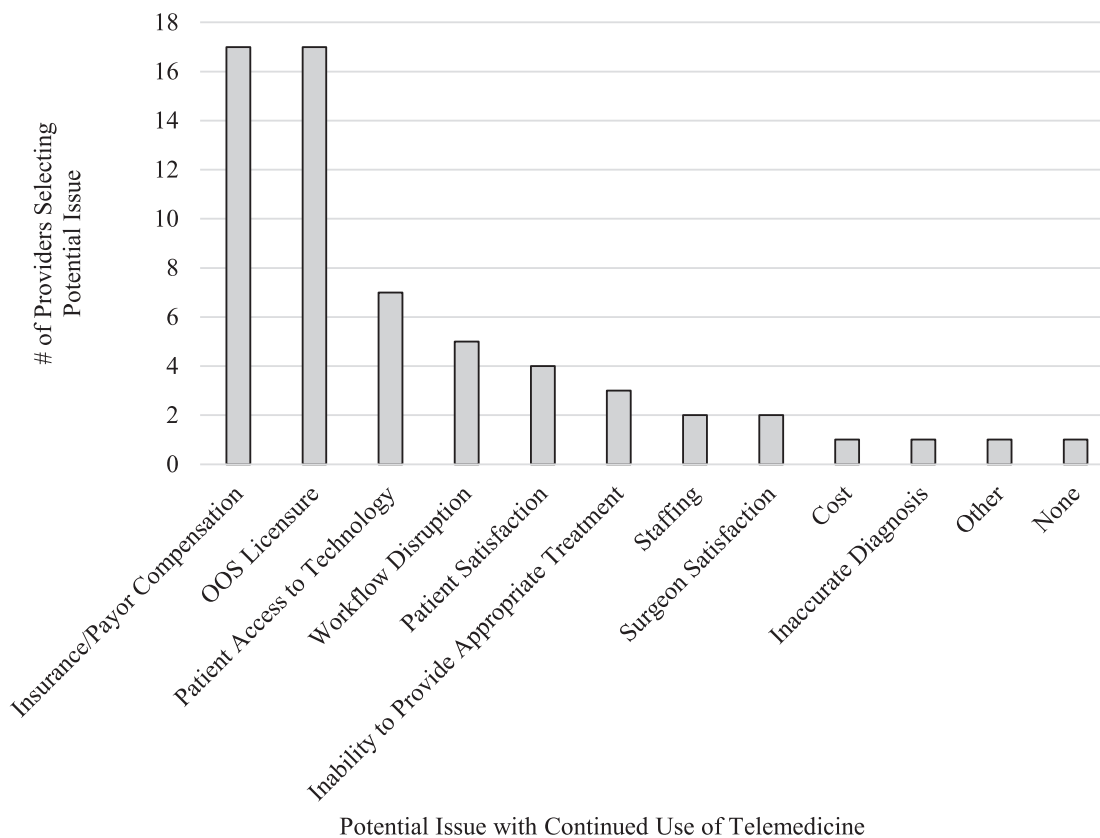
Given the complexity of the patients and the multidisciplinary coordination required to appropriately care for them, providers were surveyed on their ability to confidently coordinate plans with other care teams via video or telephone telemedicine appointments, with no in-person exam (Supplemental Table 1). For each care team (urology, colorectal surgery, gynecology, social work, psychology, nurse practitioners, and nursing), providers felt significantly more confident coordinating care plans via video telemedicine than telephone telemedicine with all teams aside from social work and psychology ( $p = 0.09$  for social work and psychology,  $p < 0.05$  for remainder).

Nearly all (94%, 17/18) providers said they will continue to offer telemedicine visits to their patients beyond the COVID-19 period. Clinician perspective on potential issues with continued use of telemedicine are shown in Fig. 2. The most common concerns were regarding insurance and payor compensation (94%) and issues with out-of-state licensure (94%) (Table 3). Providers were given the opportunity to write free texts comments on telemedicine. One provider said “[telemedicine is] a great adjunct for follow-up visits for non operative problems and for surgical follow-up after the initial post-op visit.” Another provider stated telemedicine “can be helpful for post-op visits including the initial one in select patients for select problems.”

The final part of the provider survey focused specifically on surgeon comfort and confidence with scheduling new patient telemedicine visits and possibly certain surgical procedures upon completion of that visit. Surgeons were asked to select whether they would choose video, telephone, or neither for each specific diagnosis and procedure. Results are shown in Table 4. For procedures such as an exam under anesthesia (EUA), cystoscopy, vaginotomy, or 3D cloacagram, surgeons felt significantly more confident scheduling them during a telemedicine visit, compared to a more complex operation such as a transanal pull-through or a posterior sagittal anorectoplasty (PSARP).

#### 4. Discussion

The results of this study show that, from both a patient/parent and provider perspective, telemedicine (particularly video) visits provide both satisfactory and high-quality care in pediatric patients with complex colorectal and pelvic reconstructive conditions ranging from anorectal malformations to myelomeningocele to Hirschsprung disease. More than 71% of parents felt the telemedicine visit was as effective or better than an in-person visit and More than 70% said they would prefer a telemedicine visit to an in-person visit in the future. Colorectal, urology, and pediatric adolescent gynecology specialists with varying clinical experience and comfort with technology showed confidence in most aspects of clinical care and multidisciplinary coordination while



**Fig. 2.** Potential issues with continued use of telemedicine from the provider perspective. Providers selected various potential issues they felt would arise with continued use of telemedicine.  
OOS: Out-of-state.

**Table 3**

Strengths and weaknesses of telemedicine in pediatric colorectal and pelvic reconstruction surgery.

Strengths	Weaknesses
High patient/parent satisfaction	Sensitive body regions may need to be shown via video
Low rates of misdiagnosis/complications	Potential for misdiagnosis
Can be used in the perioperative setting	May not be able to use for a preoperative visit
Providers gain confidence with continued use	Somewhat limited physical exam
Can be used for multidisciplinary care	Issues with insurance and payor compensation
Able to see patients from different states/countries	Difficulties with out-of-state licensure

utilizing telemedicine, and 94% of providers will continue to offer telemedicine visits after COVID-19. Provider confidence increased when using video compared to telephone only. Out of 118 patients surveyed, there was only one parent-reported misdiagnosis and one parent-reported adverse event that may have been related to a telemedicine visit; there were no provider-reported complications. Telemedicine can be used in the perioperative setting in complicated patients requiring multidisciplinary care and may even have utility in pre operative visits for scheduling surgery in select cases (Table 3).

Many studies have established improved patient satisfaction and overall outcomes in telemedicine in medicine, pediatrics, and surgery [1–4,7–10,12–16]. Our study echoes these findings. Parents showed a high level of satisfaction with telemedicine visits. More than four out of five parents felt their telemedicine visit was equally or less stressful than an in-person visit. While we did not look at disease-specific outcomes, we did assess overall rates of misdiagnosis, adverse events, and unplanned readmissions in this cohort, with satisfactory results. There was only one parent-

reported misdiagnosis and one parent-reported adverse event in our cohort. Upon manual chart review of the patient with a reported incorrect diagnosis, we were unable to determine what the incorrect diagnosis was. For the patient with a reported adverse outcome, we were unable to link their survey with their medical record number and unfortunately were unable to perform a chart review to confirm. Additionally, neither parent expanded on their selection in the free text portion of each question, so we were not able to obtain more details or insight. Misdiagnosis is a known possible risk of telemedicine because of the inability to perform a physical exam [17].

While there is robust literature on the patient perspective of telemedicine, there have been few studies assessing the clinician perspective on telemedicine [15,18]. As the field of medicine begins to utilize telemedicine more and more every day, it is important to consider provider perspective and opinion—if a provider is uncomfortable administering care via telemedicine, it is possible that they may have worse outcomes, spend more time and resources providing telemedicine care, or simply not offer it at all. One study sur-

**Table 4**

Surgeon responses for whether they would choose a video and/or telephone visit or neither type of visit for completing a new patient initial evaluation with an option to schedule surgery.

New patient type—possible procedure	Video and/or Telephone	Neither	p-value
Hirschsprung—EUA/biopsy	7	1	0.008
Hirschsprung—pull-through	4	3	0.59
Redo Hirschsprung—EUA/biopsy	5	2	0.11
Redo Hirschsprung—redo pull-through	4	3	0.59
ARM (F)—EUA/cysto/vaginoscopy	7	2	0.02
ARM (F)—PSARP	4	5	0.64
Redo ARM (F)—EUA/cysto/vaginoscopy	6	3	0.16
Redo ARM (F)—redo PSARP	4	5	0.64
ARM (M)—EUA/cysto	7	1	0.003
ARM (M)—PSARP	4	4	1
Redo ARM (M)—EUA/cysto	6	2	0.05
Redo ARM (M)—redo PSARP	2	5	0.11
Cloaca—EUA/cysto/vaginoscopy/3D cloacagram	7	2	0.02
Cloaca—PSARVUP	4	5	0.64
Redo cloaca—EUA/cysto/vaginoscopy/3D cloacagram only	6	3	0.16
Redo cloaca—redo PSARVUP	4	5	0.64
Functional constipation	6	1	0.008
Neurogenic bladder/bowel/myelomeningocele	9	1	<0.001
Bowel management	7	1	0.003

EUA: exam under anesthesia.

Pull-through: transanal intestinal pull-through.

ARM: anorectal malformation.

F: female.

Cysto: cystoscopy.

PSARP: posterior sagittal anorectoplasty.

M: male.

PSARVUP: posterior sagittal anorectovaginourethroplasty.

Significant values are bolded.

veyed 12 Canadian clinicians across general surgery, neurosurgery, orthopedic surgery, plastic surgery, chronic pain, and urology [15]. Three out of four clinicians felt telehealth was an acceptable alternative to providing pediatric surgical services, and all said they would use telehealth again in the future. Another study assessed telemedicine in pediatric surgery in Germany during the COVID-19 pandemic [18]. This study revealed that over half of all surveyed pediatric surgeons (54/81) did not provide telemedicine services. Of the physicians that did telemedicine appointments, only about 31% said they would treat new patients this way. Overall, their average rating of telemedicine graded on a Likert scale was 2.22 (1=satisfied, 6=unsatisfied). These studies gave a cursory look at provider view on telemedicine; comparatively, our study provided a more in-depth, specific, and comprehensive provider view.

The provider results from our study show that telemedicine can be a feasible option to provide adequate patient care even for physicians and nurse practitioners with minimal or no prior telemedicine experience. Nearly three-quarters of our providers had no experience using telemedicine prior to the onset of COVID-19; at the time of survey completion, almost two-thirds of providers had more than half of their visits via telemedicine, all felt more confident using it, and all but one provider will continue to offer telemedicine visits after the resolution of COVID-19. We did not identify any provider-reported complications, suggesting that the care provided across all levels of experience was adequate. Providers felt significantly more confident providing care across most clinical areas (diagnosis, treatment, communication with parents) with video than with telephone. As our providers are all in the surgical field, this is not surprising. Surgeons rely on physical exam more heavily than other medical specialties. Similarly, providers felt more confident coordinating care with other specialties when using video rather than telephone for their telemedicine visits.

In general, we found that providers with less than 10 years of experience felt more confident overall with their video

telemedicine visits. These patterns held similar when sub-analyzing surgeons only and NPs only, with providers with less than 10 years of experience across both subgroups more often selecting they were confident “always.” This could be because of more comfort and adaptability with the technology required for telemedicine appointments in presumably younger providers. However, providers with less than 10 years of experience were more likely to feel confident only “sometimes” compared to providers with 10 to 20 years of experience. This finding could be explained by less confidence in their clinical decisions overall, even with more comfort with telemedicine technology. Similarly, providers with the most experience clinically felt the least confident in performing clinical aspects via video telemedicine (one-quarter of providers with more than 20 years of experience felt confident only “sometimes”). These findings suggest that clinical experience is not the only factor affecting confidence with telemedicine and that, in order to feel confident with telemedicine, providers may also need a certain level of comfort with the interface technology for these types of visits. When comparing surgeons to NPs, we found that 100% of NPs felt confident “most of the time” or “always” in providing multiple aspects of clinical care with video telemedicine, whereas 81% of aggregated surgeon responses were “most of the time” or “always.” Generally, less complex patients are seen by the NPs and more complex decision-making is usually made by the surgeon. Also, at our center, NPs do not schedule surgery.

Surgeons were less hesitant to see new patients and possibly schedule surgery via telemedicine visits for less invasive procedures like an EUA, cystoscopy, and vaginoscopy, as compared to more complicated operations like posterior sagittal anorectovaginourethroplasties or redo operations like a redo PSARP or transanal pull through. This makes clinical sense, as surgeons would not consider scheduling surgery for a patient unless they were certain of the anatomy and diagnosis, which may not be readily apparent through a telemedicine visit because of the lack of physical exam-

ination. A common theme in the free text provider comments was that telemedicine is a useful adjunct in this medically and surgically complex population, but that providers would be selective as to which patients received telemedicine appointments for specific reasons (for example, new patient visits, post operative visits, or visits for non operative problems).

We believe it is optimal to use telemedicine in pediatric colorectal disease when a physical exam will not determine the need for operative intervention or change the course of the patient's treatment. It could be used in any setting where the provider feels confident that they can appropriately care for the patient and manage their condition without an in-depth physical exam. Suboptimal use of telemedicine visits in the realm of pediatric colorectal surgery includes patients in whom an exam of the perineum would be required, when the diagnosis is unknown or unclear, or when a complex, invasive operation such as a PSARP would be planned.

The two most common provider-anticipated issues with continued use of telemedicine were insurance/payor compensation and out-of-state licensure. Prior to the COVID-19 pandemic, the regulation of practicing telemedicine was specific to each state [2,10]. Obtaining a license to practice telemedicine in a specific state is overseen by that state's medical board, and each state has varying rules on the types of visits allowed, ability to prescribe medications, billing and reimbursement, and many additional nuances of telemedicine practice. During the COVID-19 pandemic, the federal government provided emergency waivers and acts to bypass many of these rules and provide adequate repayment in response to the halt of elective, in-person visits. However, after the resolution of the pandemic, it is expected that the original laws, rules, and regulations will re-enact, causing significant barriers to providing cross-state telemedicine care [10]. We were able to accommodate patients from 27 different states during this time period, who otherwise would have likely had an in-person visit. In providing these families with the option for a telemedicine visit, we potentially saved a large amount of time, money, burden, and anxiety for the patients and their families. An important aspect of telemedicine in the future will be a detailed knowledge of each state's rules and regulations. From an economic perspective, the cost of one telemedicine visit is dwarfed by the value of one surgical patient choosing our hospital for their care.

While we believe this is one of the first studies to assess detailed provider perspective on telemedicine, this study has several limitations. Firstly, we had a low response rate from patients and families with incomplete survey answers. While we were able to determine clinical similarities between the responder population and the non responder population regarding age, sex, race/ethnicity, and diagnoses, there were additional clinical variables we were unable to obtain because of the nature of our study, thus limiting overall generalizability. Although we had a 100% provider response rate, our provider cohort was only 18 despite being one of the largest centers specializing in colorectal and pelvic reconstructive care. In addition, since our center is highly specialized and focuses specifically on multidisciplinary care for complex medical and surgical patients, our findings may not be generalizable to hospitals that do not have the same level of resources and coordination of care. We did not evaluate disease-specific complications or outcomes and we were not able to verify the parent perception of misdiagnosis or adverse outcome. Larger multicenter studies looking at more detailed provider and patient outcomes should be conducted.

Telemedicine is a useful adjunct or alternative in pediatric surgery and in the care of complex patients who require multidisciplinary care. Providers show confidence with the use of video telemedicine and parents show high satisfaction, with the majority preferring telemedicine visits rather than in-person visits.

## Source of funding

None.

Supplemental Fig. 1: Surgeon Confidence with Video Visits by Experience Level

In this figure, surgeons were stratified by experience level (20 or more years, 10–20 years, or less than 10 years) and their confidence responses for performing the various clinical tasks using video telemedicine were aggregated and compared.

Supplemental Fig. 2: Nurse Practitioner Confidence with Video Visits by Experience Level

In this figure, nurse practitioners were stratified by experience level (20 or more years, 10–20 years, or less than 10 years) and their confidence responses for performing the various clinical tasks using video telemedicine were aggregated and compared. There was only one nurse practitioner with more than 20 years ( $n = 1$ ), who answered “most of the time” for each clinical area. There were no “sometimes” or “never” selections.

Supplemental Fig. 3: Provider Confidence with Video Visits

In this figure, surgeon and nurse practitioner confidence responses for performing the various clinical tasks using video telemedicine were aggregated and compared.

## Declaration of Competing Interest

None.

## Acknowledgments

None.

## Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:[10.1016/j.jpedsurg.2022.03.015](https://doi.org/10.1016/j.jpedsurg.2022.03.015).

## References

- [1] Cremades M, Ferret G, Parés D, Navinés J, Espin F, Pardo F, et al. Telemedicine to follow patients in a general surgery department. A randomized controlled trial. *Am J Surg* 2020;219(6):882–7.
- [2] Harting MT, Wheeler A, Ponsky T, Nwomeh B, Snyder CL, Bruns NE, et al. Telemedicine in pediatric surgery. *J Pediatr Surg* 2019;54(3):587–94.
- [3] Leshner AP, Shah SR. Telemedicine in the perioperative experience. *Semin Pediatr Surg* 2018;27(2):102–6.
- [4] Mihalj M, Carrel T, Gregoric ID, Anderegg L, Zinn PO, Doll D, et al. Telemedicine for preoperative assessment during a COVID-19 pandemic: recommendations for clinical care. *Best Pract Res Clin Anaesthesiol* 2020;34(2):345–51.
- [5] Nunoo-Mensah JW, Rizk M, Caushaj PF, Giordano P, Fortunato R, Dulskas A, et al. COVID-19 and the global impact on colorectal practice and surgery. *Clin Colorectal Cancer* 2020;19(3):178–90 e1.
- [6] Tyler KM, Baucom R. What every colorectal surgeon should know about telemedicine. *Dis Colon Rectum* 2020;63(4):418–19.
- [7] Kruse CS, Krowski N, Rodriguez B, Tran L, Vela J, Brooks M. Telehealth and patient satisfaction: a systematic review and narrative analysis. *BMJ Open* 2017;7(8):e016242 –e.
- [8] Taylor L, Portnoy JM. Telemedicine for general pediatrics. *Pediatr Ann* 2019;48(12):e479–ee84.
- [9] Dean P, O'Donnell M, Zhou L, Skarsgard ED. Improving value and access to specialty medical care for families: a pediatric surgery telehealth program. *Can J Surg* 2019;62(6):436–41.
- [10] Contreras CM, Metzger GA, Beane JD, Dedhia PH, Ejaz A, Pawlik TM. Telemedicine: patient-provider clinical engagement during the COVID-19 pandemic and beyond. *J Gastrointest Surg* 2020;24(7):1692–7.
- [11] Postuma R, Loewen L. Telepediatric surgery: capturing clinical outcomes. *J Pediatr Surg* 2005;40(5):813–18.
- [12] Hooshmand M, Foronda C. Comparison of telemedicine to traditional face-to-face care for children with special needs: a quasiexperimental study. *Telemed J e-Health* 2018;24(6):433–41.
- [13] Kohler JE, Falcone RA, Fallat ME. Rural health, telemedicine and access for pediatric surgery. *Curr Opin Pediatr* 2019;31(3):391–8.
- [14] Miller GG, Levesque K. Telehealth provides effective pediatric surgery care to remote locations. *J Pediatr Surg* 2002;37(5):752–4.



- [15] Shivji S, Metcalfe P, Khan A, Bratu I. Pediatric surgery telehealth: patient and clinician satisfaction. *Pediatr Surg Int* 2011;27(5):523–6.
- [16] Tomines A. Pediatric telehealth: approaches by specialty and implications for general pediatric care. *Adv Pediatr* 2019;66:55–85.
- [17] Burroughs M, Urits I, Viswanath O, Simopoulos T, Hasoon J. Benefits and shortcomings of utilizing telemedicine during the COVID-19 pandemic. *Proc Bayl Univ Med Cent* 2020;33(4):699–700.
- [18] Lakshin G, Banek S, Keese D, Rolle U, Schmedding A. Telemedicine in the pediatric surgery in Germany during the COVID-19 pandemic. *Pediatr Surg Int* 2021;37(3):389–95.