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Abbreviations:
- QI Quality Improvement
- CF Cystic fibrosis
- BPD Bronchopulmonary dysplasia
- PFTs Pulmonary function tests
- BCH Boston Children’s Hospital
- KDD Key driver diagram
- PDSA Plan-Do-Study-Act
- PERs Patient experience representatives

Article Summary: We describe rapid adoption of telehealth during COVID-19 using quality improvement strategies and also discuss the patient and provider experience with telehealth during this time.

What’s Known on This Subject: Telehealth has been used in specialized circumstances including pediatric subspecialty care in remote areas. During the COVID-19 pandemic, telehealth was rapidly adopted to allow continued access to care. Initial studies of its use have indicated positive experiences, with important drawbacks.
What This Study Adds: Our study describes a quality improvement approach to implementing a telehealth program in our pediatric pulmonary clinic, including the processes utilized and the resulting visit volume achieved. We also describe patient and provider experience with telehealth during this time.

Contributors’ Statements

Dr. Jaclyn Davis conceptualized and designed the study, designed the data collection instruments, collected data, carried out the final analyses, drafted the initial manuscript, and reviewed and revised the manuscript.

Ms. Rachel Gordon designed the data collection instruments, collected data, carried out the initial analyses, and reviewed and revised the manuscript.

Mr. Adam Hammond designed the data collection instruments, collected data, carried out the initial analyses and reviewed the manuscript.

Drs. Ryan Perkins and Frances Flanagan were involved in conceptualizing and designing the study, designed data collection instruments, collected data, and reviewed and revised the manuscript.

Drs. Tregony Simoneau and Elliot Rabinowitz conceptualized and designed the study, and critically reviewed the manuscript for important intellectual content.

Dr. Gregory S. Sawicki conceptualized and designed the study, supervised design of data collection instruments, data collection and analysis, and reviewed and revised the manuscript for important intellectual content.

All authors approved the final manuscript as submitted and agree to be accountable for all aspects of the work.
Abstract

Objectives: The COVID-19 pandemic created significant, abrupt challenges to the delivery of ambulatory healthcare. As tertiary medical centers limited elective in-person services, telehealth was rapidly enacted in settings with minimal prior experience to allow continued access to care. This QI initiative aimed to achieve a virtual visit volume of at least 75% of our pre-pandemic volume. We also describe patient and provider experience with telehealth services.

Methods: Our QI team identified primary drivers contributing to low telehealth volume, developed a telehealth scheduling protocol and data tracking system utilizing QI-based strategies. Patients and providers were surveyed on their telehealth experience.

Results: At the onset of the pandemic, weekly visit volume dropped by 65% (99 weekly visits; historical average of 281). Over the subsequent 3 weeks, utilizing rapid PDSA cycles, we achieved our goal volume. Surveys indicated that most participants had never before used telehealth (71% patients, 82% providers) yet reported high satisfaction (90% patients, 81% providers). Both groups expressed concern over lack of in-person assessments. Most patients and providers were interested in future use of telehealth.

Conclusions: With a QI-based approach, we successfully maintained access to care via telehealth services for pediatric pulmonary patients during the COVID-19 pandemic and found high rates of satisfaction among patients and providers. Telehealth will likely continue to be a part of our healthcare delivery platform, expanding the reach of our services. Further work is needed to understand effects on clinical outcomes.

Introduction

With the onset of the COVID-19 pandemic, the need for healthcare environments to rapidly adopt strategies to reduce disease spread became clear. The Massachusetts governor announced a State of Emergency March 10, 2020¹ and enacted stay-at-home orders effective March 24, 2020.² To align with this, Boston Children’s Hospital (BCH) cancelled in-person elective ambulatory care. To maintain access to care, insurance reimbursement for telehealth services was mandated.¹ Previously, telehealth had been employed in specialized settings, such as pediatric neurology³,⁴ and cardiology⁵ practices serving remote areas as well as in pediatric surgery for perioperative visits⁶, however, it had not yet been widely adopted.
in US pediatric specialty clinics at the time local stay-at-home orders went into effect. To continue uninterrupted routine care, efficient implementation of telehealth became necessary.

Pediatric pulmonary clinics serve a diverse patient population, comprised of patients with both common and rare chronic conditions including asthma, cystic fibrosis (CF), bronchopulmonary pulmonary dysplasia (BPD), airway malformations and interstitial lung disease, as well as those with acute conditions including complicated pneumonia and pneumothorax. Our patients require frequent follow-up to support ongoing evaluation, assess response to treatment and provide education around diagnosis and management. For example, routine quarterly care is recommended for all children with CF as it is for those with moderate to severe asthma.

Telehealth provides the opportunity to assess and provide longitudinal medical management, though has its limitations. While early reports during the COVID-19 pandemic highlighted that conversion from in-person to telehealth appointments was possible, optimal operational systems to support efficient scheduling and effective delivery of tele-healthcare have not been described. Best practices based on recent experience have been offered by national organizations including the AAP, though few reports utilize quality improvement (QI) methodologies to optimize procedure to meet these new demands. QI initiatives are essential to study and improve the rapidly changing healthcare delivery paradigm.

Patient and provider experiences with this new model of telehealth-based care during COVID-19 have been a focus of recent descriptive studies. Multiple studies, mostly performed in the adult population, describe overall positive experiences by both patients and providers in telehealth clinics. There are no reports to our knowledge of patient and provider perceptions of telehealth as experienced in a pediatric pulmonary subspecialty clinic.
When our hospital restricted elective in-person assessments, there was no structured approach to scheduling, organizing and executing telehealth visits in order to continue routine care for our patients. Our SMART aim starting in mid-March was to increase the number of virtual visits completed in the Division of Pulmonary Medicine to 75% (210 visits) of the historical weekly average ambulatory clinic volume (281 visits) within six weeks following the initial shut down (end of April 2020). To accomplish this, we used QI principles to inform our approach, recognizing that the call for immediate action somewhat limited our ability to follow more rigorous QI methodologies, a reality supported by others working in this space. Here, we present the strategies we adopted, our initial evaluation of provider and patient experiences with telehealth and lessons learned.

Methods

Context

This QI project was driven by changes in social interaction mandated during the COVID-19 pandemic. Prior to the pandemic, the BCH pediatric pulmonary clinic, staffed by 25 attending physicians, 12 fellows and 4 nurse practitioners, managed an average weekly clinic volume of 281 provider and 158 pulmonary lab visits. The most common visit diagnoses in 2019 were CF (18%), asthma (14%), chronic cough (9%), sleep apnea/snoring (5%) and BPD (4%). Due to the need to social distance and reserve use of personal protective equipment to urgent medical care, BCH limited elective medical care in mid-March 2020. To continue care virtually, the institution supported two technology platforms, first SBR Health, which integrated with our scheduling platform and later Zoom, which facilitated multidisciplinary visits and required manual scheduling processes. To ensure those without access to internet or a device could continue to see their providers, families could conduct their visits by telephone. As there was no virtual visit program in our division prior to the pandemic, our division developed new processes to incorporate these resources into a model of virtual care delivery.
Interventions

At the start of our shift toward telehealth in mid-March 2020, the clinic’s QI team—comprised of physicians, registered nurses and QI consultants—increased their meeting frequency from monthly to weekly. To specifically address the optimization of our new telehealth program, a workgroup was created with representation from all key stakeholders: patient experience representatives (PERs, responsible for communicating with and scheduling visits for families), PFT technicians, clinical assistants, nurses and physicians. To track progress toward reaching our SMART aim, the team defined a process for measuring virtual visit volume. Due to the rapid shift in care delivery the pandemic necessitated, subsequent Plan-Do-Study-Act (PDSA) cycles (outlined in Table 1) were implemented quickly and with overlap. The goals of these rapid PDSA cycles were broad, addressing concerns related to administrative processes, communication with patients and families, provider training and support, and patient and provider experience. Throughout this period, the QI team met weekly and also coordinated outreach to relevant stakeholders.

Measures

The primary measure tracked during this period was weekly virtual visit volume, which was compared to 2019 average weekly volume. Based on 2019 data, average weekly clinic volume was 281 visits, making our virtual visit goal 210 weekly visits (75% of 2019 volume). Balancing measures that were considered included rates of no-show and technical difficulty, however our systems at the time of this transition did not allow us to reliably obtain these data.

To assess patients’ and providers’ acceptability of telehealth visits and to identify challenges associated with its use, surveys were developed with questions designed to capture prior telehealth experience, ease of use, convenience, satisfaction and concerns regarding lack of in-person assessments. Likert scales were
used to assess satisfaction, convenience and level of concern regarding lack of in-person assessments (1=least/none, 5=most/high). For ratings of concern, scores of 1-2 were classified as low concern, 3-5 as moderate to high concern.

A subset of patients seen for a virtual visit between March 2020 and June 2020 were emailed a link for the anonymized survey starting in April. They received two subsequent email reminders to complete the survey. Patients were not solicited multiple times if they had repeat visits during this time frame, and in cases where siblings were seen, each family was sent only one survey. Patients with CF were evaluated with a similar, parallel survey with additional questions geared toward their unique care needs. Their results were analyzed separately. Pediatric pulmonary providers who participated in telehealth during this time were sent an anonymized survey link by hospital email. The scope of this work did not fall under our institution's definition of human subjects research and did not meet criteria for IRB review. Surveys are provided in Supplementary Materials.

Analysis

Virtual, as well as in-person visit volume, were tracked and reviewed with the QI team weekly. Progress was followed with visual analysis of a time-series graph. Visit diagnoses were analyzed at the end of the study period and compared to those from 2019. Given the inability to collect no-show and technical difficulty rates, we relied on regular qualitative verbal feedback from clinicians and stakeholders through frequent workgroup and division-wide meetings to understand unintended consequences of our interventions and inform our PDSA cycles. To evaluate patient and provider perceptions, descriptive survey data were reviewed monthly to address any time sensitive issues and formally analyzed at the end of the survey period.
Results

Course of Interventions

The first PDSA cycle (Table 1) aimed to assemble the telehealth-focused QI team, establish goals, define measures and plan for immediate process. Our SMART Aim was collectively determined, and we established an EMR-based algorithm to track visit volume. Our division super-user created and distributed best practice guidelines as well as tips-and-tricks references to navigate the new software.

The next PDSA cycle focused on understanding and addressing key drivers and contributors to low virtual visit volume. A fishbone diagram (Figure 1) and KDD (not shown) were constructed. To increase discussion outside our QI group, we organized huddles amongst the clinic administrative staff, increased communication at division-wide meetings and met with trainees. In these discussions, we learned of perceptions held by both families and providers of low utility of virtual visits, as well as uncertainty in the new scheduling processes. We also identified technology limitations in incorporating multi-provider care into our model, as the SBR platform supported only one provider. We obtained approval for a second platform, Zoom, to allow multiple providers to log on with a patient, necessary for trainee precepting and interdisciplinary visits.

The third PDSA aimed to improve administrative processes related to scheduling virtual visits, as uncertainty in these processes had been expressed during huddles set up in the prior PDSA. PDSA 3 began with a meeting exclusively with the Patient Experience Representatives (PERs), whose responsibilities include communicating with and scheduling patients. We drafted and sent
communications to families describing the necessary transition to telehealth, emphasizing provider support for new process. We also addressed concerns surrounding inadequate staffing to manage call burden by re-deploying clinical personnel to help with scheduling. We constructed scripts to be used by all staff communicating with patients to schedule visits. During this time we continued meeting with all stakeholders in various formats.

Finally, we assessed patient and provider experience with telehealth. Responses to patient and provider surveys were informally reviewed during the collection period and there were no widespread concerns conveyed about technical difficulties hampering the ability for the visits to be completed. Results were formally analyzed at the end of survey distribution in June.

Increasing Visit Volume

Weekly visits from March 2020 through June 2020 are presented in a time-series graph (Figure 2), stratified by virtual and in-person. The first week of March 2020 was reflective of pre-pandemic volume, with 210 in-person visits and zero virtual visits. At the onset of the pandemic, in-person visits dropped significantly to 38, with 61 virtual visits yielding a total weekly visit volume of 99 (65% reduction from historical average). Over the next three weeks, we achieved our goal of 210 virtual visits by the beginning of April and maintained this goal for many of the subsequent 10 weeks studied.

The State began a stepwise re-entry plan in mid-June and BCH accordingly resumed some in-person services. Starred dates in the time-series graph (also marked with red circles on the data points) represent 4-day weeks, during which clinic volume was expectedly less than during non-holiday weeks. We presume our unmet virtual visit volume goals in mid to late June reflect shifted efforts toward resuming
in-person visits, as infection control and safety measures allowed. Chief complaints leading to telehealth visits from March through June were similar to common chief complaints pre-pandemic: asthma (19%), CF (15%), obstructive sleep apnea/snoring (9%), chronic cough (6%), and BPD (6%).

Patient/Provider Perceptions

Fifty-two families responded to a survey sent to 392 unique families seen in our clinic by telehealth during March 2020-June 2020 (13% response rate). There was representation of patients across the pediatric age span (27% infant/toddler, 52% school age, 10% teenage, 11% 18 years or older). Most patients (71%) had no prior experience with telehealth (Table 2). Most families (77%) did not have difficulty logging in to the visit (Table 2). A majority of respondents were able to see all the providers they desired to (96%), had adequate time (98%) and felt their questions were answered (98%) during the visit. Most patients rated their visits highly satisfactory (90%) and convenient (88%). A notable proportion of patients reported at least moderate concern about the lack of physical exam (53%) and testing (42%) (Table 2). Looking to future telehealth use, 58% of patients reported a desire to have “some” of their future visits virtually, 24% preferred “most” and 8% wished to no longer participate in telehealth visits. (Table 2). Patients with CF at BCH polled as part of a parallel survey (n=20) reported similar rates of satisfaction (90%) and convenience (95%). Sixty percent were at least moderately concerned about lack of testing and most (85%) desired “some” of future visits virtually.

Thirty-five pediatric pulmonary clinicians participating in telehealth were contacted by email and 22 clinicians (63%) completed the anonymized survey. Most respondents (82%) had never used telehealth before, citing a lack of institutional support (63%), technology limitations (45%), scheduling logistics (41%) and out of state regulatory concerns (41%). A significant proportion (73%) reported technical difficulties (Table 2), with 31% describing issues that were quickly resolved, 55% endorsing issues that
took some time but were resolvable and a minority of respondents (14%) describing visits that were terminated as a result of these technical difficulties. Eighty-one percent of providers were satisfied with the telehealth experience and 50% felt telehealth had a positive impact on the provider-patient relationship. As with surveyed patients, providers conveyed concerns regarding lack of in-person assessments with at least moderate concern for lack of physical exam (90%), lack of PFTs (81%), and lack of vital signs (68%) (Table 2). Overall, provider concern regarding lack of in-person assessments was greater than that expressed by patients. Most providers (76%) felt “some” visits should be conducted by telehealth in the future, with 24% endorsing using telehealth for “most” future visits (Table 2).

Discussion

Summary

We achieved of our specific aim to increase virtual visit volume during the COVID-19 pandemic, utilizing QI processes and principles to drive change. This goal was compelled by the need to limit in-person interaction, and conversion to telehealth allowed continued access to pediatric pulmonary care. Additionally, through surveys, we demonstrated high ratings of satisfaction and convenience with telehealth, and despite technical difficulties and missing in-person testing, patients and providers expressed interest in using telehealth going forward.

Interpretation

Our success was driven by the collective efforts across our rapid PDSA cycles, many of which occurred in parallel. Since the pandemic necessitated immediate action and a drastic overhaul in our usual processes to maintain access to care, we were unable to follow a more typical QI model of performing distinct iterative tests of change, a model that would allow better evaluation of each intervention’s impact.
Foster and Stack’s (2020) recent commentary suggests that QI work in situations requiring immediate change in practice may have several phases (acute, subacute and chronic), with the acute phase focusing on protocol development and frequent communication on the rapidly evolving practices.16 Our described work falls into the acute phase of pandemic response, and we attribute much of our success to incorporating core QI principles into our project design and implementation, such as generating a clear definition of our goal, establishing meaningful and reliable measures, prioritizing patient-centered care experience, supporting frequent communication with stakeholders and using a QI framework with PDSA cycles to guide our work.

Beyond our QI efforts, we recognize other barriers to telehealth’s implementation were alleviated through institutional and regulatory policies, including technology support services and clear state guidelines mandating full insurance coverage.1 By encouraging institutions and governing bodies to continue these new supports, services and regulations post-pandemic, centers across the country can maximize the great opportunity telehealth lends to our healthcare system.

Patient engagement is another critical element to the success of telehealth’s sustainability.18 Through patient surveys, we found respondents reported positive experiences, with high ratings of satisfaction and convenience and interest to incorporate telehealth into future care. Though respondents did not convey high rates of technical difficulty, this result could be biased by those who responded, and we were unable to reliably track rates of visit no-show nor technical difficulties as balancing measures during the acute phase of this project. As we moved to the subacute phase after the scope of this project, we were able to establish more consistent practices around tracking no show as a meaningful balancing measure, as well as visit fill rate.
Clinical appropriateness for continued telehealth post-pandemic should be considered. One drawback of telehealth is the lack of in-person assessments, which was highlighted by surveyed patients and providers. Some of these missing assessments may be supplanted, at least in part, by novel home monitoring devices including pulse oximeters, virtual stethoscopes, and recently FDA-approved home spirometry devices, which may significantly add to the assessment we are able to make virtually."19,20 Our division has initiated a home spirometry monitoring program in an attempt to partially fill this gap in virtual assessment, with plans to formally study the program’s outcomes. Each specialty clinic will ultimately need to define standards of care regarding integration of telehealth into their clinical care model.

Limitations and Future Directions

There are several limitations to mention. The present study examines the feasibility of implementing telehealth in a pediatric pulmonary clinic during the COVID-19 pandemic and uniqueness of the context may limit generalizability of these findings. Additionally, the processes implemented, and technology used relied on robust administrative and information technology support available to us in a large tertiary care center. With different resources, changes to clinic process may be significantly more challenging to achieve. We recognize low patient response rate as a limitation, as it is possible those unwilling or unable to engage with technology may have been excluded, leading to a nonresponse bias toward positivity. Ongoing assessment of patient experience will be important. Finally, we were unable to reliably track desired balancing measures with our existing programs and our group is actively working on creating these measurement tools.

Telehealth will likely remain a part of our healthcare system going forward and it is essential to continue QI-guided work to optimize this form of care delivery. We advocate working with patients and families through a model of co-production to best understand how this incredible tool can be leveraged most.
effectively. Additionally, clinical outcomes including exacerbations of underlying disease, missed or delayed diagnoses, healthcare utilization and costs should be evaluated as should the interplay between telehealth, access to care and social determinants of health. Continued QI-based and outcomes-driven work will be integral in adapting an evolving virtual care model to patient and population needs, and will help us understand how to maximize the quality, equity and value of care we can deliver.

References


17. Fitzsimons J. Quality and safety in the time of Coronavirus: design better, learn faster. *Int J Qual Heal Care.* Published online 2020:1-5. doi:10.1093/intqhc/mzaa051


Table 1. PDSA Cycles

<table>
<thead>
<tr>
<th>Timeframe</th>
<th>PDSA 1</th>
<th>PDSA 2</th>
<th>PDSA 3</th>
<th>PDSA 4</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PLAN</strong></td>
<td>• Form core QI team dedicated to telehealth.</td>
<td>• Ask team members to contribute to Key Driver Diagram (KDD) and Fishbone diagram to understand barriers and where we may find points to intervene</td>
<td>• Meet with Patient Experience Representatives (PERs) to understand barriers they have been facing</td>
<td>• Gather feedback from patients and providers on telehealth experience</td>
</tr>
<tr>
<td></td>
<td>• Discuss need for virtual visit process to be rapidly implemented</td>
<td>• Consider strategies for incorporating fellows and multi-disciplinary providers into virtual visit model</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Outline needs for defining new process, facilitating provider training, tracking process, understanding patient perceptions</td>
<td>• Plan wider discussion outside of QI group</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>DO</strong></td>
<td>• Established weekly meeting frequency for core QI team</td>
<td>• Created Fishbone and KDD</td>
<td>• QI team drafted letters to family to discuss transition and created scripts for schedulers to use</td>
<td>• Created and distributed patient and provider surveys via REDCap to assess experience of telehealth.</td>
</tr>
<tr>
<td></td>
<td>• Defined SMART AIM</td>
<td>• QI meeting with fellows to elicit perspective and discuss participation</td>
<td></td>
<td>• Publicized experience with telehealth through division-wide webinar and subspecialty specific webinars.</td>
</tr>
<tr>
<td></td>
<td>• Created process flowsheet, provider tips and tricks sheet</td>
<td>• Created living document with QI processes accessible to Division</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Implemented tracking queries from medical records – virtual visits, in person visits, no shows</td>
<td>• Huddled daily to review data and address scheduling issues</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Gave first Division-wide update</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>STUDY</strong></td>
<td>• Weekly meetings well attended and generated many ideas</td>
<td>• Daily huddle allowed for real-time discussion of successes and challenges.</td>
<td>• Communication around best practices for telehealth visits were crucial.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Tracking of virtual visit showed we were below goal</td>
<td>• Major barriers identified included perceptions of patients and providers re: utility of visits, uncertainty in scheduling processes, need for different visit platforms for multi-provider (fellow)/ interdisciplinary visits</td>
<td>• Learned PERs were understaffed relative to communication volume</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Uncertainty in reliability of no-show data based on how it was collected</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>• Tips and tricks document deemed helpful by provider feedback</td>
<td></td>
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</tr>
<tr>
<td><strong>ACT</strong></td>
<td>• Continued tracking data of virtual visit and in person visits, continue to troubleshoot algorithm for defining no show rate</td>
<td>• Obtained approval for alternative platform, Zoom for multi-provider</td>
<td>• Re-deployed clinical personnel with less in-person responsibility to communicate with families</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Brainstormed key drivers to low volume numbers</td>
<td>• Brainstormed ways to improve communication with patients</td>
<td>• Continued tracking virtual visit volume</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Continued to meet as QI group</td>
<td>• Continued tracking virtual visit volume</td>
<td>• Continued to meet with QI group with added fellow representation, and with division</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Continued to meet with QI group with added fellow representation, and with division</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Considered how to improve telehealth and overcome identified challenges, including plans for home spirometry program</td>
</tr>
</tbody>
</table>
Table 2. Survey Responses

<table>
<thead>
<tr>
<th></th>
<th>Patient responses</th>
<th>Provider responses</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Telehealth use before March 2020</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>29%</td>
<td>18%</td>
</tr>
<tr>
<td>No</td>
<td>71%</td>
<td>82%</td>
</tr>
<tr>
<td><strong>Technical Difficulties</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>23%</td>
<td>73%</td>
</tr>
<tr>
<td>No</td>
<td>77%</td>
<td>17%</td>
</tr>
<tr>
<td><strong>Device Used</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Computer/Laptop with video</td>
<td>39%</td>
<td>86%</td>
</tr>
<tr>
<td>Tablet/iPad with video</td>
<td>15%</td>
<td>5%</td>
</tr>
<tr>
<td>Cellphone with video</td>
<td>42%</td>
<td>9%</td>
</tr>
<tr>
<td>Cellphone with audio only</td>
<td>4%</td>
<td>0%</td>
</tr>
<tr>
<td><strong>Concern regarding missing assessments</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>lack of testing/PFTs: 39%</td>
<td>lack of vital signs: 56%</td>
</tr>
<tr>
<td>Moderate to high</td>
<td>lack of testing/PFTs: 42%</td>
<td>lack of vital signs: 36%</td>
</tr>
<tr>
<td>N/A</td>
<td>lack of testing/PFTs: 19%</td>
<td>lack of vital signs: 8%</td>
</tr>
<tr>
<td><strong>Preferred frequency of future telehealth visits</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>None</td>
<td>8%</td>
<td>0%</td>
</tr>
<tr>
<td>Some</td>
<td>58%</td>
<td>76%</td>
</tr>
<tr>
<td>Most</td>
<td>34%</td>
<td>24%</td>
</tr>
<tr>
<td>All</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td><strong>Providers' perceived impact on patient-provider relationship</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Negative</td>
<td></td>
<td>9%</td>
</tr>
<tr>
<td>Neutral</td>
<td></td>
<td>41%</td>
</tr>
<tr>
<td>Positive</td>
<td></td>
<td>50%</td>
</tr>
</tbody>
</table>
Concern for lack in person assessments

Uncertainty around co-pays and medical costs

Billing and/or technology is too complicated

Family/providers believe visit not useful if not in-person; unnecessary if stable

Data Analyst

Patients/Families

ERP at BCH main campus, satellite locations

Low Virtual Visit Clinic Volume

Attendings, fellows, multi-disciplinary care team members

Perceptions

Concern for lack in person assessments

Uncertainty around co-pays and medical costs

Billing and/or technology is too complicated

Leave voicemails for families to reschedule as virtual

Multi-disciplinary and fellow visits

Challenges with out-of-state patients

Different approaches between BCH and satellites

Unique challenges for multi-disciplinary and fellow visits

EPIC for scheduling; templating

Powerchart (Electronic Health Record)

360 (institutional visit tracking tool)

Virtual Visit platforms: SBR Health, Zoom

No standard tracking system

Variable ways to get data (EPIC vs. 360 vs. manual)

Difficulty obtaining data needed to answer the “why’s”

Materials/Systems

Measurement

Scheduling

Figure 1. Fishbone Diagram created early April, demonstrates the identified contributors to low virtual visit volume, highlighting areas of focus.
**Figure 2.** Time-series graph representing telehealth and in-clinic visits per week from March through June 2020.

- **Formation of telehealth focused QI team**
- **Established tracking procedures**
- **Daily huddles started**
- **Meeting with fellows to open clinics**
- **Survey dissemination began**
- **Scripts for PERs**

The graph illustrates the number of visits, both in-person and virtual, along with the target visit volume. The data points show fluctuations in visits throughout the period with key events marked along the timeline. The graph also includes indicators for 4-day weeks (holiday).
Pulmonary Clinic Telemedicine Survey

Please complete this survey based upon your recent Telemedicine visit in the Pulmonary Clinic.

Thank you for helping us improve your Pulmonary Clinic experience!

What is the age of your child?

- Infant/Toddler (0-3 years)
- 4-12 years of age
- Teenager (13-17 years old)
- Adult (18 years and older)

Was this your child’s first visit with a Pulmonary provider at Boston Children’s Hospital?

- Yes
- No

Have you ever used telemedicine before for your child's healthcare?

- Yes
- No

During your visit do you feel you and your child were able to see all the members of the care team that you wish to?

- Yes
- No

Which members of the care team would you have liked to have seen this visit?

________________________________________

Please mark scores for the following questions using a scale from 1 to 5.

<table>
<thead>
<tr>
<th>Question</th>
<th>1 (least or not at all)</th>
<th>2</th>
<th>3 (neutral)</th>
<th>4</th>
<th>5 (most or very)</th>
<th>not applicable</th>
</tr>
</thead>
<tbody>
<tr>
<td>How satisfied were you with your overall treatment experience utilizing telemedicine services?</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td></td>
<td>○</td>
<td></td>
</tr>
<tr>
<td>How convenient was this visit for you?</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td></td>
<td>○</td>
<td></td>
</tr>
<tr>
<td>How concerning was the lack of testing (blood work, X-Rays, lung function testing) as part of your telemedicine visit?</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td></td>
<td>○</td>
<td></td>
</tr>
<tr>
<td>How concerning was the lack of vital signs (oxygen saturation measurement, heart rate) as part of your telemedicine visit?</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td></td>
<td>○</td>
<td></td>
</tr>
<tr>
<td>How concerning was the lack of a physical exam as part of your telemedicine visit?</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td></td>
<td>○</td>
<td></td>
</tr>
</tbody>
</table>

Were all of your issues and concerns addressed during your child’s telemedicine visit?

- Yes
- No

Do you feel you had adequate time to speak with the care team?

- Yes
- No
<table>
<thead>
<tr>
<th>Question</th>
<th>Options</th>
</tr>
</thead>
</table>
| How did you access your child's telemedicine visit?                     | Cellphone/Smarphone  
||| Computer/Laptop               
||| Tablet/iPad                  |
| Was your telemedicine encounter with audio only or audio and video?     | audio only       
||| audio and video               |
| Did you experience any technical difficulty during the encounter (including difficulty logging or staying connected to the visit, audio or video difficulties)? | Yes               
||| No                             |
| If you had technical difficulties, please briefly explain              |                 |
|                                                                         |                 |
| If telemedicine is offered in the future, how many visits in the Pulmonary clinic would you prefer to be completed by telemedicine? | None             
||| Some                         
||| Most                         
||| All                          |
| If telemedicine visits were to be offered in the future, would you be interested in technology that might allow you to assess your child's lung function at home? | Yes               
||| No                            
||| Don't Know                   |
| Please provide any additional comments you may have about your telemedicine visits. |                 |
|                                                                         |                 |
Provider Survey General Pulm

Thank you for your time and participation!!

Please consider your care of ALL Pulmonary patients in completing the survey below.

Thank you again!

Have you utilized telehealth prior to March 2020?  
☐ Yes  
☐ No

What were barriers to utilizing telehealth prior to March 2020? (select all that apply)
☐ Technology Limitations  
☐ Scheduling logistics  
☐ Out of state licensure/regulatory concerns  
☐ Concerns regarding reimbursement  
☐ Low provider comfort  
☐ Lack of interest from provider  
☐ Lack of interest from patients  
☐ Concern for low utility given lack of in-person assessments (VS, PE, weight, PFTs, sputum/throat culture)  
☐ Lack of institutional support  
☐ Patient privacy concerns  
☐ Other

Please explain  
__________________________________________

Approximately how many Pulmonary patients have you seen by telehealth?  
☐ 1-10  
☐ 11-25  
☐ more than 25

What platform do you most commonly use to conduct telehealth visits?  
☐ Zoom  
☐ SBR  
☐ EPIC Video  
☐ Doxy.Me  
☐ Doximity Dialer  
☐ Cisco Jabber  
☐ Microsoft Teams  
☐ Avizia/Amwell  
☐ Facetime  
☐ Phone Call  
☐ Cisco WebEx

How do you access your telehealth platform?  
☐ Cellphone/Smartphone  
☐ Computer/Laptop  
☐ Tablet/iPad

Are your visits conducted mostly with audio only or audio plus video?  
☐ Audio only  
☐ Audio plus video

Where do you conduct your telehealth visits?  
☐ Mostly from home  
☐ Mostly from office  
☐ About half and half
<table>
<thead>
<tr>
<th>Question</th>
<th>Response Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>On the platform that you use most, do you have the ability to share your screen with patients if desired?</td>
<td>Yes, No</td>
</tr>
<tr>
<td>If used, how did you use your screen share? (select all that apply)</td>
<td>Show imaging and/or lab results, Reviewing growth curve, Share educational materials, Other, Did not use</td>
</tr>
<tr>
<td>Please describe</td>
<td></td>
</tr>
<tr>
<td>Have you experienced technical difficulties logging onto or during telehealth visits?</td>
<td>Yes, No</td>
</tr>
<tr>
<td>How did these technical difficulties impede the visit, if at all?</td>
<td>Issues were quickly resolved, Issues took some time, but we were able to complete visit, Visit terminated as a result</td>
</tr>
</tbody>
</table>

**Please 1 to 5 scale for the following questions**

<table>
<thead>
<tr>
<th>Question</th>
<th>Scale Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>How satisfied are you with your overall experience utilizing telehealth services in the care of Pulmonary patients?</td>
<td>1 (not at all satisfied), 2, 3 (neutral), 4, 5 (completely satisfied)</td>
</tr>
<tr>
<td>How do you think the lack of pulmonary function testing impacts the care provided through telehealth?</td>
<td>1 (No impact on patient care), 2, 3, 4, 5 (Challenging to patient care)</td>
</tr>
<tr>
<td>How do you think the lack of vital signs impacts the care provided through telehealth?</td>
<td>1, 2, 3, 4, 5</td>
</tr>
<tr>
<td>How do you think the lack of weight impacts the care provided through telehealth?</td>
<td>1, 2, 3, 4, 5</td>
</tr>
<tr>
<td>How do you think the lack of physical exam impacts the care provided through telehealth?</td>
<td>1, 2, 3, 4, 5</td>
</tr>
</tbody>
</table>
How do you feel telehealth affects the clinician-patient relationship?

<table>
<thead>
<tr>
<th>1 negatively</th>
<th>2</th>
<th>3 neutral</th>
<th>4</th>
<th>5 positively</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Do you feel that you received adequate training in how to utilize your telehealth platform?

- Yes
- No

Would you be interested in receiving additional training on practicing via telehealth?

- Yes
- No

Of telehealth visits performed so far, what proportion do you feel should have been conducted in person?

- None
- Few
- Some
- Most
- All

Compared to in person office visits, telehealth visits are:

- More efficient than in person visits
- About the same efficiency as in person visits
- Less efficient than in person visits

If telehealth visits were to be offered in the future for routine patient care, about how many visits per year would you prefer to be completed by telehealth?

- None
- Some visits
- Most visits
- All visits

Would you be interested in technology that might allow for PFT or oximetry assessment at home?

- Yes
- No

Please provide any additional comments you may have

__________________________________________
Rapid Implementation of Telehealth Services in a Pediatric Pulmonary Clinic During COVID-19

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*Pediatrics* originally published online February 25, 2021;
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The online version of this article, along with updated information and services, is located on the World Wide Web at:
http://pediatrics.aappublications.org/content/early/2021/02/23/peds.2020-030494.citation