



## Telemedicine in the perioperative experience



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### ABSTRACT

Telemedicine, the remote diagnosis and treatment of patients by means of technology, provides an alternative means for patients to gain access to health care services. Telemedicine is a general term that includes the use of various communication technologies, including telephone, email, or videoconferencing. Telemedicine has the potential to reduce inefficiencies in the delivery of healthcare, diminish patient travel and wait times, and increase access to specialists for patients in rural settings. We review the use of telemedicine in the perioperative phase of care for pediatric surgical patients, their caregivers, and surgical providers, including pre-operative assessments, and post-operative follow-up. We also discuss physician billing compliance with remote telemedicine consultation and explore the barriers to adoption among the caregivers of pediatric surgery patients.

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### Introduction

Telemedicine, in the broadest sense, is provision of remote medical care using technology, rather than through an in-person encounter. Though telemedicine has been in place for more than 50 years in some rural settings, a broader interest was fueled by the more recent implementation of the Affordable Care Act, which encouraged the rapid advancement of available technologies for use in the medical field.<sup>1</sup> Telemedicine can address the healthcare disparity that exists between patient needs and healthcare availability. Such access problems persist because of lack of available public transportation, financial constraints on patients, and other fiscal deterrents. Telemedicine has the potential to minimize these barriers in access to tertiary medical care, both in the United States and abroad.<sup>2</sup> Academic health centers (AHCs) are at the forefront of telemedicine because they generally employ a large cadre of highly specialized providers, have the most technologically advanced equipment, and often play a large role in community health and community partnerships.<sup>3</sup>

Telemedicine adoption by pediatric surgical subspecialists and their patients is still in an early phase. A PubMed search for “pediatric surgery telemedicine” in January of 2018 yielded 138 English language results, with eighteen manuscripts specific to

general pediatric surgeons, and eleven addressing telemedicine in a clinical setting involving pediatric general surgery patient.<sup>1,4–13</sup> Access to pediatric surgical care remains unevenly distributed throughout the United States.<sup>14</sup> Barriers to access include the inability to pay, lack of insurance, distance to quality tertiary care facilities, inadequate knowledge, limited transportation resources, and time constraints, particularly for working families. In 2006, 97% of rural counties lacked any pediatric surgeons, which is a small improvement from 1981, when 99.3% of rural counties lacked these services.<sup>15</sup> The disparity in geographic access to pediatric surgical services is also demonstrated in other countries with significant regionalization of healthcare services, including Canada and Australia.<sup>4,10</sup> Over the past three decades, the pediatric surgical workforce has expanded rapidly with a significant increase in the number of subspecialists. While pediatric surgical subspecialists have seen a 175% increase in their numbers over the past decade, there is an uneven distribution of specialists with the majority practicing in urban centers.<sup>14</sup>

The objective of this report is to provide an overview of the common uses of telemedicine in the perioperative phase of treatment of common pediatric surgical problems. Specifically, we will review the use of telemedicine in preoperative consultations and postoperative follow-up.

### Need for preoperative surgical teleconsultations

Rural Americans travel farther than urban residents for medical and surgical care.<sup>16</sup> Surgical subspecialists are typically located in

Abbreviations: AHC, Academic Health Centers; PCP, Primary Care Practitioner; MUSC, Medical University of South Carolina.

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urban centers, usually requiring a significant travel commitment from the rural patient seeking outpatient surgical consultation. Outpatient clinic visits are clearly associated with significant out-of-pocket expenses for some families. Indirect costs of accessing healthcare, including transportation, parking, lodging, meals, and time away from school or work represent a significant burden to patients. One study found that indirect expenses for accessing a perioperative clinic visit for pediatric general surgery or urology was greater than \$50 for 33% of patients, with 74% of parents missing work.<sup>4</sup> In addition, the time of travel burden was significant. Nearly a fifth of families traveled over 200 kilometers round trip to attend a clinic visit, with a third of patients spending more than four hours traveling round trip. Because of the high cost burden and time commitment of attending even a single medical visit, addressing these barriers using telemedicine technology to care for rural patients may be beneficial for multiple stakeholders.

The AHC offers a variety of services to the surrounding community, typically with advanced technology.<sup>3</sup> Although it is unclear how health care reform will change the delivery of healthcare, the development of accountable care organizations and the emphasis on quality may promote stronger bonds between communities and their regional partners. Telemedicine consultations between rural patients and AHCs are most commonly performed in a “hub and spoke” type system.<sup>2</sup> Synchronous telemedicine consultations between the surgeon and patient use videoconferencing technology to allow the surgeon to evaluate a patient remotely. While some large AHCs offer remote synchronous telemedicine consultations in adult general surgery, use of telemedicine in the preoperative setting in pediatric surgery is an emerging field in the US.

### Development of pediatric surgical teleconsultation programs

While teleconsultation in pediatric surgery remains in the earliest stages of development, we describe a state-funded, sustainable “hub and spoke” model of teleconsultations between an AHC and rural primary care provider (PCP) offices. Patients in rural, medically-underserved areas of South Carolina faced multiple barriers to specialty care that have proven difficult to overcome, termed the “rural penalty.” To address this health care disparity, we designed a pilot program using cost-effective, simple technology to connect patients in their PCP’s office to subspecialists at the Medical University of South Carolina (MUSC). This interdisciplinary demonstration project combined the resources and expertise of a tertiary academic medical center and its large network of specialists, the insight from an established state-wide regional education consortium with long-standing experience and involvement in rural regions, community-based PCPs and an information technology group at MUSC with experience and access to software, hardware and networking infrastructure.

With initial grant monies from the Duke Endowment in 2011, we designed a “hub-and-spoke” model (see Fig. 1) using a simple software technology, called Jabber™, which provides secure, private video-conferencing on network computers at the “hub” to dedicated, locally-built carts (see Fig. 2). Because the PCP practices often do not have dedicated exam rooms for telemedicine consultation, these rural sites required a mobile cart that could be stored in a closet and placed into any room. The carts use standard wireless broadband technology that is guaranteed for these rural sites by a state agency. The “home grown” carts are composed of a desktop computer, flat screen monitor, and a high definition videoconferencing camera mounted on a rolling cart, and typically cost around 3800 dollars. Plug-in devices include a high-definition zoom camera, stethoscope, otoscope, or ophthalmoscope, as dictated by the needs of the PCP or subspecialist.

Using traditional clinic scheduling processes, patients are referred by PCPs to specialists at the AHC. Pediatric general surgery was an early participant in this program and we began seeing patients for preoperative consultation in 2014. These consults are scheduled during the pediatric surgeon’s dedicated clinic time into a “tele-consult” type visit. The pediatric surgeon uses video-conferencing software with an inexpensive camera to perform the video consultation. Any imaging or laboratory results are submitted in advance. The physical exam portion is the limiting factor in any teleconsultation, and can be greatly aided by the presence of a trained telepresenter. In the case of a PCP office, the telepresenter can be a physician, physician extender, or nurse who aids in the use of the equipment and in the performance of the physical exam. The cardiac and pulmonary exams must be performed by using a stethoscope that connects to the teleconsultation cart by USB cable. The abdominal and genitourinary exams are performed by the telepresenter under the supervision of the pediatric surgeon. Because of the physical exam limitations of teleconsultation, we have found that a virtual teleconsultation clinic for pediatric surgery is most effective with a limited list of diagnoses, including burns, umbilical hernias, umbilical masses, and circumcision evaluations. Inguinal hernias, undescended testes, and hydroceles can be evaluated with a more experienced telepresenter.

As of late 2017, there are 102 participating PCP sites around SC, in 43% of SC counties, with approximately half of those regularly using the teleconsultation service. Pediatric subspecialty consultations make up less than 10% of the consults done statewide by the teleconsultation service. Most teleconsultations are done by pediatric and adult psychiatry and nutrition services, with more than 1200 consults per year. In terms of general pediatric surgery, utilization of the virtual teleconsultation service has been slowly increasing over the past 3 years. We completed 21 consults in 2016 and approximately 35 in 2017. The majority of teleconsultations were for burns, umbilical hernias, and neonatal circumcision evaluations. Over the past year, we have seen a shift in pediatric surgical patients being referred to “telemedicine outposts,” rather than through the teleconsultation services in PCP offices. These outposts are MUSC-owned, brick-and-mortar structures that have dedicated teleconsultation facilities and telepresenters. This shift has occurred likely due to the infrequency of pediatric surgical consults at individual offices and the need for more consistent telepresenter experience than can be garnered at individual PCP offices.

Similar hub-and-spoke model telemedicine programs have been established at other children’s hospitals around the country. Children’s Mercy Hospital in Kansas City, Missouri established a pediatric telemedicine program in Kansas and Missouri in 2012 with dedicated telemedicine space in three rural outreach clinics. The program allowed patients in rural communities to travel to outreach clinics closer to their homes and connect via synchronous two-way videoconferencing technology to pediatric subspecialists at the hospital’s main campus in Kansas City, Missouri. Each clinic utilized a telemedicine cart including peripherals such as a high definition handheld zoom camera, stethoscope, otoscope, and ophthalmoscope. A nurse telepresenter at each site assisted with the physical exam under the supervision of the distant site pediatric subspecialty provider. The success of the program within pediatric medical subspecialties led to expansion into pediatric surgery in 2014. During the first two years over 170 pediatric surgical telemedicine visits were completed, including 100 new patient visits for over 40 different diagnoses. During this period, there were no limitations provided for diagnoses seen by telemedicine.

When implemented on a national scale with a highly regionalized system of care, telemedicine can be a sustainable service for pediatric surgical services. In Australia, the Queensland

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