THE FEASIBILITY AND SATISFACTION OF USING TELEMEDICINE TO PROVIDE TERTIARY PEDIATRIC OBESITY CARE

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Abstract

Although telemedicine in paediatric tertiary care has been tried, satisfaction and outcome data is limited due to small sample sizes and the variation of methods and personnel by which telemedicine technology is delivered and participants assessed. Aim: our objective was to determine the feasibility of using telemedicine to deliver Paediatric tertiary obesity care and to evaluate Patient/Physician/Staff satisfaction. Method: we used a commercially available telemedicine system to conduct a prospective study where 30 patients in a Paediatric Healthy Life Centre Outpatient Clinic were evaluated by a specialist physician using telemedicine technology. A qualitative assessment of the patient/physician/staff perceptions of telemedicine use was assessed through a five-point Likert Scale and free text answers. Results: of the 30 patient sessions, 27 (90%) consultations were performed to completion. Fifteen consultations were initial assessments. Physician, staff and patient responders agreed that the use of telemedicine is an appropriate and effective use of the clinician's skillset and time (≥96%), and can avoid patient travel from an underserved area to a tertiary care clinic (≥95%). Responders were comfortable and satisfied using the telemedicine equipment (≥85%). Physician and patients agreed that the telemedicine equipment helped the patient avoid a face-to-face visit (≥90%). Physician and patients felt the technology was effective in the management of their visit (≥93%). Conclusions: we successfully delivered tertiary obesity care through the use of telemedicine equipment in different clinical situations associated with paediatric obesity. Telemedicine is feasible, and is a realistic, successful and cost-effective modality to provide well-received specialty care for the obese paediatric population.

Keywords: telemedicine; telehealth; obesity; adolescent; tertiary care

Introduction

The prevalence of overweight and obesity among children in the United States has increased rapidly over the past several years, increasing from 5% in 1963-1970 to 17% in 2011-2012.[1-3] It is now a public health epidemic. There has been a shift in clinical care from simple identification to universal assessment, prevention and early intervention divided into four treatment stages.[2,4] The Expert Committee Recommendations for the Prevention And Treatment of Paediatric Obesity state that a patient with a body mass index (BMI) > than 95th percentile for their height and weight who has failed lifestyle modifications (Stage 1&2 Treatment Interventions), should be referred to a tertiary care weight management centre where Stage 3&4 Treatment Interventions are available. [2] The tertiary care centre works to maximise the support for behaviour changes with specialist involvement and makes available medication and weight control surgery for severely obese youth.[2] Rural children are more likely to be obese than urban children but are less likely to have access to treatment.[5] There is a paucity of such centres in rural areas as they are confined to paediatric medical centres and because of this, access is limited by many factors such as distance, insurance, time-loss, and difficulty in followup.[2]

Previous research indicates that Telemedicine is useful for services such as cardiac auscultation, Type 1 Diabetes management in children and adolescents, and psychiatry services.[6-9] Paediatric obesity treatment largely includes education, counselling, and behavioural therapy, which does not require hands-on contact or regular physical exams, lending itself to the use of telemedicine, providing an innovative outlet for reducing health disparities in rural populations and improving access to this type of care.[9] There has been some work using telemedicine to deliver obesity care. Lipana et al. reported a retrospective analysis where

substantially more telemedicine visit patients were successful in weight loss, weight maintenance, or slowing of weight gain compared to patients who took part in face-to face-visits.[10] Mulgrew et al. reported improved clinical outcomes by using telemedicine to allow endocrinologists and weight management specialists to consult with primary care providers and patients to recommend management options.[11] Davis et al reported that a telemedicine intervention for family-based obesity treatment was well received and highly feasible and that there were no differences between conditions on major outcome variables.[12,13] However, to our knowledge, there has not been any prospective study to demonstrate the feasibility of the full tertiary care evaluation, and assessment of a paediatrics patient not only for weight management but for other comorbidities associated with obese children. In our institution, we provide evaluation, assessment, and treatment of obese children and any comorbidities such as hypertension, diabetes, dyslipidaemia, non-alcoholic fatty liver (NASH), or polycystic ovarian syndrome (PCOS). Patient-centric lifestyle modifications are provided in detail within the family's cultural beliefs. Exercise and behaviour modification therapy are also specifically provided within the patient's and family own set of barriers including access to healthy food choices, safe areas for exercise and financial constraints.

At the University of South Alabama, Department of Paediatrics, Division of Adolescent Medicine, Paediatric Healthy Life Center (PHLC), an outpatient tertiary care clinic located, in Mobile, Alabama, we sought to determine the feasibility of providing a full patient encounter using a telemedicine cart with diagnostic medical equipment (DME). A pre-study needs assessment identified an audio-video system with a Bluetooth enabled stethoscope necessary to perform a complete evaluation. Furthermore, we sought to identify the level of satisfaction of the encounter expressed by the patients/family member, Registered Nurses (RN)/ Certified Registered Nurse Practitioner (CRNP)/paediatric Residents, and expert physician.

Methods

The study was conducted at an outpatient tertiary care clinic, following approval by the University of South Alabama IRB. Two members of the investigative team (RS and DP) evaluated how telemedicine technology could be incorporated into the current workflow in the adolescent clinic to manage children with obesity. Using the information collected in the pre-study needs assessment, we collaborated with JEMS technology® (Orion, MI) to use their portable desktop telemedicine equipment combined with a 3M™ Littmann® Bluetooth stethoscope (Model 3200BK27, 3M, St. Paul, MN).

The components of the telemedicine system included 1) the *telemedicine cart* for use by the RN, CRNP, Residents in one of our patient clinic examination rooms, 2) the *telemedicine workstation* for use by the expert physician on the other side of the clinic in the medical director's office, and 3) the *telemedicine web-based software*.

The telemedicine workstation consisted of a Microsoft® Surface Pro computer with components added for telemedicine; these components are listed in Table 1.

Table 1. Telemedicine system components.

Telemedicine Cart
Portable office cart
JEMS all-in-one portable PC
SONY HD-USB PTZ camera
3M™ Littmann® Electronic Stethoscope
Secure wireless Internet connection
Single-line corded telephone with speaker capability
Telemedicine Workstation
Microsoft® Surface Pro 3 12-inch tablet
SONY® XB950B1 extra base wireless headphone
Apple® Ipad 2 running JEMS iOS application
Single-line corded telephone with speaker capability

The telemedicine software used was developed by JEMS technology®, a web-based platform. The platform provides a secure, HIPAA-compliant and reliable way to connect and transmit, video, from patients using a SONY® PTZ camera to the physician site. The physician used JEMS iOS application previously installed on Apple® Ipad 2 to view live streaming of the patient. We used the 3M™ Littmann® Bluetooth stethoscope and associated software, 3M™ Littmann® TeleSteth™, to perform physical examinations over lungs and heart. All data were transferred unidirectionally using a secure Internet connection. Each telemedicine consultation was documented within the PHLC's electronic medical record, NextGen® (Horsham, PA), which allows patient follow up through the continuum of care. We acknowledge the existence of bi-directional interactive video conferencing telemedicine technology, however, this technology is often prohibitive to the general

paediatricians in underserved/rural/remote areas due to the cost and high bandwidth requirement. Unidirectional audio was chosen in an effort to test the simplest, least expensive version of telemedicine technology.

To evaluate the project's feasibility and the perceptions of those involved, four distinct surveys were developed: Physician-Pre, Physician-Post, RN/CRNP/Resident-Post and Patient/Family-Post. The physician completed the Physician-Pre survey prior to each telemedicine visit/session to collect basic information about the patient, the reason for the consultation, other comorbidities, and other descriptive information. At the conclusion of each consultation, a post-consultation survey was completed by the same physician. This survey included additional questions regarding the impact of the telemedicine session on medical decision-making, and whether the technology prevented the need for a face-to-face visit between the patient and the consulting clinician. The RNs/CRNPs/Residents who used the telemedicine cart in the patient's room completed a different post-consultation survey designed to collect additional information pertaining to the encounter. This survey included many of the same questions as the Physician-Post survey but was intended to obtain the RN/CRNP/Resident's perspective. The Physician-Post and RN/CRNP/Resident's -Post surveys both included questions regarding the perception of quality of the actual care provided with the video conferencing for those surveyed. The pre and post surveys were linked using a unique session identifier that was used randomly at the discretion of the first author. The patient or family completed a survey at the end of telemedicine session, which was similar to the RN/CRNP/Resident survey assessing the perceptions of their comfort with and quality of care received during the telemedicine visit.

Responses for all questions were structured using a 5-point Likert scale (ranging between strongly disagree (1), disagree (2), neutral (3), agree (4) and strongly agree (5)), as well as free-text comments, and remarks. We used paper-based questionnaires to conduct the survey.

Prior to deployment of the system, investigator RS trained the Physician and RN/CRNP/Residents in one-on-one sessions. The first part of the training focused on working the Telemedicine cart, desktop computer, JEMS web-based software, DME, and basic troubleshooting. The second part of the training asked participants to demonstrate their skills in a simulated patient scenario.

We conducted a feasibility study between Feb 2016 and Aug 28, 2016, at PHLC. Upon arrival of a scheduled patient to the clinic, they were asked if they were willing to participate in the above-study. If they agreed to participate in the study, initial appropriate paperwork and consent were obtained. Basic demographics and a questionnaire regarding their history of present illness, past medical history, family history, and dietary and exercise habits were collected by the initial triage RN. The RN/CRNP/Resident set up the telemedicine cart in the patient's room while the expert physician reviewed the medical record and questionnaire. After which, the Physician-Pre survey was completed. The RN/CRNP/Resident remained in the patient's room during the consultation, ensuring that the telemedicine cart was functioning appropriately, moving the cart as needed, manipulating and using the DME, and reassuring or interacting directly with the patient in a face-to-face manner. The IT support team from the University of South Alabama and the author RS were available during each consultation as needed. Patients were granted $25 at the end of telemedicine session.

The patient's room in the PHLC was considered the originating site of the telemedicine consultation. The expert physician was located at his office on the other side of the clinic, physically separate from the patient's room. Verbal communication between the CRNP/RN/Resident/patient and the expert physician took place via a landline in each patient room. The expert physician's office was considered the distant site of the telemedicine consultation. Having the Physician in the medical clinic in the PHLC ensured that if there were any concerns generated by medical staff, patient or family, the physician could complete the consultation face-to-face and also to visit the patient at the end of the telemedicine session (Figure 1).

Upon completion of the telemedicine consultation the Physician-Post, RN/CRNP/Resident-Post and Patient/Family surveys were completed. The expert physician completed his assessment and plan in the PHLC EMR.

Analyses of survey data included content analysis of free-text answers, and descriptive statistics, including means, standard deviations, and percentages using Microsoft® Excel®. Likert scores of 4 and 5 (agree and strongly agree) and scores of 1 and 2 (strongly disagree and disagree) were combined respectively, in the final

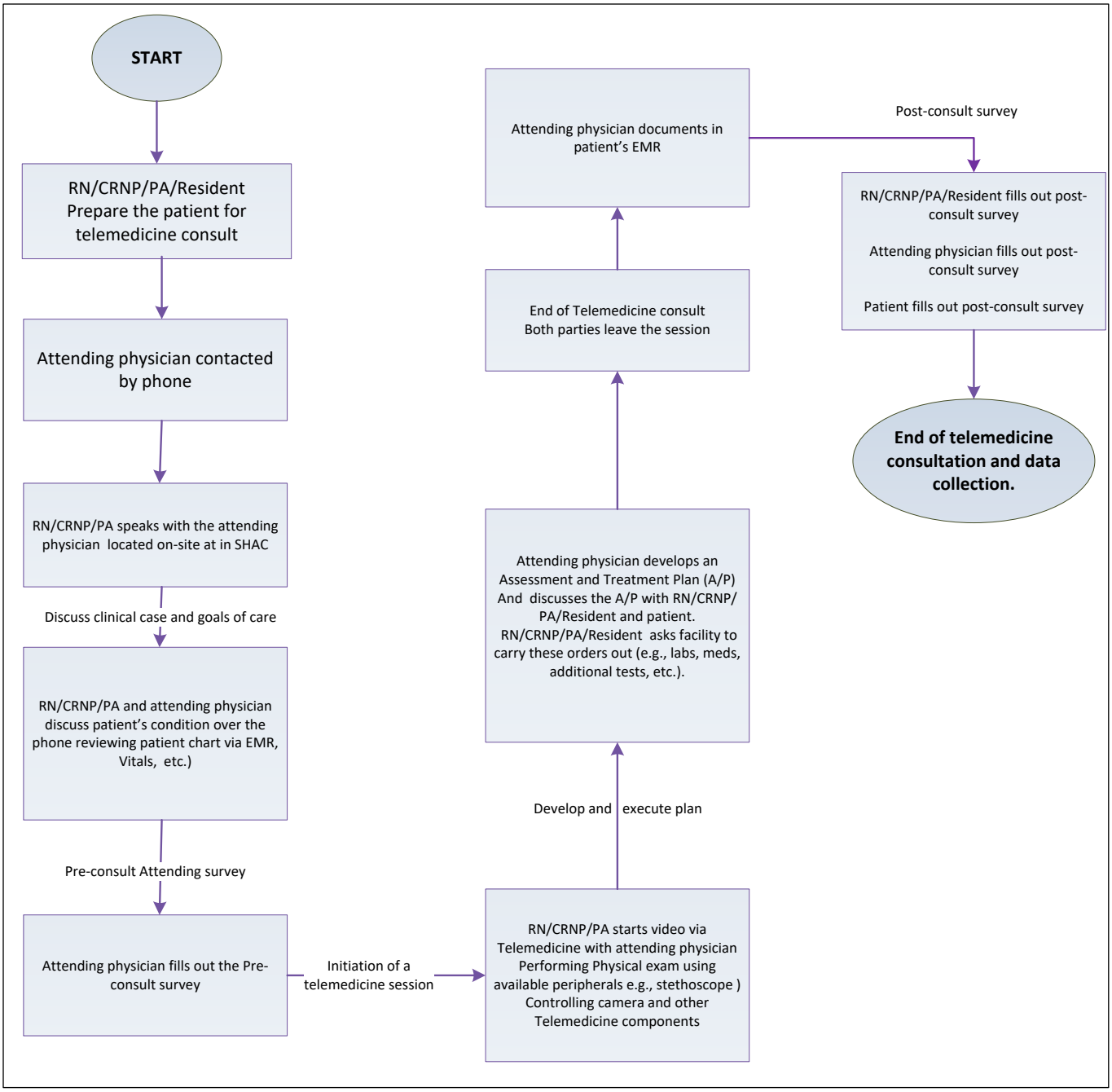

Figure 1. Workflow and data collection.

analysis. The neutral responses were reported individually.

Results

Thirty patients with a mean age of 14.5 ± 2.4 y agreed to participate in the study (Table 2).

Most patients were female 17 (57%) and African American 19 (63%). There were 6 (20%) Caucasians, 1 (3%) Hispanic and the origins of 4 (13%) were not recorded. During the 6-month study period, one expert physician, two CRNPs, one RN and two Interns in a paediatric training residency, initiated a total of 30 telemedicine consultations, with 27 consultations being completed. The three incomplete sessions were due to the inability to connect with the JEMS server. Once the telemedicine session initiated, the consultation took an average of 21 ± 11 min to complete. The majority of

consultations completed 15 (56%) were initiated for an initial assessment. The stethoscope was used with 24 patients (89%) and laboratory tests were ordered for 19 patients (60%). In addition to weight concern, the most common comorbidities associated with the telemedicine consultations were Acanthosis Nigricans (67%; 20/27), followed by lipid disorder, diabetes, PCOS, hypertension and orthopaedic related injuries (7%; 2/27). Data transmission rates averaged 100Mb/s up and 100Mb/s down.

The physician found the video stream quality to be acceptable, in all but one consultation, 26/27 (96%) (Table 3, question 3.1). He was able to hear the other person using the telephone adequately in 26/27 (96%) of the sessions (question 3.2). In the 24 sessions where the 3M™ Littmann® Bluetooth stethoscope was used to assess the heart or lungs, there were 4 sessions where the physician responded that he could not hear to his satisfaction. Additional ratings of the telemedicine system are shown in Table 3.

The telemedicine system was effective in the medical management of all patients and an effective use of the RN/CRNP/Resident's skillset and time. The telemedicine system allowed provision of appropriate care, thereby avoiding a face-to-face visit by an attending physician 96% (26/27) of the time (Table 4, question 4.6). The neutral response given by the physician was due to a Wi-Fi connectivity issue with our Microsoft Surface Pro®.

The physician reported that he was unable to complete an adequate physical exam in 3 of 27 cases (Table 4, question 4.4). These were sessions where the physician felt unable to adequately assess the abdomen, could not hear heart sounds to his satisfaction and could not evaluate the patient's genitalia, respectively. These sessions did not include the session scored as neutral in question 4.6. In one session, the clinic's EMR could not be accessed and the plan of care could not be documented in the medical record but this was not attributed to errors with the telemedicine equipment.

The RN/CRNP/Resident responded that they were able to use the telemedicine equipment to support the needs of the Physician 74% of the time (20/27) (Table 5, question 5.3). Seven sessions (19%) were deemed neutral or unsatisfactory. Free text comments indicated that in six of these seven sessions, the 3M™ Littmann® Bluetooth stethoscope was not immediately functional or had intermittent connection errors. One of the seven sessions was deemed unsatisfactory due to physician's delay in connecting to 3M™ Littmann® TeleSteth™ soft-

Table 2. Patient and telemedicine consultation characteristics.

Telemedicine Consultation n=27			
Consult for an initial assessment	15 (56)	Nonalcoholic steatohepatitis	0 (0)
Consult for follow up visit	12 (44)	Acanthosis nigricans	20 (67)
Weight concern	27 (100)	Dysmenorrhea	1 (3)
Diabetes mellitus	2 (7)	Polycystic ovary syndrome (PCOS)	2 (7)
Impaired glucose tolerance	1 (3)	Hypertension	2 (7)
Pseudotumour cerebri	1 (3)	Eating disorder	1 (3)
Lipid disorder	2 (7)	Used digital stethoscope	24 (89)
Orthopaedic related injuries	2 (7)	Ordered laboratory tests	18 (60)

Table 3. Physician/RN/CRNP/Resident assessment of the telemedicine technology.

Expert Physician Perceptions:	Strongly Agree and Agree n (%)*	Neutral	Disagree and Strongly Disagree
3.1 I was able to see the patient and/or images on the screen without delay, choppiness, or interruption in video quality	26 (96)	1 (4)	0
3.2 I was able to hear the RN/CRNP/Resident without delay, choppiness, or interruption in sound quality	26 (96)	0	1 (4)
3.3 I was able to hear the heart sounds adequately	21** (88)	1 (4)	2 (8)
3.4 I was able to hear the lung sounds adequately	20** (83)	2 (8)	2 (8)
RN/CRNP/Resident Perceptions:			
3.5 I was able to hear the Physician without delay, choppiness, or interruption in sound quality	27 (100)	0	0

*All percentages calculated out of a total of 27 completed sessions. ** The stethoscope was used in 24 of the 27 cases completed.

ware. The physician survey also identified this issue in free text comments and rated this session neutral.

RN/CRNP/Resident felt that the telemedicine system allowed provision of appropriate care, therefore avoiding a face-to-face visit by an expert physician in 24 (89%) cases (Table 5, question 5.4). One out of 27 sessions was assessed as neutral and 2/27 (7%) sessions were deemed unsatisfactory. The cases deemed unsatisfactory for question 5.4 were the same cases identified in question 5.3. RN/CRNP/Resident felt comfortable and satisfied using the telemedicine equipment 85% of the time (23/27) (Table 5, question 5.7). Three respondents were neutral and one was dissatisfied. These were the same cases identified in questions 5.3 and 5.4. Despite dissatisfaction with the equipment in some sessions, providers did not have to

Table 4. Physician perception of the impact of telemedicine consultation on clinical staff and patient care.

	Strongly Agree and Agree n (%)*	Neutral	Disagree and Strongly Disagree
4.1 The patient seemed comfortable communicating during the telemedicine consult.	27 (100)	0	0
4.2 The RN/CRNP/Resident seemed comfortable communicating during the Telemedicine consult.	27 (100)	0	0
4.3 I was able to obtain an adequate history of present illness, past medical history, and review of symptoms.	27 (100)	0	0
4.4 I was able to complete an adequate physical exam.	24 (89)	1 (4)	2 (7)
4.5 I was able to document an adequate assessment and plan within the medical record.	26 (96)	0	0
4.6 The Telemedicine equipment allowed me to provide appropriate care while helping the patient avoid a face-to-face visit by an attending physician.	26 (96)	1 (4)	0
4.7 The use of Telemedicine is an appropriate and effective use of the RN/CRNP/Resident's skillset and time.	27 (100)	0	0
4.8 The Telemedicine consult can avoid patient travel from an underserved area to the tertiary care clinic.	27 (100)	0	0
4.9 Overall, I was comfortable and satisfied using the Telemedicine equipment.	27 (100)	0	0
4.10 Overall, I found the technology effective in the medical management of this patient	27 (100)	0	0

*All percentages calculated out of a total of 27 completed sessions.

Table 5. RN/CRNP/Resident perceptions of the impact of telemedicine consultation on clinical staff and patient care.

	Strongly Agree and Agree n (%)*	Neutral	Disagree and Strongly Disagree
5.1 The patient seemed comfortable communicating during the telemedicine consult.	27 (100)	0	0
5.2 The physician seemed comfortable communicating during the telemedicine consult.	27 (100)	0	0
5.3 I was able to use the telemedicine equipment to support the needs of the Physician.	20 (74)	2 (7)	5 (19)
5.4 The telemedicine equipment allowed me to provide appropriate care while helping the patient avoid a face-to-face visit by the attending physician.	24 (89)	1 (4)	2 (7)
5.5 The use of telemedicine is an appropriate and effective use of attending physician's skillset and time.	26 (96)	1 (4)	0
5.6 The telemedicine consult can avoid patient travel from an underserved area to the tertiary care clinic.	26 (96)	0	1 (4)
5.7 Overall, I was comfortable and satisfied using the telemedicine equipment.	23 (85)	3 (11)	1 (4)

*All percentages calculated out of a total of 27 completed sessions.

stop the session before its completion in these cases. Dissatisfaction with equipment usage had very little impact on the RN/CRNP/Resident perceptions that telemedicine can avoid patient travel from an underserved area to the tertiary care clinic with only one respondent disagreeing (Table 5, question 5.6). No free text responses were given by this respondent.

The patient/family member agreed or strongly agreed that the telemedicine system was effective in the medical management of their visit 25/27 (93%) (Table 6, question 6.5). One respondent was neutral and one respondent was dissatisfied with the visit. For 26 (96%) of the sessions, they reported the use of telemedicine was an appropriate and effective use of the RN/CRNP/Resident's skillset and time (Table 6, question 6.2). They all felt that the telemedicine system allowed the physician to provide appropriate care, therefore avoiding a face-to-face visit by an attending physician (Table 6, question 6.1). The free text response provided by the dissatisfied respondent to question 6.5 expressed the preference for a face-to-face visit but no specific reason for the preference was provided. Otherwise no free text responses were given.

In all cases the physician and patient/family member agreed or strongly agreed that the telemedicine consult can avoid patient travel from an underserved area to the tertiary care clinic.

Discussion

To our knowledge, there have not been previous prospective studies to demonstrate the feasibility of the full tertiary care evaluation and assessment of a paediatric patient with BMI > 95%. Management of childhood obesity involves developing a long-term relationship between the patient, their care givers and the providing physician. This is in contrast to other studied telemedicine workflows like tele-radiology where the clinician provides an impression and then moves on. We sought to determine the feasibility of providing a full patient encounter using a telemedicine cart with DME in real time and to identify the level of satisfaction with the encounter expressed by the patients, nurses, and expert physician.

Our results show that both an expert physician and RN/CRNP/Residents and Patient/Family were similar in perceiving that telemedicine was an appropriate and effective use of their skillsets and time, providing appropriate care without a face-to-face visit by the consulting clinician.

The finding that both the expert physician and Patient/Family agreed the telemedicine technology was effective in the medical management of the patient is encouraging. All group responses were particularly encouraging given the various impacts that the telemedicine unit imposed on workflows. Perhaps most notably, the telemedicine system changed the role of the RN/CRNP/Residents from simply discussing the patient condition with the attending physician, to actively participating in the diagnosis and management of the condition, and requiring them to develop a new skillset to use this technology. The telemedicine cart provided additional value to the expert physician, who obtained additional information from the use of DME, audio, and video that might not otherwise be available for off-site telephone consultations. These findings are particularly relevant, given low access to providers in under-served areas and the rise in patient-centred models of care in today's era of medicine. We tried to envision and use the simplest version of telemedicine

Table 6. Patient/ Family Perceptions of the Impact of Telemedicine Consultation on Clinical Staff and Resident.

	Strongly Agree and Agree n (%)*	Neutral	Disagree and Strongly Disagree
6.1 The telemedicine equipment allowed the physician to provide appropriate care while helping the patient avoid a face-to-face visit by an attending physician.	27 (100)	0	0
6.2 The use of telemedicine is an appropriate and effective use of the RN/CRNP/Resident's skillset and time.	26 (96)	0	1(4)
6.3 The telemedicine consult can avoid patient travel from an underserved area to the tertiary care clinic.	27 (100)	0	0
6.4 Overall, I was comfortable and satisfied using the Telemedicine equipment.	27 (100)	0	0
6.5 Overall, I found the technology effective in the medical management of my visit.	25 (93)	1(4)	1(4)

*All percentages calculated out of a total of 27 completed sessions.

technology available that could actually provide benefit, in order to allow this to be translated to the communities/areas with very limited resources. It is possible that the integration of telemedicine led by physicians can further increase access to high-quality medical care for adolescent and childhood obesity in remote rural communities and to reduce negative outcomes due to lack of access to physicians in those circumstances.

Although there is a paucity of studies evaluating videoconferencing's feasibility and effectiveness of telemedicine consultations for obesity among children and adolescents, a study by Lipana et al. demonstrated in a retrospective analysis, that telemedicine was an effective strategy to care for childhood obesity in remote areas.[10] Given our study is the first feasibility study in real time management, we focused on the feasibility of using the technology as well as identifying strategies for staff acceptance and therefore did not include any patient-specific outcomes.

The results from our study provide information on the perspectives, concerns and expectations regarding the utility of telemedicine in the management of obesity in adolescent tertiary care. There was an almost universal theme for the failed sessions/dissatisfaction from providers that had to do with the reliability of the equipment and the confidence/skillset to troubleshoot when errors occurred. This indicates that technology education and skillset development are important aspects of a telemedicine program as well as a reliable Wi-Fi signal to ensure consistent connectivity.

Our results suggest that video conferencing, as a feature of telemedicine may be useful on an ongoing basis in tertiary care centres. This is a relatively affordable technology that could avoid burden and cost for the providers and patients and reduce no-show rates in tertiary care centres. Providers are able to receive a real-time consult from a specialist with minimal investment in technology, as well as improve confidence in local medical systems by providing access to this specialty care. Patients who may have difficulty accessing larger medical institutions due to economic hardship or geographic isolation can access these specialty services without excess costs. Results also revealed that those who were involved recognised improvements in the quality of care that can be implemented in the future with the use of this technology.

This study is limited by its focus on feasibility and not on patient or provider specific outcomes such as long-term weight loss management, dietary modification or behavioural intervention. Our study was also limited to a single outpatient clinic with a relatively small number of patient consultations. This may reduce the generalizability of our findings to other tertiary care centres and patient populations. However, the use of a single clinic and number of encounters studied is consistent with the number of patients that visit our facility. Our study is also limited by the fact that only a single consulting clinician participated as the expert physician due to the lack of specialists in this part of the country.

Telemedicine has the potential to be useful in remote areas. By making this care more convenient to receive and deliver, it has the potential to improve outcomes through improved compliance and increased specialist contact. It would be wise to study the outcome of such implementation to measure short and long-term assessment of weight management, dietary modification, behavioural intervention and no-show rates, in a tertiary care centre in a randomised controlled trial.

Our results support that telemedicine used by an expert physician for consultations of adolescent stage 3 and 4 weight management is perceived to be an effective use of their skillset and time and in the medical management of the patient, and avoids the need for face-to-face visits. We believe that this will provide access to underserved areas and improve compliance with therapy and specialty care.

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Conflict of Interest. The author declares no conflicts of interest.

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