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Using a centralized nursing team to implement multi-specialty pediatric remote patient monitoring programs



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ABSTRACT

Background: The increase in telehealth usage has sustained since the beginning of the COVID-19 pandemic. While Remote Patient Monitoring (RPM) programs are abundantly used in the management of adults, pediatric RPM programs remain rare.

Methods: An RPM department was developed to serve several, multi-specialty pediatric programs. This department uses a centralized nursing team that manages all patients enrolled in RPM programs. Each program is unique and created in partnership with the centralized nurses and the ambulatory care teams. The various programs allow for transmission of patient- and caregiver-generated health data and consistent communication between the patient or caregiver and the managing providers, allowing for real-time plan adaptation.

Findings: Over 1200 patients have been managed through the 18 various RPM programs. Approximately 300 patients are monitored each month by the centralized nursing team. Patient and caregiver experience has been high due to resources offered including on-demand video visits and text messaging with the nursing team.

Discussion: Multi-specialty RPM departments help to expand the reach of an institution and provide care to more patients. Quality improvement must be ongoing to ensure equity of participation and perceived benefit of the programs for both providers and patients and caregivers.

Application to practice: Pediatric RPM programs can improve patient care delivery by decreasing days away from home while improving access to care. Ensuring equitable opportunity for patient participation is imperative in achieving success for an RPM department.

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Background

History of Remote Patient Monitoring

Access to care has grown substantially in importance since the beginning of the COVID-19 pandemic. Within the first six months of 2020, it was estimated the 41% of American adults avoided or delayed care due to stay-at-home orders, facility closures, or other reasons. This created a lack in communication between care teams and patients, causing significant risk for serious safety events and patient harm (Czeisler et al., 2020). While in-person care decreased, telehealth usage surged as an alternative care delivery modality throughout the

pandemic, with a growth of 80 times more than pre-COVID usage in its most heightened state. Usage has stabilized itself throughout late 2020 and early 2021 at about 38 times pre-COVID usage. A consumer survey found that 76% of consumers are interested in using telehealth for care delivery, compared to 11% pre-COVID, demonstrating that telehealth usage will continue to sustain in a post-COVID era (Bestsenny et al., 2021).

One method of telehealth utilized by patients in the home is Remote Patient Monitoring (RPM). RPM can be defined as a modality of telehealth that uses digital health technologies to collect and transmit health data from a patient to their healthcare team. This health data is referred to as patient- and caregiver-generated health data, which is collected in a patient's home environment and electronically transmitted to the healthcare team in either a synchronous or asynchronous way (Foster et al., 2022). The use of RPM grew tremendously throughout the pandemic, as it allows providers to maintain care and proactively treat symptoms associated with chronic disease (Hegde & Eid, 2021). Additionally, providers were able to manage COVID positive

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patients using phone calls and an RPM app, which was safe and more cost effective than simply following the COVID positive patients by phone (Shah et al., 2021).

Several institutions had adopted RPM programs prior to the pandemic. However, a majority of RPM programs served adult populations with very little involvement in pediatrics. One RPM program that focused on pulmonary rehabilitation for older adults supplied patients with equipment then asked them to complete 8-week educational and exercise series while providers reviewed real-time biometric data submitted during these activities, allowing providers to complete rehab sessions during the pandemic (Jangalee et al., 2021). Another monitored heart rate, temperature, oxygen saturation, and severity of symptoms in adult patients diagnosed with COVID to decrease staff utilization for management of these patients (Shah et al., 2021). Additional RPM programs for adults including monitoring those with implanted cardiac defibrillators (Hummel et al., 2019), a prototyped total knee arthroplasty RPM device (Cushner et al., 2022), and continuous glucose monitors (Johnson & Miller, 2022), have shown improved physical outcomes for patients, as well as improved self-management of healthcare needs.

Pediatric RPM programs remain rare, but isolated programs have begun to emerge at children's hospitals in the management of chronic pediatric diseases, including cardiac disease, diabetes, and asthma. Cardiac implantable device use has grown in relevance within pediatrics, and RPM programs allow patients to report their symptoms and cardiac events for review by their managing team (Sasangohar et al., 2018). For those with diabetes, RPM programs that allowed real-time reporting from the patient's continuous glucose monitor helped to reduce provider time spent reviewing data and improve patient management by stabilizing glucoses (Ferstad et al., 2021). A randomized control trial of sensor-based electronic monitoring for asthma revealed improvements in Asthma Control Test scores and improved quality of life, but increase in Emergency Department utilization and hospitalizations (Gupta et al., 2021).

Developing an RPM Department for Pediatrics

In 2017, this institution created the first multi-specialty pediatric RPM department, tailored to meet the needs of several chronic diseases of childhood. Over the last five years, this RPM department has expanded significantly and the dedicated nursing team has implemented 21 novel pediatric RPM programs within 11 hospital specialties. Ten of these programs have been created since the emergence of the COVID-19 pandemic in early 2020. The institution sought to design programs that reach pediatric patients with high healthcare utilization or difficulty accessing care in hopes of preventing serious safety events and minimizing the amount of in-person care a child requires. All programs were developed by the nursing staff in partnership with the ambulatory care teams after identifying the needs of the population and goals of the program. This helps each patient receive an individualized experience tailored to their needs and allows nursing staff to identify the best plan of care for that patient. This institution's RPM programs have three primary aims: 1) decrease in-person healthcare utilization while simultaneously increasing access to care, 2) provide equitable and inclusive care to pediatric patients, and 3) maintain high patient satisfaction in alternative care delivery.

Purpose

The aim of this review is to discuss how a large RPM department with multi-specialty RPM programs has been implemented at an academic, pediatric hospital. Through the successes and failures of the RPM programs, the objective is to provide insight to other healthcare organizations on how to create centralized, multi-specialty RPM programs for pediatric patients with chronic conditions.

Methods

Setting and population

The institution is a large, 700-bed quaternary academic children's hospital in the Midwest with two primary locations. The main location is located in an urban neighborhood, and the suburban satellite location is approximately twenty-five minutes from the main location. Some initially implemented RPM programs have since been discontinued due to lack of benefit to the patients and care teams. RPM currently enrolls patients in 17 programs within 10 divisions (Table 1) – all patients are managed by the medical center's primary care and subspecialty clinics.

Once identified as eligible for the program, the patients are managed from their homes. The RPM nurses currently hold licensure in five nearby states, allowing patients who reside in these states to take part in the programs. However, as needs continuously develop and change, the RPM nurses acquire additional state nursing licenses to offer RPM services to patients.

Staffing structure

A centralized nursing team is responsible for managing all patients enrolled in RPM programs, across all specialties. Specialty Resource Unit registered nurses (RN) are used to staff the centralized RPM nursing team to provide the most holistic knowledge of the complex patients. Specialty Resource Unit nurses are trained over several months throughout all 17 clinical divisions offered at the institution, allowing for high-level knowledge of all disease processes and disorders enrolled in the various offered RPM programs. All nurses rotate between providing bedside patient care in the Specialty Resource Unit and RPM. During their time working bedside, the RNs are required to work in the different inpatient settings, helping maintain skills across different divisions. This rotation helps to improve safety and maintain knowledge to provide RPM patients with the best and most up-to-date recommendations for care.

At the launch of RPM, hours were staffed Monday through Friday from 0700 to 1900 with two nurses each day (i.e., one nurse from 0700 to 1500 and one nurse from 1100 to 1900), allowing for overlap during the busiest mid-day hours. Due to tremendous growth, hours have expanded and the staffing model has been revised to meet the needs of the patients.

Currently, the nurse-to-patient ratio is 1:80. The department is staffed with one full-time clinical lead nurse, two full-time monitoring nurses, and four rotating monitoring nurses. The full-time nurses maintain standby status in the Specialty Resource Unit by working several bedside shifts each six-week schedule to continue to build and maintain bedside skills and knowledge, and the rotating nurses spend half their time in RPM and half in the Specialty Resource Unit. Three nurses are

Table 1
List of current populations served.

Specialty	Programs Offers
Cardiology	Adult Congenital Heart Defect High Risk for Heart Failure, Cardiomyopathy, Cardiac Tube Weaning, Heart Transplant, Ventricular Assist Device
Complex Care	Failure to Thrive
Genetics	Cleft Infants at Risk for Failure to Thrive
General Pediatrics	Asthma, Failure to Thrive
Gastroenterology	Failure to Thrive, Short Gut Non-Total Parenteral Nutrition, Short Gut Total Parenteral Nutrition Dependent
Neonatology	Feeding Tube Dependent, Concern for Inadequate Weight Gain, High Calorie Formula Dependent, Oxygen Dependent
Nephrology	Peritoneal Dialysis
Pain	Post Op Knee/Shoulder Repair with Nerve Catheter, Post Op Pectus Excavatum Repair
Pulmonology	Asthma
Transplant	Post Op Liver Transplant

scheduled each day – two nurses are primarily responsible for managing the patient portal (alerts, messages, video requests from patients, etc.) while the third nurse manages patient education, patient enrollment, initial set-up, and additional data reporting duties. This structure allows the two monitoring nurses to be solely focused on patient management in order to improve safety, communication, and time for care delivery for the patients.

The RPM nurses are responsible for triaging all patient- and caregiver-generated data that is received. As part of the initial triaging, the RPM nurses are the first line of communication with the patients. RPM nurses identify additional information needed to determine the patient's current status and develop a plan of care. Once this is completed, the RPM nursing team acts as an advocate for the patient and caregiver by communicating with the appropriate care team member (e.g., physician, registered dietitian, social worker). RPM nurses always recommend a plan of care for the patient to follow in the interim, then adjust as needed after discussing the situation with the ambulatory care team.

Billing

During its first five years, the RPM department was funded out of the institution's general operating budget, with no cost to families. Following the demonstration of efficacy and rapid expansion, the department began exploring long-term funding solutions. The COVID-19 pandemic brought many changes to the coverage of telehealth services by Centers for Medicare and Medicaid Services and commercial payers. One of these changes was the unbundling of Current Procedural Terminology codes for RPM. In order to lay the groundwork for billing, the institution completed an integration of the RPM data portal and electronic health record.

Program and pathway design

Once an RPM program is identified as a need in the institution, the program and pathway design work begins. A *program* is defined as the diagnosis group the patient belongs to – each program decides upon their own unique questionnaire and data requests, as well as frequency of completion. A *pathway* is defined as the questionnaire/check-in the patient receives. Each pathway contains unique questions created for the program population. These questions can be single-choice, multi-choice, yes/no, or free text. Additionally, biometric data collection including weight, blood pressure, heart rate, oxygen saturation, temperature, and mid-upper arm circumference is embedded within the pathway.

There is a standard process followed to completing a new RPM program build. The RPM clinical lead nurse and RPM business director begin each program design with an initial meeting with the managing ambulatory care team and any additional inpatient care team members. The goal of the initial meeting is to determine the purpose of the program, patient volumes, length of patient enrollment in program, eligibility criteria, and initial pathway builds (e.g., ideas for patient questionnaires and biometric entries). After the initial meeting, the RPM clinical lead nurse uses training and prior experience to create sample pathways that fit the needs of the patient population and capture potential high risk presentations.

Once the pathways have been approved by the ambulatory care team, the clinical lead nurse works in partnership with the team to determine a response plan (Table 2) for the RPM nursing team based on the biometric and questionnaire data that is collected. Pathways include “alert responses” that are triggered by high risk pathway responses, indicating further follow up with the patient is necessary. This response plan allows for standardization in triaging of any alerts and creates a

Table 2
Example of response plan.

Question	Answer	Response
Has your child had an increase in vomiting today?	Yes	Monitor additional responses
What was the color of each spit up or vomit?	Formula	RPM RN to triage/resolve. Contact care team via electronic health record. If immediate concern, contact on-call provider.
	Mucous	RPM RN to triage/resolve. Contact care team via electronic health record. If immediate concern, contact on-call provider.
	Bright green bile	Contact family to determine frequency and amount. Contact on-call provider immediately, and forward to care team in electronic health record.
	Blood	Contact family to determine frequency and amount. Contact on-call provider immediately, and forward to care team in electronic health record.

plan of action for all teams to identify who is responsible for the next steps if an alert is triggered.

After these steps, the clinical lead nurse begins the submission for the mobile application (app) vendor for build within their app. She completes a pathway build request identifying the purpose of the program, estimated patient volume, and each question with potential answer. Any alert for an answer must be determined and identified within the request. Once that is submitted, the pathway goes through an additional governance approval through the vendor's medical team.

Finalization of eligibility criteria, enrollment process-mapping, and goal-setting for successful completion of the program are the last steps in design. Each program defines their own unique eligibility requirements, allowing for ease of patient identification and ability to maintain clear ownership over the patient's RPM. Once these have been completed, education is provided to the care teams responsible for identifying patients. Education on the new program is also given to RPM nurses prior to the initial launch of the program. When all education has been completed, the RPM nursing team can begin enrolling patients and actively monitoring (Fig. 1).

Enrollment

Enrollment at the institution is defined as the educational process with the caregiver at the time of initiation of active monitoring. After a patient is identified as eligible based on the previously defined criteria, the RPM enrollment RN meets with the patient at the bedside (if inpatient) or in clinic (if identified outside of an admission). Rarely, if the patient is identified outside of these circumstances, the RPM RN will complete enrollment over the phone. The RPM RN downloads the app with the patient or caregiver on their designated data-enabled device, typically a smart phone. Once downloaded, the RPM RN sets up access to the app and educates on the purpose of the program, goals for graduation, and active monitoring hours. The patient or caregiver then completes an example pathway with the RPM RN to identify any barriers (not understanding a question, not loading correctly, etc.). The RPM RN then provides examples for the remaining features of the app (HIPAA-compliant text messaging, on-demand video calls, education library, etc.) to ensure caregiver understanding. Any equipment (scale, blood pressure cuff, mid-upper arm circumference tape, and/or pulse oximeter) that is needed for the program is all demonstrated and compared to inpatient equipment by the RPM RN to validate accuracy. If the patient is enrolled via the phone, equipment is provided by the clinic or

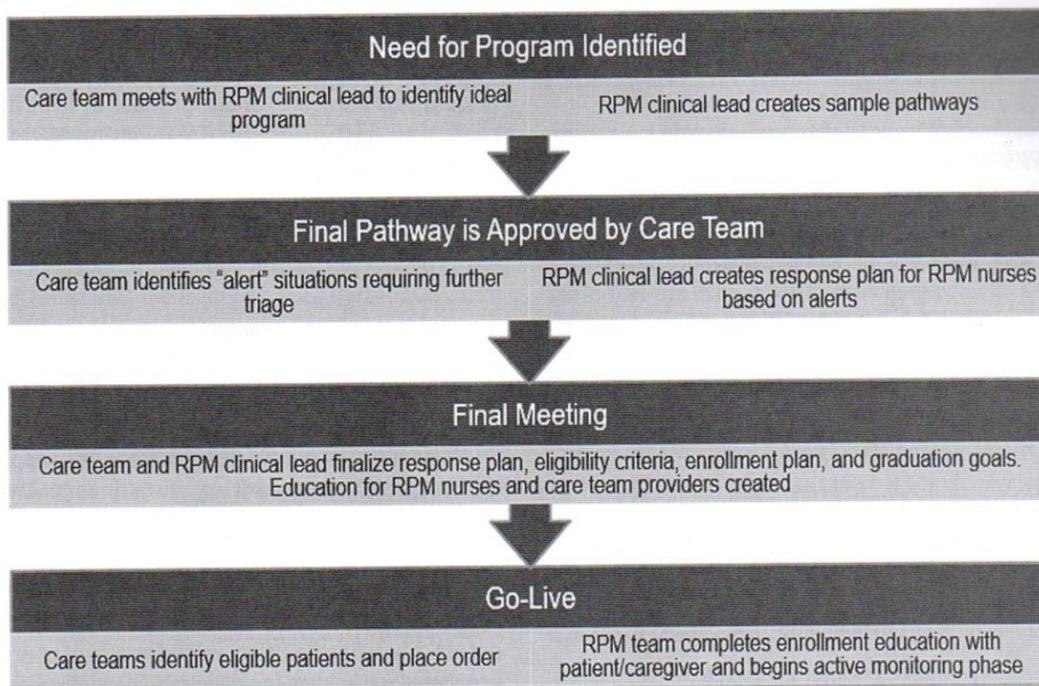


Fig. 1. Process map for building a New RPM program.

inpatient care teams prior to leaving the institution or shipped to the home once identified. In these instances, the RPM RN will follow up after receipt to instruct on use and verify accuracy either over the phone or video call.

Active monitoring and program completion

Patients complete pathways based on pre-set schedules (daily, twice daily, weekly, etc.) for their program via the app. The data is transmitted in real-time to a web-based portal that is accessible by the centralized RPM nursing team. Guided by the pre-determined response plan, the RPM RN reviews the submitted data and intervenes based on any alerts or trends identified that may indicate the need for further triaging. While actively monitored, patients receive automatic notifications from the app to complete their check-in on the days required. If a patient does not respond on the day that is required, the RPM RN has a workflow that is followed to contact the patients and ask for data submission. If there is an equipment malfunction or biometric outlier identified during the active monitoring phase, the RPM RN will troubleshoot the equipment with the patient or caregiver and replace as needed.

There are four ways a patient can be completed from the active monitoring phase – 1) graduation, or successful completion after meeting criteria set by the care team, 2) transfer of care to another institution or managing clinic, 3) change in condition, i.e., change in level of care or expiration, or 4) discharge due to lack of family engagement or inability to contact. Graduation is the goal for each patient, including those with chronic conditions. Those with chronic conditions such as peritoneal dialysis require increased monitoring during a high risk, acute phase of care. For some chronic conditions, RPM graduation may occur after receiving a transplant, while for other chronic conditions graduation may occur after supporting them through that high-risk phase of care. Each program has their own criteria for a patient to be graduated – for example, successfully weaning off of Total Parenteral Nutrition, meeting World Health Organization weight gain guidelines over 6 weeks, or adequate weight gain once the nasogastric tube is removed. After graduation occurs, the patient typically requires less follow up by the managing providers, allowing for more infrequent data collection at clinic appointments or primary care visits. Whenever a patient is completed for any of the four reasons, they can always be restarted in the active monitoring phase if appropriate and determined by the care team.

Patient and caregiver resources

Additional resources available to the patient and caregiver while actively monitored are HIPAA-compliant text messaging, on-demand video calls, and an on-demand educational library.

The text messaging feature is utilized most often by the patients and caregivers as it allows for fast and convenient access to a nurse. Through these messages, they can communicate any questions or concerns about the patient's current status or plan, and the nurse can take over communicating with the appropriate team members (e.g., registered dietitian, provider, etc.) to determine the best plan of care for that patient. Text messages are first priority in the RPM RN workflow as they are typically more acute situations occurring with that patient – during scheduled business hours, patients and caregivers can typically expect a response within 5 to 10 minutes.

On-demand video calls have become increasingly useful during the pandemic as they allow the RPM RN to assess the patient visually and determine if a plan of care can be developed while remaining in the home, or if the patient needs to be seen in person at the PCP or ED. These calls are also utilized to complete patient education on pain management, feeding tube care, and more.

The on-demand educational resources are created by the nursing team and contain videos and handouts on the most common skills each population may need – for example, patients with a feeding tube have videos on placing a nasogastric tube, setting up a feed bag, and programming a feeding pump – and can be paused, rewound, and replayed as many times as needed for the parents to understand and ensure they are completing the skill correctly. These resources are referenced often by the RPM RN team to help complete skills associated with the patient condition. On-demand videos are additionally linked into pathways and launch for viewing when certain responses are chosen by the patient or caregiver.

Adherence

Patient adherence is measured by dividing the number of pathways completed by the patient by the number of pathways presented to the patient. Adherence is measured and broken down by program and duration enrolled. When a patient is non-adherent to their program schedule, the RPM nurses contact that patient to determine any barriers that

Table 3
Patient satisfaction pathway questions.

Patient Satisfaction Questions
1. Remote Patient Monitoring technology is easy to use
2. I am comfortable participating in my child's care through Remote Patient Monitoring
3. I would recommend Cincinnati Children's Remote Patient Monitoring program to others
4. Have you had one or more video calls with the Remote Patient Monitoring care team?
5. Video calls enhance the experience
6. Using any number from 0 to 10, where 0 is the worst experience possible and 10 is the best experience possible, what number do you rate your Remote Patient Monitoring experience?
7. Please provide any additional feedback for the Remote Patient Monitoring team

exist and educate the patient or caregiver on the importance and benefits of participating. RPM nurses contact the patient or caregiver several times before initiating discussion for discharge with the care team. If a patient is non-adherent with RPM, they are typically transitioned back to frequent in-person clinic visits to obtain the data needed to manage their plan of care.

Patient satisfaction

Patient satisfaction is measured via a satisfaction pathway (Table 3) in the app every 60 days while the patient is active in the program. If a patient is completed prior to being active for 60 days, they receive the satisfaction pathway upon completion of RPM. Questions 1–3 are five-point Likert scale options ranging from strongly disagree to strongly agree, and questions 4 and 5 contain yes/no options. The final two questions ask for a rating from 0 to 10 and any additional free text feedback the patient or caregiver would like to provide.

Quality improvement approach

A hospital-wide quality improvement (QI) group was formed in 2021, comprised of a hospital medicine physician lead, an RPM clinical nurse lead, clinical quality specialist, data analyst, project manager, and patient

caregivers. The group followed the organization's improvement science model to standardize RPM throughout the different specialties and improve equity and quality of care provided by RPM. Initial work focused on standardizing enrollment by measuring barriers to missed patient enrollments. Patient adherence to their assigned program is a second focus of the group – caregivers have been vital advocates for changes, helping to improve their program and the experience for other patients and caregivers. Additionally, patient utilization, including emergency department visits, ambulatory visits, and inpatient admissions, is measured by this team to identify RPM outcomes.

Findings

Upon initiation of RPM in 2017, there were approximately six patients actively monitored at any given time. In May 2022, there were 296 patients actively monitored, showing 50 times growth compared to initial patient volumes. This has been due to the launch of programs created by the RPM RN team. The COVID-19 pandemic lent itself as an opportunity for care teams to identify which patients they could keep out of the hospital through new RPM programs or expansion of existing programs, also helping to grow patient volumes (Fig. 2).

Enrollment rate

This institution's RPM department defines enrollment rate as the number of patients enrolled compared to the number of patients who met eligibility criteria to enroll. When the QI group was initially started, the enrollment rate was 83%. Interventions including setting more defined eligibility criteria for each population, educating care teams responsible for ordering RPM on that criteria, creating patient handouts highlighting benefits of RPM, and change in the enrollment education process were implemented through 2021 and early 2022. These interventions improved enrollment rates to 91%.

Improving patient management

For the post-op knee and shoulder repair population, management in RPM has decreased oxycodone utilization. Pre-RPM oxycodone

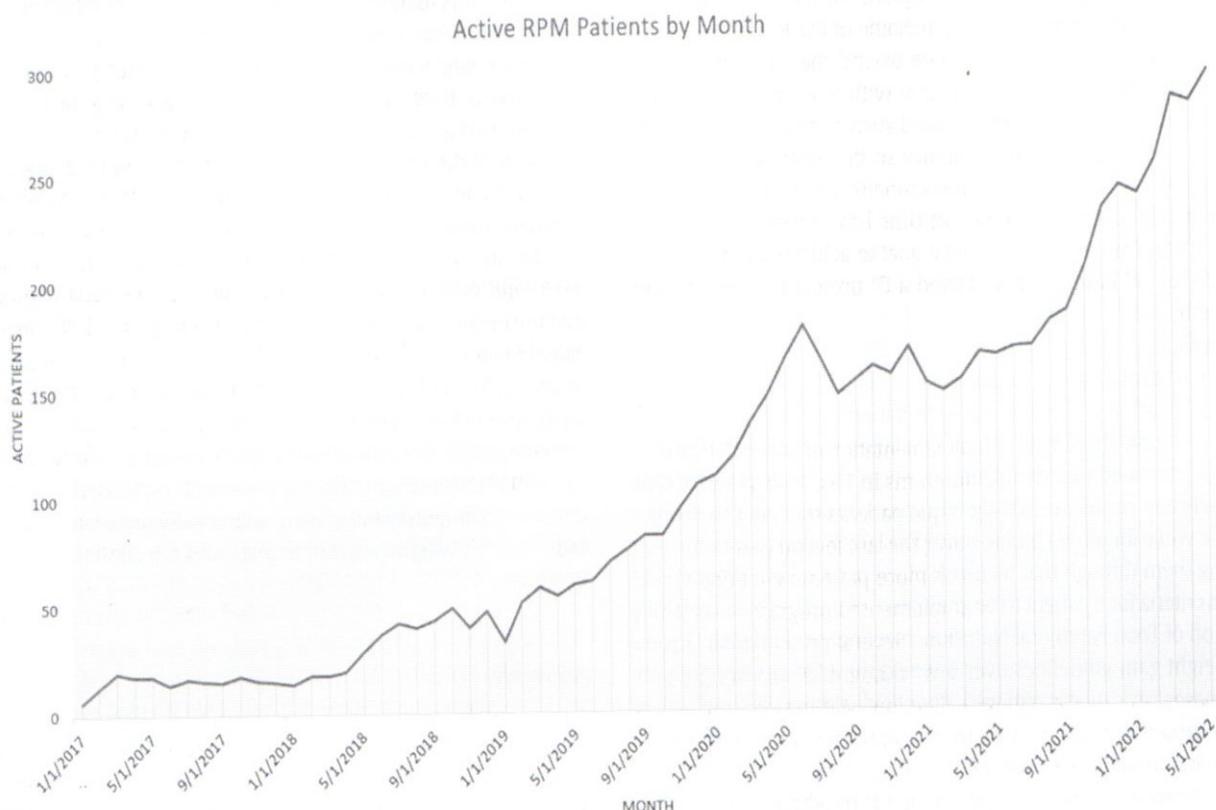


Fig. 2. Graph of actively monitored patients per month.

Table 4
Patient satisfaction results.

Question	Strongly Agree or Agree
Video calls enhance the experience	89%
I would recommend RPM to others	98%
I am comfortable participating in RPM	98%
RPM technology is easy to use	98%
Overall experience rating (out of 10)	9.1

dosing was 20 weight-based doses per patient. Since RPM launched this program, the RPM RNs have implemented a post-op day two video call that focuses on pain management education and alternative pain management solutions. The nursing team tracks oxycodone usage at post-op day five. These interventions have led to a change in protocol twice. The first change was a decrease in oxycodone doses to 14, and the second change (current practice) was a decrease in doses prescribed to 10.

Patient satisfaction

Patient satisfaction (Table 4) has remained high through each new program launch. Approximately 2000 satisfaction surveys have been completed since RPM launched. Table 4 shows a summary of patient responses. Additionally, free text responses including “Absolutely love that nurses manage the app so you get a response right away instead of waiting for someone to call you back,” “Having my son’s team available at my fingertips brings me a great amount of peace,” “I love that if any of my numbers are slightly off I get a text or a phone call to check to see if I’m okay,” and “LOVE this program. It has helped my husband and I feel comfortable bringing our baby home safely!” have been received.

Adherence

Adherence data has shown that family engagement decreases over time the longer patients are enrolled in programs, emphasizing the need to identify graduation goals and minimize caregiver burden. While each population demonstrates different average lengths of adherence, most of the short-term program patients are adherent throughout the entirety of the program. Some of the longer-term programs begin to see a drop in adherence around the 6 month mark of participation. This prompted conversations with providers to determine interventions that could be implemented such as graduating patients sooner or decreasing pathway frequency so that caregivers are more likely to remain engaged while actively monitored. A roll-up of all patients no matter program or length of time has shown an average of 68% adherence. The QI leads have set a goal to achieve 80% adherence by June 2023 and have already started a QI project to help us meet that goal rate.

Discussion

Through successful design and implementation of a large RPM infrastructure, the 17 currently active programs in 10 divisions serve over 300 patients per month and 1229 unique patients to date. The department has shown significant growth over the last several years, allowing the centralized nursing team to reach more patients with additional chronic diseases of childhood. The implemented programs have been associated with high patient satisfaction. Several principles have contributed to the department’s success: thoughtful and intentional patient/caregiver-generated data collection, staffing structure, and quality improvement work that led to standardization and prioritization of the patient/family voice.

Program creation has been streamlined throughout the development of each new program. As populations grow, the RPM nurses are

able to use their experience during the build phase to make it as standardized as possible. This benefits the nursing team, provider team, and patient and caregiver experience through eliminating inconsistencies in pathway responses, enrollment procedures, and patient management. By establishing concrete eligibility criteria that make it easy to identify who is eligible for RPM, eligible patients are more equitably offered enrollment into RPM.

Programs have been created in partnership with the RPM nursing team that has experience in managing patients and can identify the ideal ways to obtain unique data points for each program. This supports intentional and thoughtful collection of patient data that helps the patient and caregiver best understand exactly what the team is looking for as well as help the providers make changes in plan of care without feeling overwhelmed through data burden. When patients and caregivers understand why a data piece is being collected and how it affects the care received, they are more likely to adhere to the program.

The RPM nurses can also identify situations that require further follow up from the ambulatory care teams and how to contact, if needed. By knowing what data should trigger a warning for the nursing team, developing the response plan is quick and easy. RPM nurses know when a certain data point requires additional follow up from the care team and cannot be resolved through nurse only triage. From there, the nurses are able to identify the best point and method of contact due to prior experience with program development and monitoring patients.

Dedicating two nurses to patient management and one nurse to patient education and enrollment has helped to improve the quality of care provided to patients. The nurses that are focused on patient management are able to triage alert situations and answer questions or concerns from patient messages at a faster rate, decreasing the delay for patient care and improving patient satisfaction. Additionally, this has decreased risk of safety events by eliminating outside responsibilities from those responsible for managing patients.

Patient satisfaction has been a driving force of program updates. Through free text responses, patients and caregivers are able to discuss improvement ideas. These ideas, such as preferred time of program completion, have been implemented and demonstrated higher overall levels of adherence to the program after implementation. Satisfaction stays high throughout the entirety of the active monitoring phase of the program. Adherence, however, does tend to decrease the longer the patient is active, with the exception of any long-term patients (peritoneal dialysis, ventricular assist device, adult congenital heart disease) that are required to complete RPM for treatment.

QI efforts have standardized the programs by requiring care teams to develop eligibility criteria if it had not existed before, allowing for easier identification of eligible patients for the care teams. The enrollment process has also been standardized through the QI group – all care teams have adjusted to enrolling patients in person unless unavailable (identified during holidays, off-hours, etc.). This helps the RPM nurses know exactly when and how they should approach the patients for enrollment. Outcome measures have been standardized that benefit each program, including length of stay and inpatient admissions.

Patient and caregiver champions have also added to the progress made in improving their various RPM programs. Feedback such as improved education, supply kits for intake and output measuring, and an educational demonstration video have been suggested to help ease the transition into RPM for families and provide them with the resources needed to understand the objective and complete the requirements.

Evident application to practice

RPM programs should be created that cover a variety of chronic conditions of childhood. Offering several multi-specialty programs will allow the furthest reach of patients served by the organization. Identifying concrete eligibility criteria will help to ensure all patients who are

eligible for each program are offered the chance to participate, no matter perceived compliance or socioeconomic status. RPM pathways should focus on biometric and qualitative data that is necessary to develop a plan of care that meets the real-time needs and presentation of the patient. While additional data may be helpful for long-term trending for the provider, patients or caregivers may become burnt out from submitting too much data that they do not see as beneficial to their treatment. Length of active monitoring time and severity of patient diagnosis may affect adherence as well. Successful criteria should be established to help begin discussions of patient completion from the program.

Research implications

It is imperative that we prioritize measuring outcomes associated with the implementation of pediatric RPM programs. RPM offers valuable opportunities to improve the process of health care delivery that may translate to improved access to care, better health outcomes, and lower costs of care. Evaluating the impact of RPM requires a measurement strategy that is intentional, thorough, and representative of the priorities of various stakeholders (e.g., patients, providers, health systems, and payers). Examples of metrics that are wise to follow include: utilization, cost of care, disease-specific health outcomes, patient satisfaction, and equity stratifiers (such as enrollment by language or socioeconomic status). These measures help to support access to, equity of, and safety of the implemented RPM program (Chuo et al., 2020).

Limitations and health equity

One significant limitation to the RPM programs offered is the inability to enroll patients with a primary language other than English. These patients account for a majority of the failed enrollments. Excluding patients with a primary language other than English requires us to exclude a large number of patients the organization manages. While the app used to collect RPM data allows for translation to Spanish, French, and several other languages, right to left languages (such as Arabic) are unavailable. Another concern is the ability to translate text messages received from the families or have a live interpreter available for on-demand video calls. This institution currently does not have any bilingual RPM nurses available, so translation and interpretation would require a secondary resource. A large limitation in translation is timeliness – patients and caregivers message in concerns that may need addressed within a half hour, but translation at the organization requires a two hour wait time to ensure accuracy and resource availability. Work is being done to identify additional resources that can be deployed to the telehealth division to support RPM in translation and interpretive services, beginning with Spanish. Creating a pathway that is translated at the beginning and identifying these resources prior to implementing a new program can avoid this limitation.

Additional limitations exist in ensuring health equity. Patients who are of lower socioeconomic status, native language, or race may have increased limitations in participation. Measuring enrollment and adherence rates by these equity stratifiers can highlight important gaps in care and guide us to targeted improvement endeavors.

Patients with one of two technology barriers is a second limitation. If a patient does not have access to a data-enabled device, they are unable to participate. One in eight Americans are living in poverty with only 71% having access to a data-enabled device (Nouri et al., 2020), increasing the disparity and inequity of care delivery to those patients. Additionally, patients and caregivers with limited technology knowledge tend to decline participation in the program due to feeling uncomfortable with their skills, again eliminating a group of patients from participating. The initial infant scale used for a majority of the patients served

required a second app that did not communicate with the RPM app. This caused significant confusion for the caregivers. The market on RPM approved infant scales is extremely small, and identifying a scale that was cost effective and accurate posed a difficult challenge for the RPM team. After several years, a new scale that does not require a separate app, but rather has a screen embedded, has been purchased and implemented with any newly identified patient.

The last limitation relates to patient satisfaction data collection. Patient satisfaction data is received through the app that patients and caregivers are aware the entire nursing team has access to. This may skew results as patients are less inclined to be honest in their thoughts on experience in the program in fear that honesty may mean less satisfactory care for their child or themselves.

Conclusions

RPM has many benefits, from decreasing patient days away from home, to improving medical management, to improving patient or caregiver trust and confidence in their care delivery. Pediatric RPM programs are lacking throughout the country, but existing programs have demonstrated success. To improve access to care and equity, pediatric institutions should implement multi-specialty RPM departments that have the ability to manage a variety of patient diagnoses and chronic conditions of childhood. Allowing patients and caregivers to stay in the home and receive medical management is important now more than ever, as more institutions begin to develop additional telehealth offerings.

CRedit authorship contribution statement

Kylee Denker: Conceptualization, Investigation, Validation, Writing – original draft, Writing – review & editing, Visualization, Project administration, Data curation. **Micah Dean:** Methodology, Writing – review & editing, Project administration, Funding acquisition, Software, Resources. **DaVona Chapman:** Methodology, Investigation, Writing – review & editing. **Courtney Sump:** Conceptualization, Writing – review & editing, Supervision, Data curation, Investigation, Validation.

Declaration of Competing Interest

Kylee Denker: There are no conflicts of interest.

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