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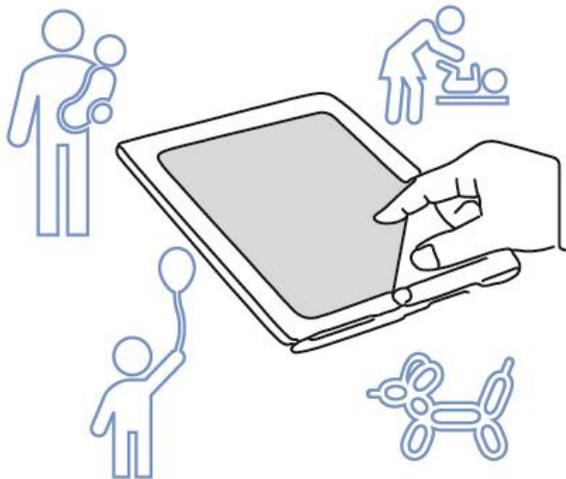
Pediatric RPM *focus*

Remote patient monitoring & telemedicine in Neonatal and pediatric age group

Scope of pediatric remote monitoring

There is growing interest in remote patient monitoring (RPM) among pediatric age group for the sake of simplicity and efficient provision of healthcare as evidenced through increased number of scholarly articles published in the past five years. RPM, hospital-based monitoring and telemedicine are gaining popularity among pediatricians. There are more than 45 research articles explored and reported various aspects of remote monitoring and

telemedicine among pediatric patients.¹ RPM among pediatric patients can be used under diverse clinical conditions. Various aspects of RPM concentrating on the biometric monitoring, economic benefit, patient satisfaction is being probed into and promising results are shown in teleconsultation, tediagnosis, tele-management and tele-support through RPM platforms. The following sections provides short overview of emerging RPM themes with pediatric care impact.



Monitoring in patients with ICDs

Continuous glucose monitoring (CGM)

Pediatric teleconsultations



Telehealth is an essential tool in ensuring better patient engagement, ease of health access and equitable health services. Patient privacy, security and integrity of patient aspects within the telehealth ecosystems should be diligently scrutinized.

Dr. Prakash R

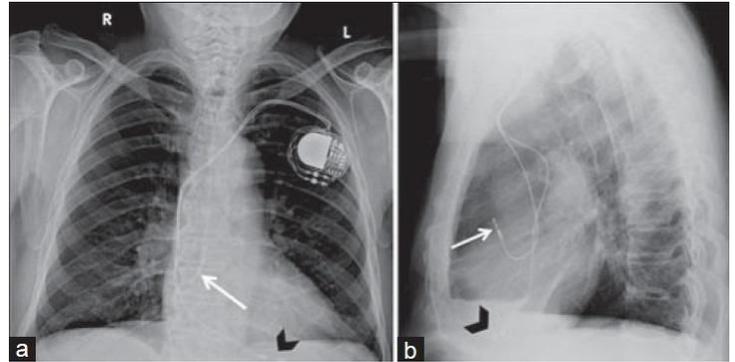
MBBS, MD (pediatrics), FNB (Pediatric cardiology)

Consultant, Department of Pediatric Cardiology, Narayana Institute of Cardiac Sciences, Bangalore, India

Remote monitoring of patients on cardiovascular implantable devices

Attempts to quantify the benefits of using implantable cardiac devices among pediatric patients with arrhythmia yielded several promising outcomes. Leoni et al., has found use of pacemaker remote monitoring is not only acceptable and increases patient satisfaction, but can also, replace the periodic out-patient visits without compromising patient safety.²

In the view of increasing complexity of patients and devices, PACES Expert Consensus Statement on the Indications and Management of Cardiovascular Implantable Electronic Devices (CIED) in Pediatric Patients provides comprehensive and evidence-based recommendations for use of CIED. Accordingly, CIED is indicated (class of recommendation class I with benefits outweighing the risks) in isolated sinus node dysfunction (SND) with age-inappropriate bradycardia or secondary to chronic medical therapy, isolated congenital complete atrioventricular block with symptomatic bradycardia, with a wide QRS escape rhythm, complex ventricular ectopy, or ventricular dysfunction, or mean ventricular rate is < 50 bpm, atrioventricular (AV) block with clinically significant ventricular tachycardia (VT), symptomatic patients with idiopathic advanced second or third-degree AV block, postoperative advanced second- or third-degree AV block, infants with complex bradycardia having congenital heart disease, post cardiac transplantation with persistent symptomatic bradycardia, neuromuscular diseases with symptomatic bradycardia due to SND or any degree of AV block, Kearns-Sayre syndrome for any degree of AV block, channelopathy patients with pause dependent, clinically significant VT, long QT Syndrome, catecholaminergic polymorphic ventricular tachycardia, patients who are



X-ray of pacemaker with right atrial and ventricular lead

survivors of sudden cardiac arrest or with documented spontaneous sustained VT with diagnosis of Brugada syndrome, hypertrophic cardiomyopathy, arrhythmogenic cardiomyopathies, nonischemic dilated cardiomyopathy.³

Noninvasive cardiac rhythm monitoring is indicated in all patients prior to placement of an insertable cardiac monitors.^{3,4} Remote interrogation and monitoring (RIM) are recommended within 2–4 weeks post CIED implantation. RIM is recommended for all patients with a CIED that has been recalled or has an advisory to enable early detection of actionable events and confirm proper device function. RIM of CIEDs is recommended every 3–12 months for pacemakers and 3–6 months for ICDs. Frequency should be increased (every 1–3 months) for CIEDs approaching elective replacement indicators. It is recommended that allied health care professionals possess International Board of Heart Rhythm Examiners certification or equivalent experience if they provide RIM and are involved in patient management decisions.³

Continuous Glucose Monitoring in children

Management of type 1 diabetes mellitus is particularly challenging. However, with real-time continuous remote glucose monitoring (CGM) can trigger a specified notification system in case of hyper and hypoglycemia provides exact representation of patients' glycemic control

and simplifies diabetes management.⁵ These remote monitoring systems can alert parents as well as clinicians for corrective actions. The process is particularly successful in shortening the duration of nocturnal hypoglycemia⁶ and prevents related adverse events. There is growing evidence

for CGM improving glycemic control by expanding the time in range, and notifying time below and above range and accurate monitoring of glucose variability in both type 1 and type 2 diabetes.⁷ Though CGM offers rich data much more than offered by conventional self-monitoring blood glucose, and allows a detailed evaluation of blood glucose with behavior,⁸ successful utilization of CGM technology in routine clinical practice remains relatively low.⁹ A CGM recommendations in pediatric age group sufficiently old¹⁰ and there is growing interest in wide implementation of this telehealth approach to improve glycemic control at least of patients using insulin medications.¹¹

Advanced Technologies & Treatments for Diabetes (ATTD) Congress in 2019 developed clinical CGM targets to supplement the currently agreed-upon metrics for CGM-derived times in glucose ranges. Ten most clinically important metrics during evaluation of CGM are – number of days CGM worn (minimum 14 days), percentage of time CGM is active recommend 70% of data from 14 days), mean glucose, Glucose management indicator (GMI), Glycemic variability (%CV) target $\leq 36\%$, percentage of reading and time $>250\text{mg/dL}$, $181\text{--}250\text{mg/dL}$, $70\text{--}180\text{mg/dL}$, $54\text{--}69\text{mg/dL}$, $<54\text{mg/dL}$.⁹ The panel recommends time in the range of $70\text{--}180\text{mg/dL}$ as target range.⁹

Pediatric teleconsultations

Teleconsultation of infants, neonates, children, adolescents and young adults provides unique advantages and at the same time poses special difficulties. Though there are isolated attempts to prove the superiority of teleconsultations with respect to traditional face-to-face patient engagement in atopic dermatitis,¹² primary eye care,¹³ neonatology¹⁴ and other therapeutic areas,¹⁵ its widespread implementation and adoption needs higher validation. However, with awareness of masses about the advantages of teleconsultation coupled with technological penetration, this modality of patient engagement is expected to be a forerunner. With telemedicine defining a newer version of doctor-patient relationship and higher emphasis is being laid out on the communication responsibilities, patient abandonment, liabilities issues and malpractice issues are expected to wane off increasing the standard of care. Regional and national policies addressing privacy, security and breach notification are pivotal in governing the legal issues associated with teleconsultation platforms and services.¹⁶



Conclusions: remote patient monitoring in neonatology offers newer and effective ways of patient engagement overcoming the distance barrier, time constraints and can bring about equitable distribution to underserved populations. These strengths enable teleconsultation to penetrate into many pediatric settings and translate into predictors of actionable events, trigger out-patient visit in serious conditions and minimize hospital visit when not needed.

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