

The Impact of Remote Patient Monitoring on Pediatric Patients with Diabetes

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Definition of Terms

- Hemoglobin A1c, often abbreviated as HbA1c
- Telehealth, also known as Telemonitoring
- Remote patient monitoring, often abbreviated as RPM
- Diabetic ketoacidosis, often abbreviated as DKA
- REDCap, secure web application for data collection

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Problem

- Incidence of type 1 and type 2 diabetes in pediatric patients both in the U.S. and worldwide, is on the rise¹⁻³
- Financial burden, also increasing⁴
 - 2012, total cost of diagnosed diabetes in U.S. \$245 billion; 43% spent on inpatient care due to poorly controlled diabetes¹
 - Multicenter cohort analysis (42 children's hospitals): over a 5 year follow up period, >1 in 4 children admitted in DKA experience >1 additional DKA admission within the next 365 days⁴
- Among youth with diabetes, death more likely to occur due to an acute complication (DKA, hypoglycemia)⁵

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Problem

- From November 2014-November 2015
 - 195 hospital encounters included the ICD-10 code for DKA (including ER visits and admissions)
 - 141 resulting in hospital admissions
 - approximately 40% were repeat admissions⁶
- Per national and international standards of care, UMMC pediatric endocrinology follows up with patients every 3 months⁷; in some cases, further intervention may be needed

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Description of Telehealth RPM Initiative

- UMMC telehealth partnered with division of pediatric endocrinology in 2015
- Service is reimbursable (Senate Bill 2646)
- Process:
 - place consult, approve insurance, obtain consents
 - kit shipped to home
 - telehealth RNs remotely monitor via real-time glucose readings
 - protocol
- Goal: prevent unnecessary hospital encounters and allow the provider to make insulin adjustments between visits

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Description of Telehealth RPM Initiative

RPM Kit



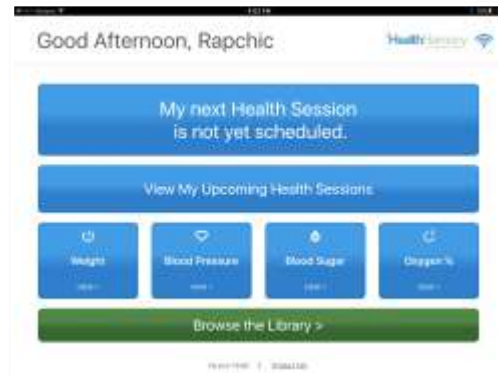
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Description of Telehealth RPM Initiative

Patient view



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Project Purpose

The purpose of this scholarly project was to determine the effect of the telehealth RPM system initiative on HbA1c and diabetes-related ER visits and hospital admissions in the pediatric diabetes population at UMMC.

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Review of Literature

Initial review of literature indicated that the use of telehealth technology in pediatric patients with poorly controlled diabetes is promising.

- *Meta-analysis*: children and adolescents experienced more substantial reduction in HbA1c, compared to non-users of telehealth⁹
- *RCT in Scotland* utilizing telehealth found improvement in glucose monitoring frequency, but no change in HbA1c¹⁰
- *Cochrane Review*: telehealth intervention decreased HbA1c, but did not include patients with type 2 diabetes, did not measure other outcomes (i.e. hospital encounter frequency)¹¹
- *Telehealth systematic review*: 2 out of 6 studies, through meta-analysis, revealed a statistically significant decrease in hospital admissions due to telehealth intervention; third study found telehealth intervention to be clinically effective in reducing hospital encounters in pediatric patients with diabetes^{12,13,14}

Methodology

- Settings and participants
 - Outpatient setting-pediatric endocrinology
 - Identified participants via RPM enrollment logs, using EPIC to determine eligibility for chart review
 - 0-18 years with type 1 or 2 diabetes
 - Exclusions: enrollment <30 days, co-morbid condition of pregnancy
 - IRB approval 2/19/2019

Methodology

- Data collection
 - Retrospective chart review of patients enrolled between November 2015 and September 2017 (N=89)
 - 12 months prior to enrollment, and up to 12 months after enrollment (at intervals of enrollment duration of 3, 6, 9, and 12 months)
 - Pre and post enrollment data: HbA1c, ER visits, hospital admissions
 - PHI: name, DOB, enrollment and discharge date-stored in REDCap

Methodology

- Data analysis
 - Using SPSS version 25, conducted paired t -test to determine if there was a statistically significant mean difference (using a level of significance of ≤ 0.05) between standard care and RPM on the outcomes of HbA1c, ER visits, and hospital admissions

Findings

Patient Demographics	Number (n=89)
Male participants	38
Female participants	51
Mean age (years)	15.7 (5.4-18 years)
Participants with type 1 diabetes	75
Participants with type 2 diabetes	14
Mean duration of diabetes (years)	6.32
Mean duration of RPM enrollment (days)	309.8

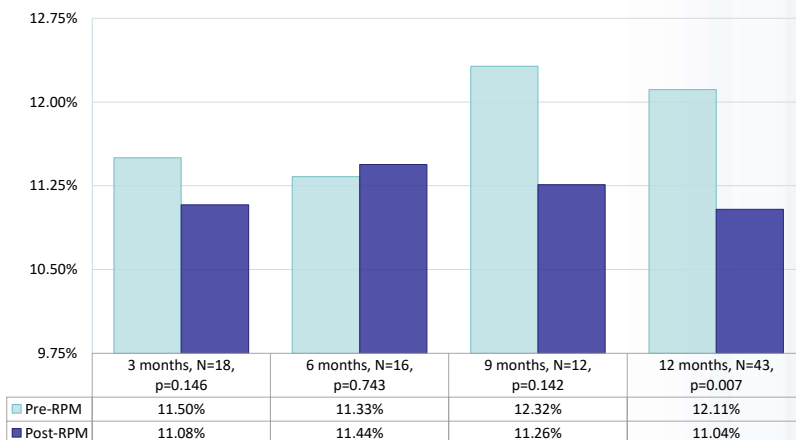
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Findings

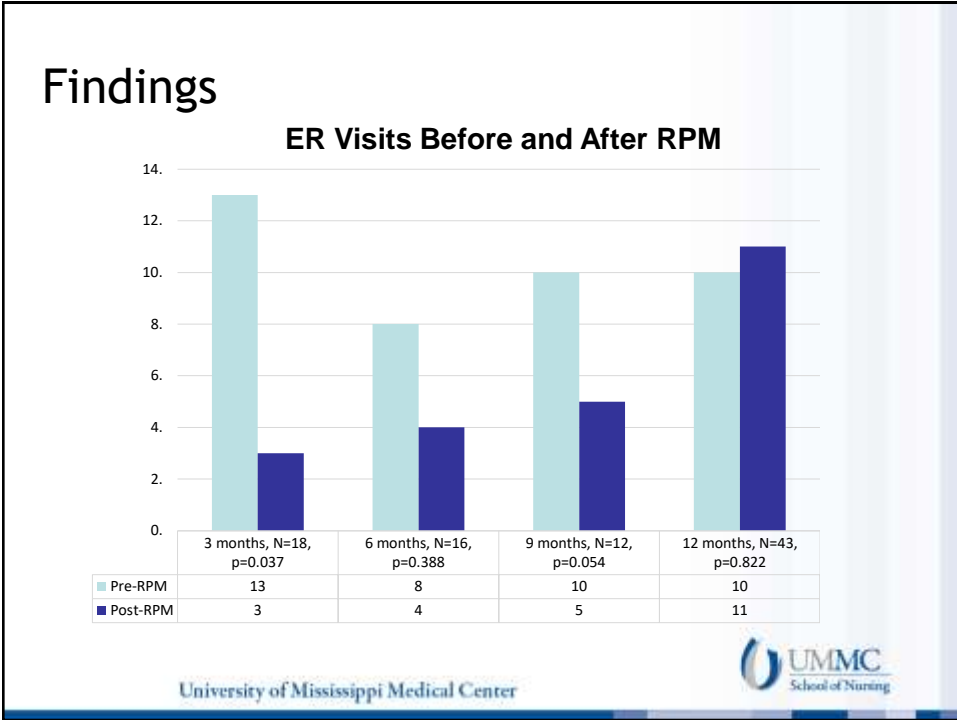
HbA1c Levels Before and After RPM



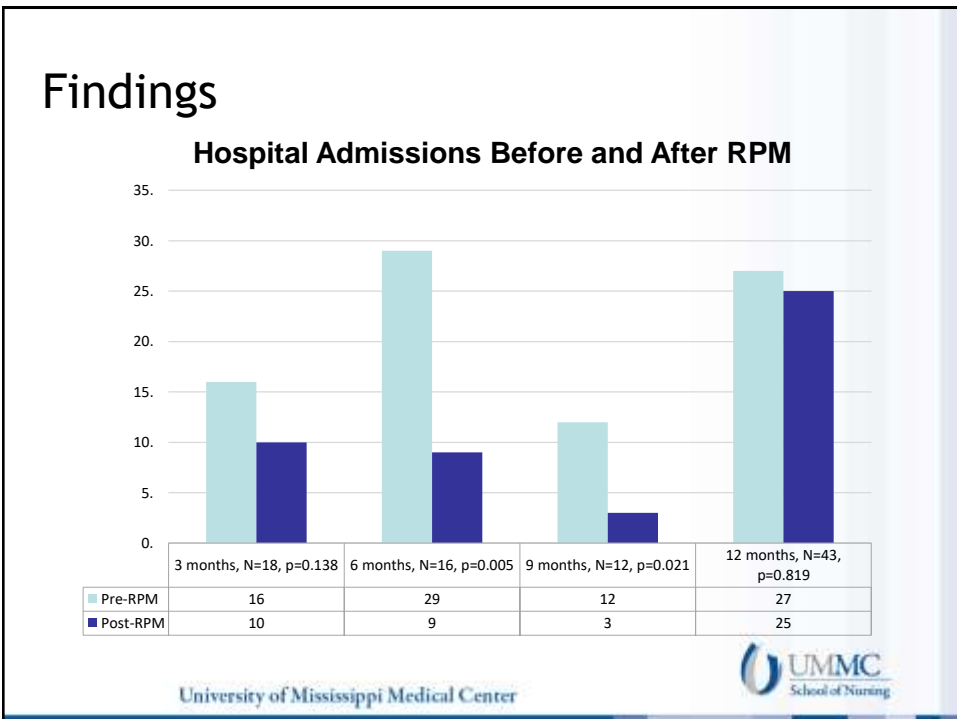
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Findings

Outcome	Pre-RPM	Post-RPM	P-Value
HbA1c			
3 months	11.50%	11.08%	0.146
6 months	11.33%	11.44%	0.743
9 months	12.32%	11.26%	0.142
12 months	12.11%	11.04%	0.007*
ER Visits			
3 months	13	3	0.037*
6 months	8	4	0.388
9 months	10	5	0.054
12 months	10	11	0.822
Hospital Admissions			
3 months	16	10	0.138
6 months	29	9	0.005*
9 months	12	3	0.021*
12 months	27	25	0.819

*denotes statistically significant

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Findings: HbA1c

- Decrease in HbA1c, statistically significant
 - Enrolled up to 12 months, $t(42)=2.842$, $p=0.007$, $M=1.069$
- Decrease in HbA1c, although not statistically significant
 - Enrolled up to 3 months, $t(17)=1.522$, $p=0.146$, $M=0.422$
 - Enrolled up to 9 months, $t(11)=1.583$, $p=0.142$, $M=1.060^{**}$
- *Increase* in HbA1c, although not statistically significant
 - Enrolled up to 6 months, $t(15)=-0.334$, $p=0.743$, $M=0.120^{***}$

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Findings: ER Visits

- Statistically significant decrease in ER visits
 - Enrolled up to 3 months, $t(17)=2.263$, $p=0.037$, $M=0.556$
- Decrease in ER visits, although not statistically significant
 - Enrolled up to 6 months, $t(15)=0.889$, $p=0.388$, $M=0.250$
 - Enrolled up to 9 months, $t(11)=2.159$, $p=0.054$, $M=0.417$
- *Increase* in ER visits, not statistically significant
 - Enrolled up to 12 months, $t(42)=-0.227$, $p=0.822$, $M=0.023$

Findings: Hospital Admissions

- Statistically significant decrease in hospital admissions
 - Enrolled up to 6 months, $t(15)=3.273$, $p=0.005$, $M=1.25$
 - Enrolled up to 9 months, $t(11)=2.691$, $p=0.021$, $M=0.750$
- Decrease in hospital admissions, although not statistically significant
 - Enrolled up to 3 months, $t(17)=1.558$, $p=0.138$, $M=0.333$
 - Enrolled up to 12 months, $t(42)=0.230$, $p=0.819$, $M=0.047^{**}$

Discussion

- Consistent with previous studies utilizing a telehealth intervention, this study, in general, showed a decrease in HbA1c levels, ER visits and hospital admissions post-RPM enrollment
 - Increased contact with RPM staff, education modules, insulin adjustments
 - Avoid potential hospital encounters by acting on real-time glucose readings

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Discussion

- Limitations
 - Cohort accounts for small portion of clinic population (89 of approximately 900)
 - Participants use of other ERs not reflected in data collection or analysis
 - Possible confounding factors
 - Connectivity issues
 - Manual entry of glucose levels

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Conclusions

- The results of the data analysis demonstrate the possible effectiveness of RPM as a tool for improving outcomes in pediatric patients with type 1 or type 2 diabetes, especially at certain time intervals
- With insurance coverage of RPM service, may benefit by increasing access to care
- Recommendations for future research
 - Larger power/duration of study methodology
 - Use of CGM in place of finger sticks
 - Incorporate behavioral/psychological aspect to the intervention

Questions?

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