The Role of Remote Therapeutic Monitoring in Postoperative Rehabilitation Following Total Knee Arthroplasty

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INTRODUCTION: Remote Therapeutic Monitoring (RTM) is an emerging digital health modality that enables remote engagement and oversight of patient rehabilitation using data-driven platforms. While RTM has been formally recognized by CMS for reimbursement, some payors remain resistant to reimbursing these services, and RTM's clinical utility and value in orthopaedic care remain undefined. Our practice implemented a digital health platform in 2023 to support patient education, guided rehabilitation, and RTM. The purpose of this study was to determine the impact of RTM on healthcare resource utilization, patient-reported functional outcomes, and complication rates following total knee arthroplasty (TKA).

METHODS: We performed a retrospective cohort analysis of all primary TKA patients treated at a single orthopedic practice. Patients were included only if their postoperative rehabilitation was performed entirely within the practice, excluding patients using outsourced physical therapy (PT). Beginning in 2024, our standard TKA rehabilitation protocol was changed to preferentially use hybrid (PT/RTM) care. Patients or surgeons could opt instead for PT-only or RTM-only care. RTM consisted of patient education, surveys, and home exercises overseen by a physical therapist with occasional scheduled phone/telehealth encounters to review progress. Patients from the first 10 months of 2024 were assigned to one of three cohorts: PT-only, RTM-only, or hybrid care. A fourth cohort was selected from all patients who underwent TKA in 2022, prior to the option to use RTM at our practice as a historical control. All patients having TKA in 2023 were excluded as RTM use was not standardized during this initial launch phase. Patients were followed for a minimum of 6 months. Healthcare resource utilization metrics assessed included expected reimbursement and number of postoperative rehabilitation encounters (PT and RTM). KOOS JR scores were collected preoperatively, 6 months, and 1 year postoperatively. Expected reimbursement was normalized to current Medicare allowables. Postoperative resource utilization, functional scores (KOOS JR), and reoperation rates were compared using ANOVA and chi-square testing. Postoperative manipulation (MUA) was considered separate from other reoperations.

RESULTS: A total of 1,699 patients met the inclusion criteria, with 836 patients in the historical control (i.e. pre-RTM PT-only group), 433 patients in the PT-only group, 399 patients in the hybrid group, and 31 patients in the RTM-only group. Demographic variables were not significantly different, apart from age (mean 66.8 years in hybrid vs. 68.7 in PT-only; $p = 0.01$). The RTM-only group demonstrated the lowest mean encounter count (1.2 ± 0.4) and expected reimbursement for rehab services ($75 ± 41) compared to hybrid care (9.9 ± 7.4; $1342 ± 893) ($p < 0.001$). Hybrid care also had lower costs and fewer visits than the PT-only group (12.4 ± 8; $1619 ± 978) ($p < 0.001$). All cohorts (PT-only, hybrid, and RTM-only) showed significant improvements in KOOS JR outcomes at 6 months, and no significant differences were observed in KOOS JR outcomes across groups ($p=0.12$). This trend held true in the subset of patients who had reached 1-year postoperative follow-up ($p = 0.33$). The overall rate of reoperation was 2.2% across all groups and did not differ significantly across groups ($p = 0.31$). The overall rate of MUA was 6.8% across all groups and did not differ significantly across groups ($p = 0.73$).

DISCUSSION AND CONCLUSION: This study supports the use of RTM as a modality for postoperative rehabilitation in TKA patients. RTM significantly reduced costs and the need for in-person PT. While the numbers are limited in the current study, RTM-only patients experienced dramatically reduced resource utilization without any compromise in functional recovery or safety. KOOS JR outcomes were clinically equivalent across all groups, and reoperation rates remained uniformly low. There was no increase in postoperative manipulations. These findings demonstrate that RTM can serve both as a supplement to in-person rehab and an effective stand-alone, lower-cost alternative for appropriate patients without sacrificing quality. Future prospective trials should focus on identifying ideal patient profiles, optimal engagement strategies, and long-term cost-effectiveness.

Patient Cohort	n	Mean Age (years ± SD)	Mean BMI (kg/m2 ± SD)	Gender (M/F)	Side (R/L)
PT-only	433	68.7 ± 9.4	31.3 ± 5.7	172/261	213/220
Hybrid	399	66.8 ± 9.2	32.1 ± 5.4	171/228	217/182
RTM-only	31	66.6 ± 10.0	32.4 ± 5.9	10/21	15/16
Historical control (PT-only)	836	68.7 ± 9.5	31.7 ± 5.8	332/504	452/384
All Patients	1699	68.2 ± 9.5	31.7 ± 5.8	685/1014	897/802
		Significant difference between PT-only and hybrid (p = 0.01)	p = 0.24	p = 0.55	p = 0.33

Patient Cohort	Mean Expected Reimbursement for Rehab Services ($ ± SD)	Mean PT Encounters (± SD)	Mean RTM Encounters (± SD)	Mean Total Encounters (± SD)
PT-only	$1619 ± 978	12.4 ± 8	0 ± 0	12.4 ± 8
Hybrid	$1342 ± 893	9.9 ± 7.4	1.8 ± 0.9	11.7 ± 7.3
RTM-only	$75 ± 41	0 ± 0	1.2 ± 0.4	1.2 ± 0.4
Historical control (PT-only)	$1708 ± 866	15.5 ± 7.4	0 ± 0	15.5 ± 7.4
All Patients	$1569 ± 929 p < 0.001	13.1 ± 8 p < 0.001	0.5 ± 0.9 p < 0.001	13.5 ± 7.8 p < 0.001

Patient Cohort	Mean Preop KOOS JR (± SD)	Mean 6 Month Change KOOS JR (± SD)	Reoperation (Rate)	MUA (Rate)
PT-only	45.9 ± 13.9	+25 ± 17.5	8 (1.8%)	33 (7.6%)
Hybrid	45 ± 13.6	+19.7 ± 20.8	4 (1%)	25 (6.3%)
RTM-only	49.1 ± 10.1	+13.3 ± 25.7	0 (0%)	1 (3.2%)
Historical control (PT-only)	-	-	26 (3.1%)	56 (6.7%)
All Patients	45.8 ± 13.7 p = 0.36	+23.5 ± 18.6 p = 0.12	38 (2.2%) p = 0.31	115 (6.8%) p = 0.73