Rehospitalization Occurrences, Duration, and Costs in Patients Monitored with Implantable Loop Recorders or Mobile Cardiac Outpatient Telemetry Post-Stroke

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INTRODUCTION

The American Heart Association/American Stroke Association (AHA/ASA) identifies atrial fibrillation (AF) as a common and high-risk condition for second ischemic stroke (IS).[1] When the cause of IS is unknown, it recommends long-term rhythm monitoring (LTRM) with mobile cardiac outpatient telemetry (MCOT), implantable loop recorders (ILR), or other (unspecified) methods for AF detection.[1]

- **ILR**s are implanted devices that record abnormal heart rhythms, typically exceeding 2 minutes. Recordings are periodically (e.g., daily) relayed to a storage facility, to be later analyzed by a healthcare provider.[2, 3]
- **MCOT** is a wearable monitor that continuously analyzes cardiac signals. Abnormal episodes, typically longer than 30 seconds, are relayed in near real-time to a staffed facility for evaluation and caregiver notification.

Differences between ILR and MCOT, including episode duration thresholds, may influence detection and impact care.[4, 5]

OBJECTIVE

To compare hospital utilization and costs associated with either ILR or MCOT in patients following an ischemic stroke.

METHOD

We used Optum's de-identified Clinformatics® Data Mart Database to retrieve data on patients admitted for IS from January 1, 2017, to December 31, 2020, who received ILR or MCOT within 30 days post-discharge. Over an 18-month period post-IS, we compared rehospitalizations and hospital days, subcategorizing them into all, emergency, and recurrent stroke, as well as rehospitalization costs.

To be included in the study, patients had to meet additional criteria:

- Continuous observation: 1 year before and 18 months after the index IS
- Index discharge within 15 days to home or to non-acute, non-hospice care
- Survival past the month of index
- No other LTRM device exposure during the study period
- No diagnosis of IS, AF, or atrial flutter in the year prior to index

Groups were balanced (criterion: Cohen's $d \leq 0.1$), according to patients' baseline characteristics including:

- Charlson comorbidities[6]
- Charlson comorbidity index and count
- Hypertension, valvular disease, obesity[5]
- Obstructive sleep apnea, hyperlipidemia, smoking[5]
- Index characteristics: severity, acuity, length of stay, intensive care unit use, discharged status, index year
- Age, sex, and healthcare costs the year before index

Rehospitalizations were defined as any hospital inpatient visit during follow-up. **Emergency** refers to the subset of these reported as emergent or trauma center according to the Centers for Medicare and Medicaid Services (CMS) definitions.[7] **Recurrent stroke** are the subset of all rehospitalizations with a first listed diagnosis in the ICD-10-CM I63 group.

Severity at index was determined using the embedded distinctions for complications or comorbidities (CC) in the reported Disease Related Group (DRG): without CC (least severe), with CC, and with major CC (most severe).[8]

Multivariable generalized linear regression models were used to further account for patient baseline characteristics, assuming gamma distributions for costs and Tweedie distributions for rehospitalizations and days.

RESULTS

Among 2,244 patients, with 1,122 patients in each risk-balanced device group,

- MCOT patients had significantly fewer rehospitalizations (per 100 patients), overall (ILR 70.3, MCOT 59.8; Δ = 10.5, 95% CI 1.3–20.2, *P*=.022); emergency (Δ = 9.2, 95% CI 2.3–17.0, *P*=.011); and for recurrent IS (ILR 15.4, MCOT 8.6; Δ = 6.8, 95% CI 3.9–11.3, *P*<.001).
- MCOT patients spent 1.3 (95% CI 0.6–2.2, *P*<.001) fewer days (ILR 4.8, MCOT 3.5) in the hospital.
- Average rehospitalization costs (ILR $20,920, MCOT $17,566) were $3,354 lower for MCOT patients (95% CI $941–$6,654, *P*=.040).

Figure 1. Rehospitalization Costs (2022 United States Dollars)

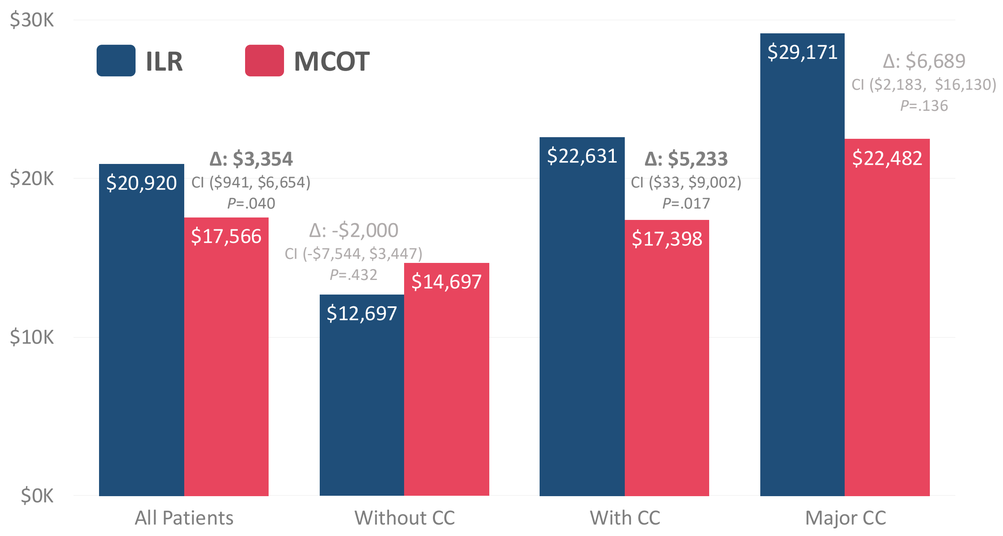

Table 1. Rehospitalizations and Days in the Hospital

Severity at Index	Acuity/Cause	Rehospitalizations (per 100 Patients)					Days in the Hospital (Average per Patient)				
		ILR	MCOT	Δ	Δ 95% CI	*P*-value	ILR	MCOT	Δ	Δ 95% CI	*P*-value
All Patients ILR N: 1,122 MCOT N: 1,122	All Inpatient	70.3	59.8	**10.5**	(1.3, 20.2)	.022	4.8	3.5	**1.3**	(0.6, 2.2)	<.001
	Emergency	48.2	39.0	**9.2**	(2.3, 17.0)	.011	3.3	2.3	**1.1**	(0.5, 1.7)	<.001
	Recurrent Stroke	15.4	8.6	**6.8**	(3.9, 11.3)	<.001	1.0	0.5	**0.5**	(0.3, 0.9)	<.001
Without CC ILR N: 308 MCOT N: 308	All Inpatient	46.4	46.2	0.2	(-15.0, 14.7)	.978	3.3	2.5	0.8	(-0.5, 2.0)	.174
	Emergency	30.2	30.2	0.1	(-11.1, 11.2)	.991	2.3	1.5	0.8	(-0.2, 1.8)	.060
	Recurrent Stroke	14.1	9.6	4.5	(-2.8, 11.1)	.152	1.0	0.6	0.4	(-0.1, 1.0)	.070
With CC ILR N: 618 MCOT N: 618	All Inpatient	74.0	61.5	**12.6**	(0.8, 25.8)	.040	4.9	3.6	**1.3**	(0.2, 2.5)	.017
	Emergency	51.7	39.8	**11.9**	(2.8, 23.8)	.015	3.4	2.5	**0.9**	(0.1, 1.9)	.029
	Recurrent Stroke	15.4	8.3	**7.1**	(3.0, 12.9)	<.001	1.0	0.6	**0.4**	(0.0, 0.9)	.007
Major CC ILR N: 196 MCOT N: 196	All Inpatient	98.4	72.4	**26.0**	(0.5, 52.5)	.038	7.3	4.4	**2.9**	(0.8, 5.2)	.005
	Emergency	73.1	45.2	**27.9**	(7.5, 48.8)	.006	4.9	2.7	**2.2**	(0.8, 3.9)	.003
	Recurrent Stroke	18.9	8.2	**10.8**	(0.2, 22.1)	.013	1.1	0.3	**0.8**	(0.3, 1.6)	<.001

According to the severity of the index hospitalization,

- MCOT patients had fewer readmissions among patients with CC (Δ = 12.6, 95% CI 0.8–25.8, *P*=.040); and with major CC (ILR 98.4, MCOT 72.4; Δ = 26.0, 95% CI 0.5–52.5, *P*=.038), per 100 patients, including for recurrent IS (ILR 18.9, MCOT 8.2; Δ = 10.8, 95% CI 0.2–22.1, *P*=.013).
- Among patients with CC, the MCOT group had lower average rehospitalization costs (ILR $22,631, MCOT $17,398; Δ = $5,233, 95% CI $33–$9,002, *P*=.017).
- Among patients without CC, no significant differences were found in rehospitalizations (Δ = 0.2, 95% CI –15.0 to 14.7, *P*=.978), days, nor costs.

Abbreviations and Notes: CC: Complications or comorbidities; CI: 95% Confidence interval (bootstrap with replacement); N: Patient count; *P*: *P*-value; Δ: Difference (Δ = ILR result – MCOT result).
Differences in **bold** in Figure 1 and Table 1 indicate statistical significance (*P*-value ≤ 0.05, Wald's test).

CONCLUSIONS

Significant differences in hospital utilization and costs were associated with the choice of rhythm monitor following an ischemic stroke (IS). Patients monitored with MCOT experienced fewer rehospitalizations, spent less time in the hospital, and incurred lower costs. Among patients without complications or comorbidities with the index IS, outcomes showed no statistically significant differences between the device groups.

In patients with any level of complications or comorbidities (>70% of our sample), notable and statistically significant improvements in outcomes were seen in the MCOT-monitored group. These findings suggest important potential benefits from the use of MCOT for post-IS monitoring in these patients. Incidentally, by freeing up hospital beds (including emergency) for other patients, this could also result in improved resource allocation. Given the magnitude and consistency of these differences, further research is recommended, particularly into the direct causal mechanisms through which they may arise.

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