# AN EYE ON USABILITY: SIMULATION BASED HUMAN FACTORS EVALUATION OF LEFT VENTRICULAR ASSIST DEVICE PERIPHERALS

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#### Introduction

Thanks to advancements in left ventricular assist device (LVAD) technology and management over the last decades, the currently available HeartMate 3 LVAD (HM3) shows excellent clinical outcomes with a 1-year survival of 85.9% [1]. However, constrained usability of wearables remains as a challenge in LVAD therapy [2, 3]. The aim of this study was to comparatively assess the usability of CorWave (CW) peripheral prototypes and HM3 wearables in simulated scenarios.

### Methods

This cross-sectional single center cohort simulation study involved former LVAD patients post heart transplantation (HTX) and laypeople without LVAD handling experience. Subjects were provided with either HM3 or CW peripherals and instructed to complete six predefined scenarios. The simulation setting included a 4-perspective room video and first-person eye tracking recordings (see Figure 1). Outcome measures were defined as initial success rates, time to success during two attempts, pump-off duration and an 18-item post scenario survey.

#### Results

Forty-six untrained subjects (30 HM3 vs. 16 CW, median age 63.5 (IQR = 10.0) vs. 60.0 (16.0) years, p = 0.41; 53% former LVAD patients, p = 0.76) were enrolled and completed 276 scenarios, revealing higher initial success rates for the CW group (92.7% vs. HM3 80.6%, p = 0.008).

The change of power supply revealed highest complexity for the HM3 cohort, resulting in ten unintended driveline disconnections, five times higher time to success (p < 0.001) and three times lower initial success rates when compared to the CW cohort. Controller exchange success rates were comparable, however both time to success and pump-off durations were twice as long for the HM3 ( $p \le 0.005$ , see Table 1). While more CW subjects perceived the cable lengths as appropriate (81% vs. HM3 67%, p = 0.001), 41% of the participants agreed on too heavy peripherals (p = 0.85).



Figure 1: Exemplary four-perspective room recording combined with eye tracking perspective.

## Discussion

This study emphasizes the user centered design benefits of the novel CW concept compared to HM3 peripherals, promising to enhance both quality of life and safety of future LVAD patients.

#### References

- 1. Jorde et al., Ann Thorac Surg, 117(1):33-44, 2024.
- 2. Schlöglhofer et al., J Heart Lung Transplant, 42(4):466-477, 2023.
- 3. Dunn et al., Ann Biomed Eng, 47(12):2431-2488, 2019

Table 1: Initial success rates and time to success within two attempts per simulated scenario, stratified by cohorts. HM3: HeartMate 3; CW: CorWave

Simulated scenario	Initial success rate n (%)			Time to success (two attempts) Median (IQR), seconds		
	CW	HM3	p-value	CW	HM3	p-value
Battery exchange in normal light	16 (100%)	27 (90.0%)	0.54	16.5 (8.5)	32.5 (18.8)	<0.001
Power supply change to AC power	15 (93.8%)	8 (26.7%)	<0.001	48.0 (30.3)	260.0 (158.0)	<0.001
Driveline dis- and reconnection	11 (68.8%)	23 (76.7%)	0.73	41.5 (49.3)	41.5 (44.0)	0.29
Controller exchange	15 (93.8%)	27 (90.0%)	0.79	31.0 (32.0)	83.0 (63.5)	< 0.001
Battery exchange in dim light	16 (100%)	30 (100%)	-	12.0 (7.3)	21.0 (19.0)	0.001
Battery exchange within carry bag	15 (93.8%)	30 (100%)	0.35	40.5 (24.8)	75.0 (45.0)	< 0.001

