The impact of HeartMate 3 speed on outcomes in the Momentum 3 clinical trial

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MOMENTUM 3

Disclosures

- Drs. Haft, Ransom, Lowes, Lee, : None
- Dr. Katz: Research grants from Abbott and Consultant for Abbott (payments made to me)
- Drs. Estep, Itoh, Silvestry : Consultant for Abbott (payments made to me)
- Dr. Bhama: Speaker’s bureau (payments made to me)

The MOMENTUM 3 IDE and CAP studies are Abbott sponsored studies.

Background

- Continuous flow pumps work at fixed operating speeds speed set by the clinical providers
  - Initial speed is set based upon intraoperative echo and invasive hemodynamic parameters
  - Ramp studies can be employed to optimize speed setting using echocardiography or hemodynamic parameters
- Setting the pump speed too low may lead to persistent heart failure with insufficient forward flow and LV unloading
- Setting the pump speed too high may lead to suction events, right heart failure or arrhythmias
- PREVENT study[1] correlated HM II pump speed with Hemocompatibility Related Adverse Events (HRAE).

[1]Maltais, S. *et al. JHLT* 36, 2017.

Objective

- Characterize HM3 pump speeds in the MOMENTUM studies

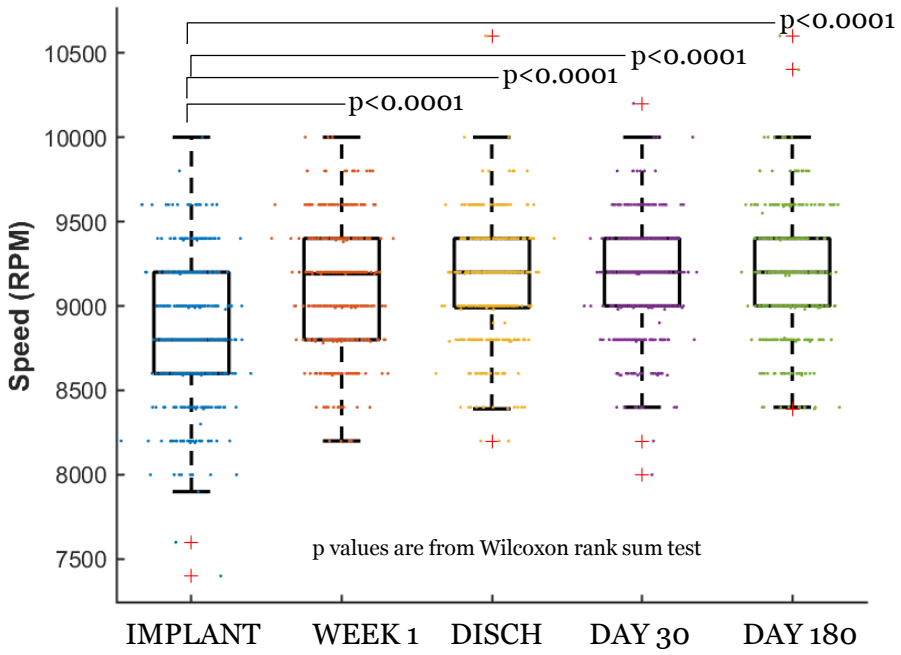
  Data from the full cohort of IDE (NCT02224755) subjects and first 500 participants in the CAP study (NCT02892955) were utilized for the analyses presented here.

- Identify clinical variables associated with speed selection

- Determine if early speed setting is independently associated with
  - HRAE, death, or emergent transplant
  - Functional status and quality of life

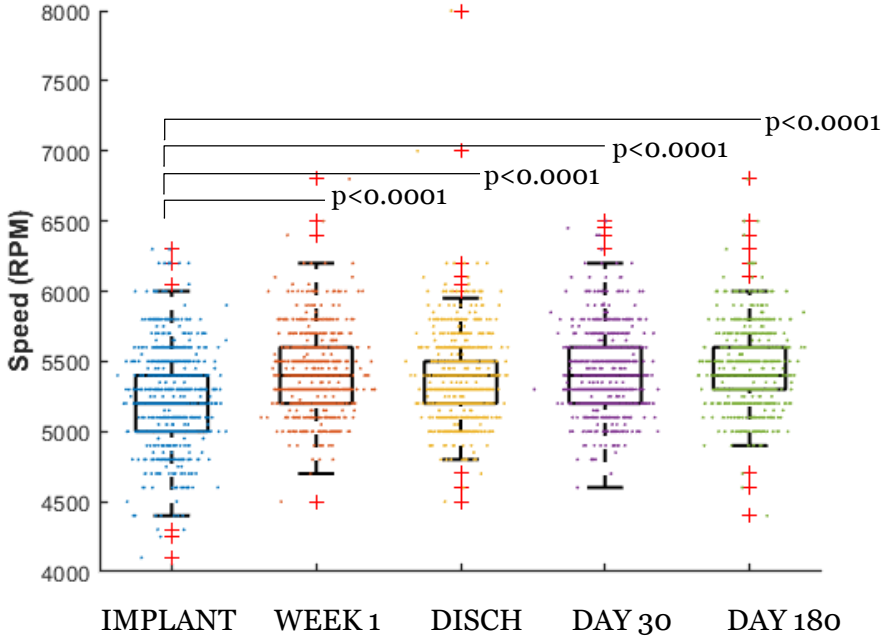
Distribution of pump speeds by study visit

HM II



Interval	n	Median	Q1	Q3
IMPLANT	502	8800	8600	9200
WEEK 1	497	9200	8990	9400
DISCHARGE	470	9190	8800	9400
DAY 30	481	9200	9000	9400
DAY 180	414	9200	9000	9400

HM 3



Interval	n	Median	Q1	Q3
IMPLANT	953	5200	5000	5400
WEEK 1	956	5400	5200	5600
DISCHARGE	954	5400	5200	5500
DAY 30	941	5400	5200	5600
DAY 180	862	5400	5300	5600

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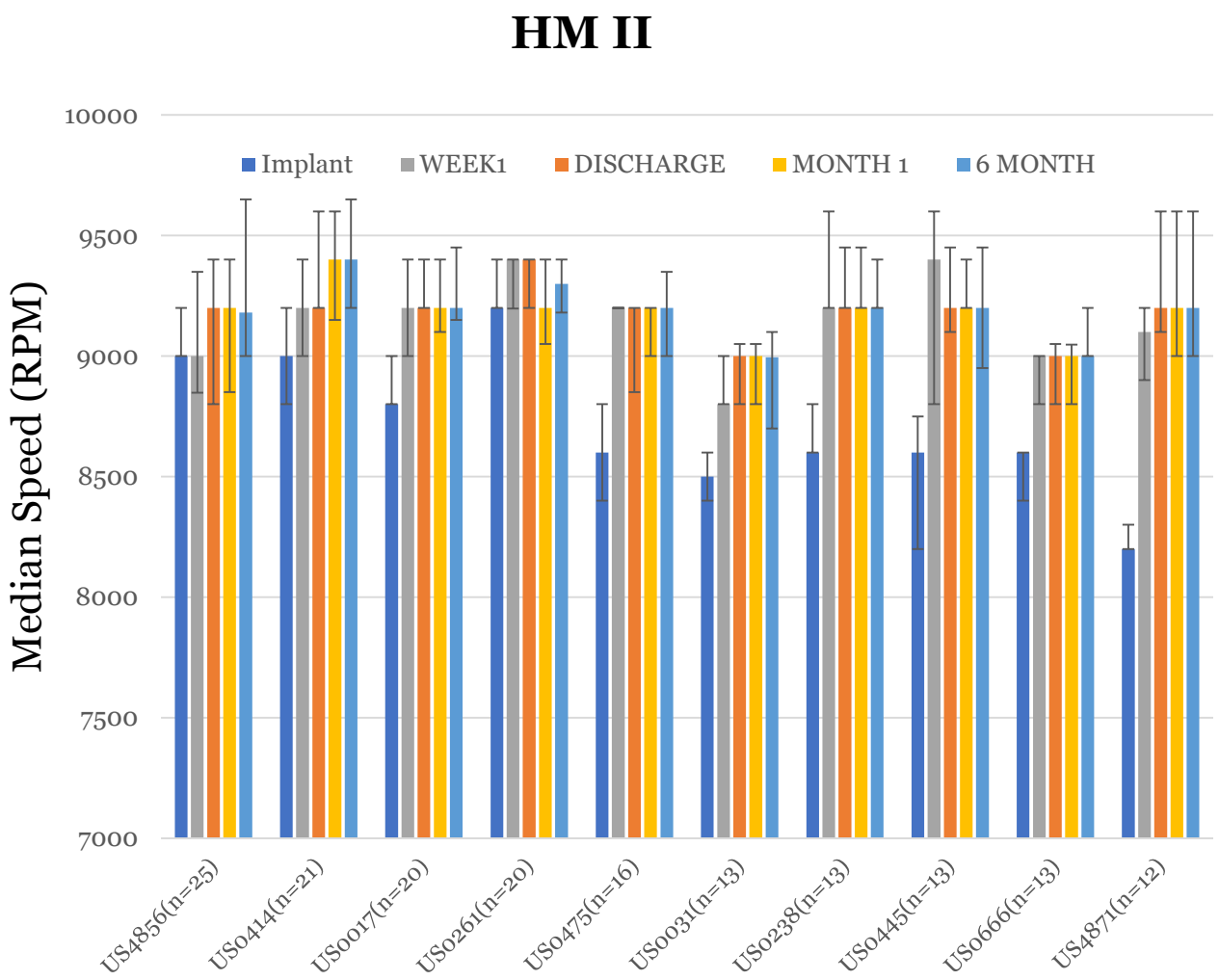
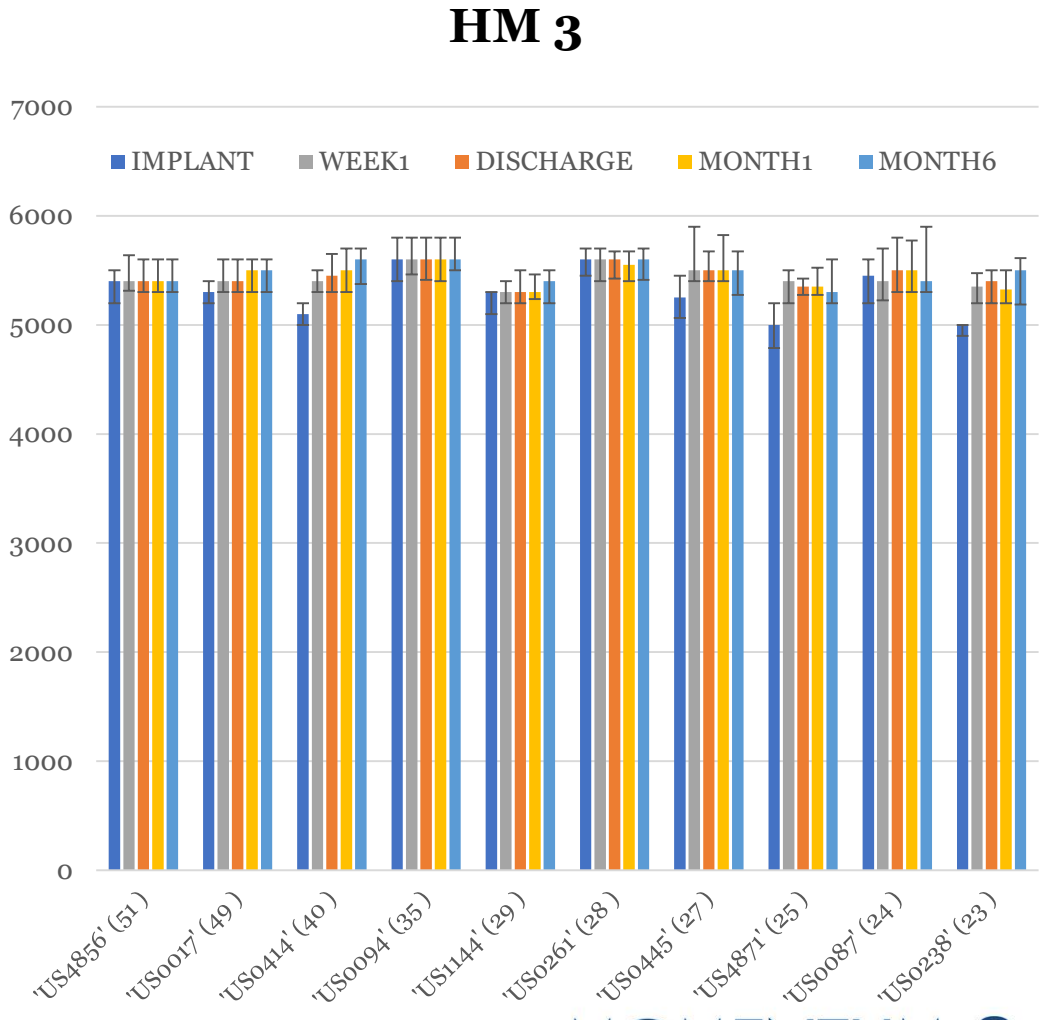
Distribution of pump speeds by site and study visit





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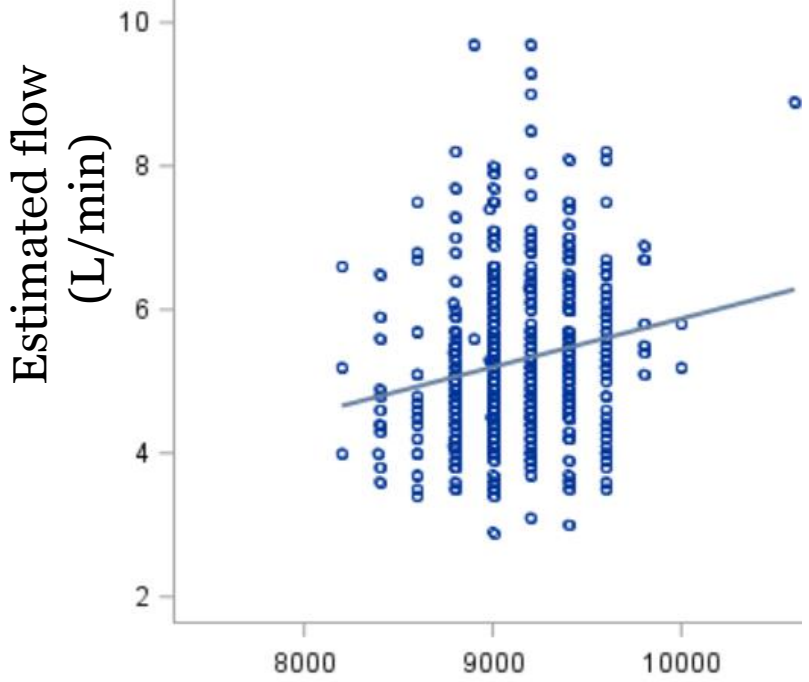
Pump Speed vs. Estimated Flow at Discharge

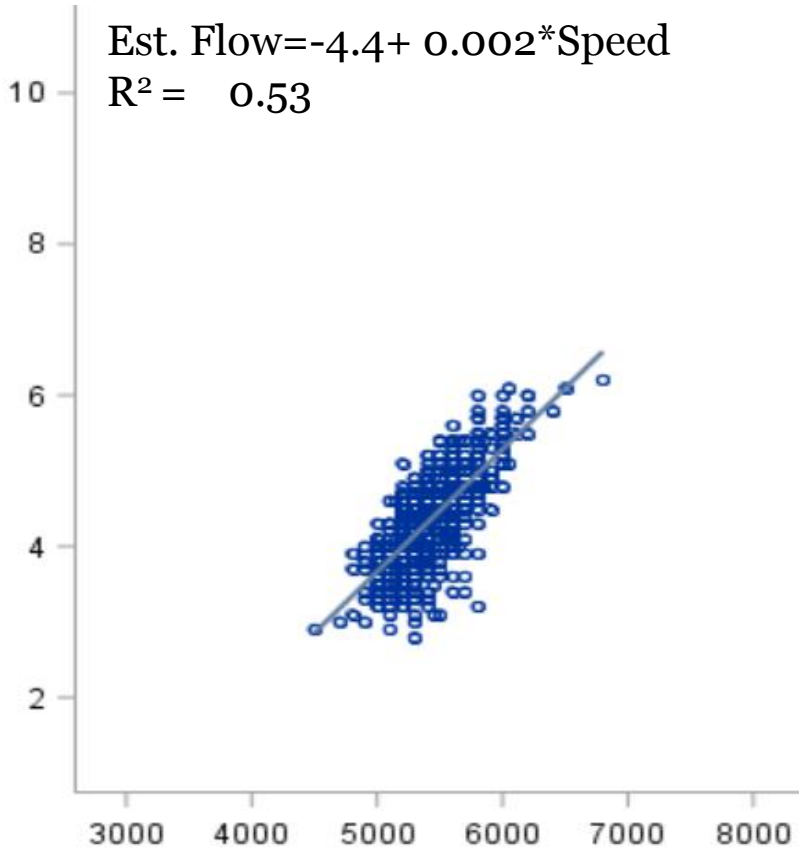
HM II

Est. Flow= -0.88 +0.0007*Speed
R^2 = 0.03



HM 3

Est. Flow=-4.4+ 0.002*Speed
R^2 = 0.53



Discharge Speed (RPM)

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Multi-variable analysis

- The variables in the table below (at baseline) were assessed for associations with:
  - pump speed
  - composite clinical outcome: total count of HRAE, death, or expedited transplant for pump thrombus
- Candidate variables for inclusion in the multi-variable (MV) model were identified using univariate (UV) analysis with $p < 0.15$, from the above list.
- These variables identified in the UV analysis were eliminated from the MV model, stepwise, until all remaining variables had $p<0.05$.

Demographics	CV History	Hemodynamics	Labs	Pump Settings[2]
Age	Ischemic etiology of HF	LVESD	TBili	Implant speed
Gender (male)	Inotrope Medications	LVEDD	Creatinine	Discharge speed
Race (white)	IABP	CVP to PCWP Ratio	BUN	Estimated flow
BSA	INTERMACS	PAPi		
BTT[1]/DT		PVR		

[1]Includes BTC.
[2] Only included for composite clinical outcome analysis.
Value in () indicates the reference value.

Predictors of Implant Pump Speed

HM II

Predictor Variable	Parameter Estimate	P-value
Age	-3.35	0.0281
BUN	-4.047	0.0044
Gender	92.16	0.044
PAPi	9.8	0.0451

HM 3

Predictor Variable	Parameter Estimate	P-value
LVEDD	2.6	0.0081
BSA	154.9	0.0002

Simple linear regression was used to identify independent predictors of event rates.

Predictors of Discharge Pump Speed

HM II

Predictor Variable	Parameter Estimate	P-value
Gender	110.5	0.0039
BSA	314.7	<0.0001
BUN	-3.6	0.0014

HM 3

Predictor Variable	Parameter Estimate	P-value
Age	-2.6	0.0001
Gender	56.1	0.0054
LVEDD	1.9	0.0045
BSA	275.2	<.0001

Simple linear regression was used to identify independent predictors of event rates.

Predictors of Composite Clinical Outcome

HM II

Predictor Variable	Parameter Estimate	P-value
Age	0.0150	0.0071
BUN	0.0101	0.0287

HM 3

Predictor Variable	Parameter Estimate	P-value
Age	0.027	<0.0001
Gender	-0.31	0.03
LVESD	-0.016	0.0011

The negative binomial model was used to identify independent predictors of event rates .

6MWT vs. Discharge Speed: HM3

Speed Quartile	Baseline	6 Months	Change from Baseline at 6 Months	BL vs. 6 mo. p-Value[1]	Impact of Discharge speed on change in SMWD at 6 mos.[2]
<Q1	106.6 (0.0, 266.0) (99)	316.9 (242.0, 396.2) (78)	183.0 (30.5, 300.0) (65)	<0.0001	0.082
Q1-Q3	0.0 (0.0, 237.0) (625)	322.2 (240.0, 396.2) (525)	178.3 (45.2, 329.0) (461)	<0.0001	
>Q3	0.0 (0.0, 200.0) (122)	330.0 (256.0, 384.0) (101)	231.3 (110.7, 334.4) (90)	<0.0001	

Data are presented as Median (Q1, Q3) (N).
[1]Non-parametric paired comparison.
[2]p-value is from linear regression model adjusted for gender, intended use, INTERMACS profile, ischemic cardiomyopathy, CRT/CRT-D, IABP, age > 65, LVEF, LVEDD, LVESD, CKD change at 30 days, BSA.

EQ5D Index Score vs. Discharge Speed: HM3

Speed Quartile	Baseline EQ5D Index Score Mean ± SD (n)	6 Months EQ5D Index Score Mean ± SD (n)	Change from Baseline at 6 Months Mean ± SD (n)	BL vs. 6 mo. p-Value[1]	Impact of Discharge speed on Change in EQ5D Index Score from baseline to 6-months p-Value[2]
<Q1	0.72 ± 0.18 (106)	0.77 ± 0.17 (91)	0.047 ± 0.25 (85)	0.0774	0.033
Q1-Q3	0.66 ± 0.22 (664)	0.80 ± 0.16 (605)	0.14 ± 0.26 (568)	<0.0001	
>Q3	0.64 ± 0.23 (128)	0.78 ± 0.18 (119)	0.14 ± 0.26 (113)	<0.0001	

Data are presented as Median (Q1, Q3) (N).
[1]By two-sided t-test with alpha = 0.05
[2]p-value is from linear regression model adjusted for gender, intended use, INTERMACS profile, ischemic cardiomyopathy, CRT/CRT-D, IABP, age > 65, LVEF, LVEDD, LVESD, CKD change at 30 days, BSA.

NYHA Class I/II at 6 months vs. HM3 Discharge Speed

Speed Quartiles	6 Months	p-Value[1]
<Q1	77.1% (74/96)	0.73
Q1-Q3	81.3% (494/608)	
>Q3	77.5% (93/120)	

[1]Logistic Regression Model adjusted for Gender, Intended Use, INTERMACS Profile, Ischemic Cardiomyopathy, CRT/CRT-D, IABP, Age > 65, LVEF, LVEDD, LVESD, CKD change at 30 days, BSA.

Conclusions

- HM3 speed was significantly lower at implant compared to other time points up to 180 days.
  - Variability in speed settings was minimal post discharge for HM3
- Male gender, younger age, larger BSA and LVEDD were associated with higher pump speeds.
- Early HM3 speed was not independently associated with HRAE.
  - Older age, smaller LVESD and female gender were significant independent predictors of the composite clinical endpoint
- Lowest quartile of pump speed was independently associated with reduced functional and quality of life benefit

We THANK all the patients, our investigators, clinical nurse coordinators, and allied health personnel for their dedication to the conduct of the MOMENTUM 3 trial