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Digital Care Transformation: Interim Report from the First 5,000 Patients Enrolled in a Remote Algorithm-based Cardiovascular Risk Management Program to Improve Lipid and Hypertension Control

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Undertreatment of hypercholesterolemia and hypertension (HTN) remains a persistent clinical challenge, even among patients at high cardiovascular risk. Approximately 30-50% of patients do not receive optimal medical treatment, despite most of these treatments being generic, established in practice guidelines and having established cost effectiveness. [1, 2]

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We designed, and are actively implementing a remote, algorithmically-driven, disease management program that utilizes navigators and pharmacists, supported by specialists, to initiate and titrate medications within the Mass General Brigham health system. We enrolled patients with uncontrolled low density lipoprotein-cholesterol (LDL-C) and/or blood pressure identified via medical record screening or direct referrals not meeting current guideline-directed therapeutic targets. Patients in the lipid program were categorized according to current guideline-specificied[3] hierarchical groups - established atherosclerotic cardiovascular disease (ASCVD), diabetes, severe hypercholesterolemia (LDL-C >190 mg/dl), or high-risk primary prevention – to determine treatment thresholds. Blood pressure was measured with digitally-connected home blood pressure cuffs. Following guideline-recommended clinical algorithms, pharmacist (prescribing under collaborative drug therapy management [CDTM] programs) initiated and titrated medications. The supervising physician was readily available for additional clinical management. Non-licensed navigators were the primary communication channel with patients, ordering laboratory tests and providing education at preset intervals until treatment targets were achieved (LDL-C guideline-directed thresholds[3] and average home blood pressure <130/80 mmHg). Primary care physicians (PCPs) were notified of identified patients and could defer patient enrollment. Clinical staff were supported by a custom-built software program (CardioCompass) external to the EHR that provided decision support, patient-relationship management and communication tools (eg, texting). [4, 5] No in-person visits were required. The project was approved by our institutional review committee with a waiver for informed consent. We encourage investigators interested in data sharing and collaboration to contact the corresponding author.

Between Jan 1, 2018 and May 21, 2020, we screened 18,810 patients and enrolled 5,000 patients in the cholesterol and HTN programs. During COVID-19 pandemic (March-May 2020), enrollment increased by nearly 25%. The median age was 64 years, 55% were female, and 26% non-white. Of the 3939 patients enrolled in the cholesterol program, 1385 (35%) had established ASCVD group, 995 (25%) had diabetes but no ASCVD, 1247 (32%) had LDL-C >190 mg/dl group, and 312 (8%) were high-risk primary prevention. To date, 1343 (34%) patients completed the initial titration phase, 1623 (41%) remain under active titration, and 973 (25%) were referred to a clinician, withdrew, or became unreachable. To date, 1819 (46%) of all patients are at guideline-directed LDL-C thresholds.

The Table presents LDL-C changes in all patients enrolled and in those patients who entered the maintenance phase of the program after active titration. Compared to baseline, LDL-C reduction was 24 mg/dl (18%) in all patients enrolled, including those who remain in active titration or dropped out, and 52 mg/dl (42%) in those who achieved maintenance after completed titration (each $p<0.001$). Significant LDL-C reductions occurred in all four cholesterol patient categories. Lipid-lowering therapy increased significantly from baseline.

Of 1,437 patients enrolled in the HTN program, 556 (39%) completed initial titration, 431 (30%) remain under active titration and 450 (31%) were referred to their PCP or expert clinics, withdrew, or became unreachable. Mean home systolic/diastolic BP reduction compared to program entry was 14/6mmHg ($p<0.001$ for both). The proportion of patients on 1,2,3 or 4 antihypertensive medications changed from 42%, 25%, 7% and 2% at baseline

to 31%, 35%, 19%, and 5% in maintenance ($p<0.001$). No serious adverse program-related outcomes occurred. Mean (SD) number of calls / titrations per patient were 15(9) / 2(1) for Lipid and 27(10) / 2(1) for HTN program.

This remotely delivered, navigator and pharmacist-led lipid and HTN management program demonstrates that standardized algorithmic care of at-risk but undertreated patients is an effective and efficient strategy to optimize guideline-directed therapy for lipids and HTN across large populations. This provides a model for expanding remote healthcare delivery to increase access to care, reduce health inequities, and improve healthcare quality. This implementation project does not have a comparator group, however because the baseline data are consistent with national averages, we feel the differences can rationally be ascribed predominately to the intervention.

The majority of the therapeutic benefit of this program was achieved by improving adherence utilizing mostly generic medications. In addition to improved achievement of treatment targets, remote algorithmic management programs of this type can improve quality metrics for value-based contracts, unburden the provider to focus on more complex care, and provide more patient education and longitudinal support.

Consistent with national trends, we found that despite ongoing population health initiatives in a large, diverse health care system, many patients do not to receive or follow guideline-directed treatment. The basis for these therapeutic gaps is multifactorial and include challenging patient, provider, and system-level issues. Our program provides an end-to-end solution including patient identification, improved data collection, education, and defined treatment-pathways with that ability to prescribe and titrate therapy. When implemented at scale, and with optimized data collection, this model provides a robust framework that can be deployed within learning health systems.

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References

1. Muntner P, Hardy ST, Fine LJ, Jaeger BC, Wozniak G, Levitan EB and Colantonio LD. Trends in Blood Pressure Control Among US Adults With Hypertension, 1999-2000 to 2017-2018. JAMA. 2020;in press:doi:10.1001/jama.2020.14545.
2. Patel N, Bhargava A, Kalra R, Parcha V, Arora G, Muntner P and Arora P. Trends in Lipid, Lipoproteins, and Statin Use Among U.S. Adults: Impact of 2013 Cholesterol Guidelines. J Am Coll Cardiol. 2019;74:2525–2528. [PubMed: 31727291]
3. Grundy SM, Stone NJ, Bailey AL, Beam C, Birtcher KK, Blumenthal RS, Braun LT, de Ferranti S, Faiella-Tommasino J, Forman DE, Goldberg R, Heidenreich PA, Hlatky MA, Jones DW, Lloyd-Jones D, Lopez-Pajares N, Ndumele CE, Orringer CE, Peralta CA, Saseen JJ, Smith SC jr., Sperling L, Virani SS and Yeboah J 2018 AHA/ACC/AACVPR/AAPA/ABC/ACPM/ADA/AGS/APhA/ASPC/NLA/PCNA Guideline on the Management of Blood Cholesterol: Executive Summary: A Report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines. Circulation. 2019;139:e1046–e1081. [PubMed: 30565953]
4. Desai AS, Maclean T, Blood AJ, Bosque-Hamilton J, Dunning J, Fischer C, Fera L, Smith KV, Wagholikar K, Zelle D, Gaziano T, Plutzky J, Scirica B and MacRae CA. Remote Optimization of

Guideline-Directed Medical Therapy in Patients With Heart Failure With Reduced Ejection Fraction. JAMA Cardiol. 2020.

5. Fisher NDL, Fera LE, Dunning JR, Desai S, Matta L, Liquori V, Pagliaro J, Pabo E, Merriam M, MacRae CA and Scirica BM. Development of an entirely remote, non-physician led hypertension management program. Clin Cardiol. 2019;42:285–291. [PubMed: 30582181]

Table.

Clinical Results of the Lipid and Hypertension Programs

LIPID PROGRAM	**All Patients Ever Enrolled - currently active, in maintenance, or exited**		**Patients in Maintenance**									
	All Patients (n=3,939)		**All Patients (n=1,343)**		**ASCVD (n=473)**		**Hx of LDL-C>190 mg/dl (n=413)**		**Diabetes (n=350)**		**Primary Prevention (n=107)**	
	Baseline	**Follow-up**	**Baseline**	**Follow-up**	**Baseline**	**Follow-up**	**Baseline**	**Follow-up**	**Baseline**	**Follow-up**	**Baseline**	**Follow-up**
LDL-C (mg/dl), mean (SD)	133 (43)	109 (46)	125 (40)	73 (24)	99 (39)	57(17)	159 (41)	91 (22)	121 (23)	73 (20)	129 (26)	79(25)
Change mg/dl), mean (SD)	−24 (−18%)		−52 (−42%)		−42(−42%)		−68(−43%)		−48(−40%)		−50 (−39%)	
p-value *	< .001		< .001		< .001		< .001		< .001		< .001	
Any lipid lowering therapy (n/N,%)	2,500 (63%)	3,100 (79%)	1081 (80%)	1,305 (97%)	378 (80%)	470 (99%)	328 (79%)	407 (99%)	296 (85%)	340 (97%)	70 (65%)	88 (82%)
Change (%)	24%		21%		23%		24%		15%		25%	
p-value *	< .001		< .001		< .001		< .001		< .001		0.064	
Any statin (n/N,%)	2,375 (60%)	2,957 (75%)	1,045 (78%)	1,266 (94%)	364 (77%)	447 (95%)	320 (77%)	400 (97%)	293 (84%)	334 (95%)	68 (64%)	85 (79%)
Change (%)	25%		21%		23%		25%		14%		25%	
p-value *	< .001		< .001		< .001		< .001		0.005		0.080	
Any high-intensity statin (n/N,%)	1,152 (29%)	1,570 (40%)	534 (40%)	721 (54%)	221 (47%)	339 (72%)	132 (32%)	199 (48%)	146 (42%)	155 (44%)	35 (33%)	28 (26%)
Change (%)	36%		35%		53%		51%		6%		−20%	
p-value *	<.001		<.001		<.001		<.001		0.20		0.26	
Ezetimibe (n/N,%)	283 (7%)	556 (14%)	120 (9%)	228 (17%)	83 (18%)	153 (32%)	23 (6%)	48 (12%)	11 (3%)	23 (7%)	3 (3%)	4 (4%)
Change (%)	96%		90%		84%		109%		109%		33%	
p-value *	< .001		< .001		< .001		0.010		0.013		0.99	

LIPID PROGRAM	**All Patients Ever Enrolled - currently active, in maintenance, or exited**		**Patients in Maintenance**									
	All Patients (n=3,939)		**All Patients (n=1,343)**		**ASCVD (n=473)**		**Hx of LDL-C>190 mg/dl (n=413)**		**Diabetes (n=350)**		**Primary Prevention (n=107)**	
	Baseline	**Follow-up**	**Baseline**	**Follow-up**	**Baseline**	**Follow-up**	**Baseline**	**Follow-up**	**Baseline**	**Follow-up**	**Baseline**	**Follow-up**
Any PCSK9i (n/N,%)	32 (1%)	95 (2%)	13 (1%)	44 (3%)	11 (2%)	35 (7%)	2 (0%)	7 (2%)	0 (0%)	0 (0%)	0 (0%)	2(2%)
Change (%)	197%		238%		218%		250%		0%		0%	
p-value *	< .001		< .001		< .001		0.10		NA		NA	

HYPERTENSION PROGRAM	**All Patients Ever Enrolled - currently active, in maintenance, or exited**		**Patients in Maintenance**	
	(n=1,437)		**(n=556)**	
	Qualifying BP	**Follow-up**	**Qualifying BP**	**Follow-up**
SBP, mmHg (mean, SD)	165 (18)	135 (17)	163 (18)	124 (8)
Change in SBP (mmHg, %) from qualifying SBP	−30 (−18%)		−39 (−24%)	
p-value *	< .001		< .001	
DBP, mmHg (mean, SD)	92 (9)	77 (11)	90 (8)	72 (7)
Change in DBP (mmHg, %) from qualifying SBP	−15 (−16%)		−18 (−20%)	
p-value *	< .001		< .001	

	First 1-week home mean BP	**Follow-up**	**First 1-week home mean BP**	**Follow-up**
SBP, mmHg (mean, SD)	140 (17)	135 (17)	138 (15)	124 (8)
Change in home SBP (mmHg, %)	−5 (−4%)		−14 (−10%	
p-value *	< .001		< .001	

LIPID PROGRAM	All Patients Ever Enrolled - currently active, in maintenance, or exited		Patients in Maintenance									
	All Patients (n=3,939)		All Patients (n=1,343)		ASCVD (n=473)		Hx of LDL-C>190 mg/dl (n=413)		Diabetes (n=350)		Primary Prevention (n=107)	
	Baseline	Follow-up	Baseline	Follow-up	Baseline	Follow-up	Baseline	Follow-up	Baseline	Follow-up	Baseline	Follow-up
DBP, mmHg (mean, SD)	81 (10)	77 (11)	78 (9)	72 (7)								
Change in home DBP (mmHg,%)	−4 (−5%)		−6 (−8%)									
p-value *	< .001		< .001									

SBP – systolic blood pressure; DBP – diastolic blood pressure, SD – standard deviation.

* A paired t test was used for the maintenance patients and the standard Welch sample t test was used for enrolled patients to calculate the p values (https://www.rdocumentation.org/packages/stats/versions/3.6.2/topics/t.test)