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Leon H. Charney Division of Cardiology

Building Electronic Tools To Enhance and Reinforce CArdiovascular REcommendations for Heart Failure (BETTER CARE-HF)

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Mineralocorticoid antagonists (MRA) are vastly under-prescribed in HFrEF

- Approximately **65-75%** of patients eligible for MRA are not prescribed this life-saving medication.
- Closing this treatment gap could save **over 20,000** lives per year in the United States.

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Greene, et al. JACC 2018
Fonarow, et al. Am Heart J 2011
Mukhopadhyay, et al. BMC Cardiovasc Disord 2022

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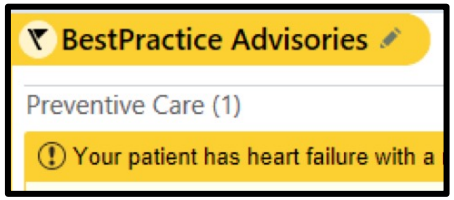
Electronic health record (EHR) tools are low-cost, scalable, and can improve prescribing

- When developed for other medications, EHR tools have shown modest effectiveness (4.4 percentage points in a metanalysis).
- However, there is **wide variability** in EHR tool development and design.
- The optimal delivery and timing of EHR tools is **unknown**.

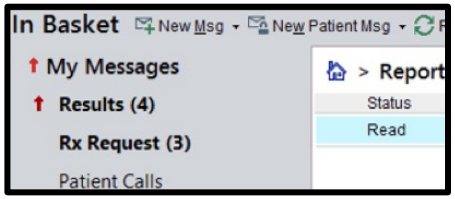
Kwan, et al. BMJ 2020

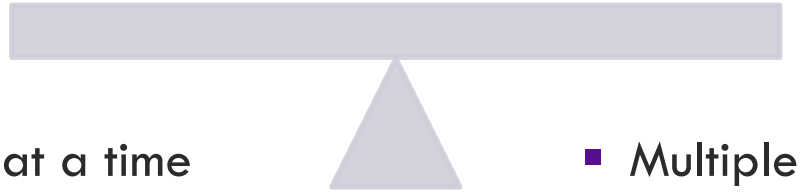
Two EHR Tools: Alerts and Messages



Alerts

Messages





- Single patient at a time
- During clinical encounter
- Could disturb workflow

- Multiple patients at once
- Seen between encounters
- Does not disturb workflow

BETTER CARE-HF Hypotheses

- Among patients with HFrEF who are evaluated by a cardiologist in the outpatient setting, an alert or a message will improve prescribing of MRA as compared to usual care.
- An alert will also be more effective than a message at improving prescribing of MRA.

Inclusion and Exclusion Criteria

Inclusion Criteria	Excluded if MRA Contraindicated	Additional Exclusion Criteria
• Age ≥ 18 • Seen in outpatient cardiology practice • Most recent EF ≤ 40% • Not already prescribed MRA therapy	• Hypotension (SBP < 90 mm Hg) • Hyperkalemia (most recent K > 5.0 mmol/L) • Kidney disease (GFR ≤ 30 mL/min/1.73m^2 • Documented MRA allergy or intolerance	• Ventricular assist device • Cardiac amyloid • Hospice

Selected Group of Patients
Reduced "Alert Fatigue"

Study Design

Cluster-randomization by cardiologist
(60 per arm)

All patients seeing same cardiologist were assigned to the same arm.

Alert
for a single patient at the time of visit

Message
for multiple patients in between visits

Usual Care
(no alert or message)

Study Setting

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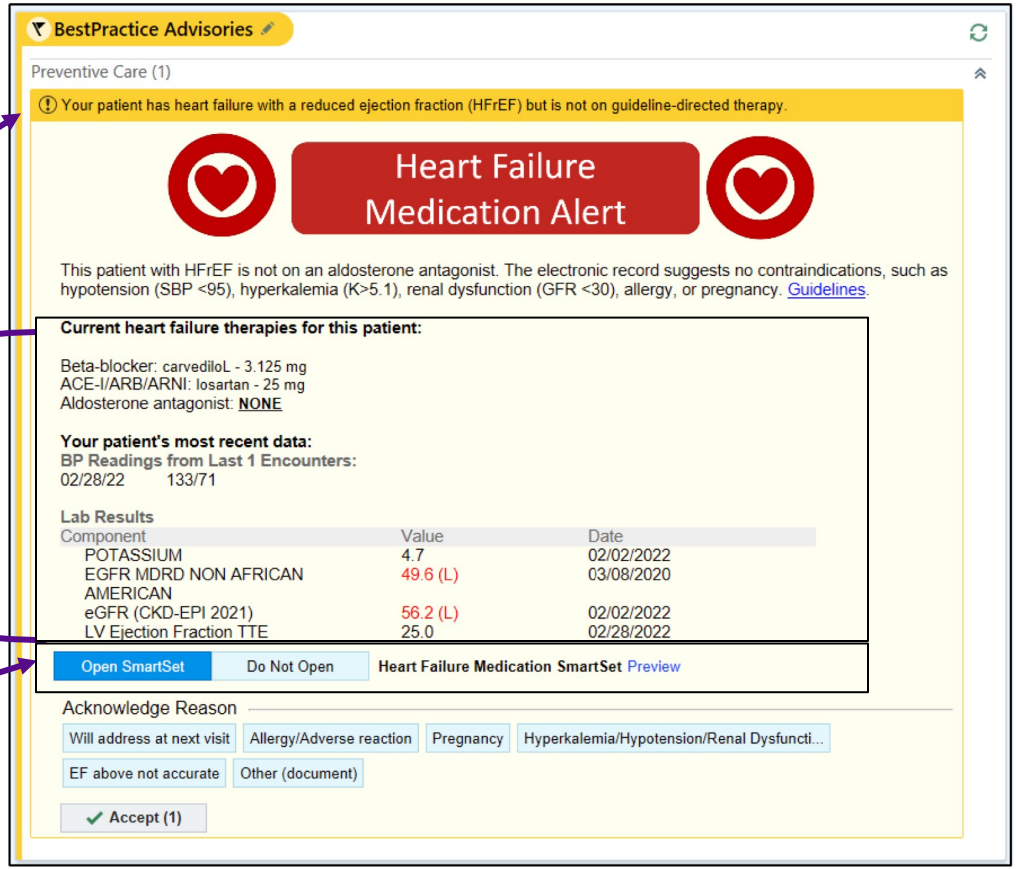
Intervention Development and Features

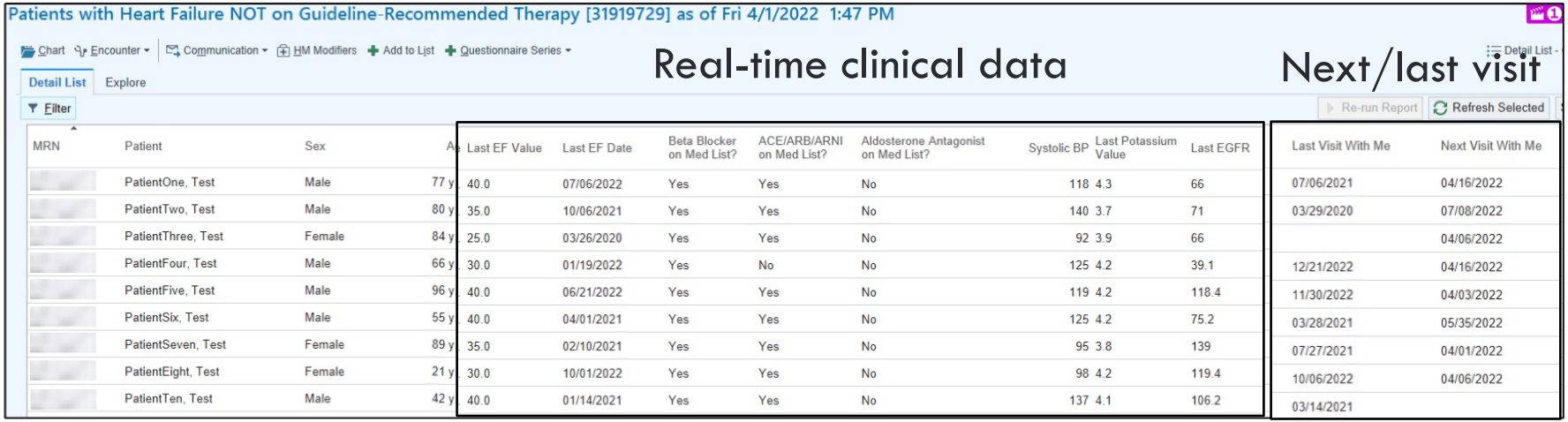
- Iterative development process that included end-user semi-structured interviews, pilot-testing, and refinement.
- Development of alerts and messages was informed by **Cognitive Load Theory**, **Nudge Theory**, and the **5 Rights of Clinical Decision Support** frameworks.
- Interventions were automated, EHR-embedded, and displayed real-time clinical data.

Alert Arm

- Positioning at the top of the chart
- Real-time clinical data
- Pre-selected order set



Message Arm



MRN	Patient	Sex	Age	Last EF Value	Last EF Date	Beta Blocker on Med List?	ACE/ARB/ARNI on Med List?	Aldosterone Antagonist on Med List?	Systolic BP	Last Potassium Value	Last EGFR	Last Visit With Me	Next Visit With Me
[redacted]	PatientOne, Test	Male	77 y	40.0	07/06/2022	Yes	Yes	No	118	4.3	66	07/06/2021	04/16/2022
[redacted]	PatientTwo, Test	Male	80 y	35.0	10/06/2021	Yes	Yes	No	140	3.7	71	03/29/2020	07/08/2022
[redacted]	PatientThree, Test	Female	84 y	25.0	03/26/2020	Yes	Yes	No	92	3.9	66		04/06/2022
[redacted]	PatientFour, Test	Male	66 y	30.0	01/19/2022	Yes	No	No	125	4.2	39.1	12/21/2022	04/16/2022
[redacted]	PatientFive, Test	Male	96 y	40.0	06/21/2022	Yes	Yes	No	119	4.2	118.4	11/30/2022	04/03/2022
[redacted]	PatientSix, Test	Male	55 y	40.0	04/01/2021	Yes	Yes	No	125	4.2	75.2	03/28/2021	05/35/2022
[redacted]	PatientSeven, Test	Female	89 y	35.0	02/10/2021	Yes	Yes	No	95	3.8	139	07/27/2021	04/01/2022
[redacted]	PatientEight, Test	Female	21 y	30.0	10/01/2022	Yes	Yes	No	98	4.2	119.4	10/06/2022	04/06/2022
[redacted]	PatientTen, Test	Male	42 y	40.0	01/14/2021	Yes	Yes	No	137	4.1	106.2	03/14/2021	

- Sent monthly via EHR
- Physician opens list by clicking a link

Outcomes

Primary outcome

- New MRA prescription during study period

Secondary outcome

- Prescription of new BB, ACEI, ARB, or ARNI

Statistical Considerations

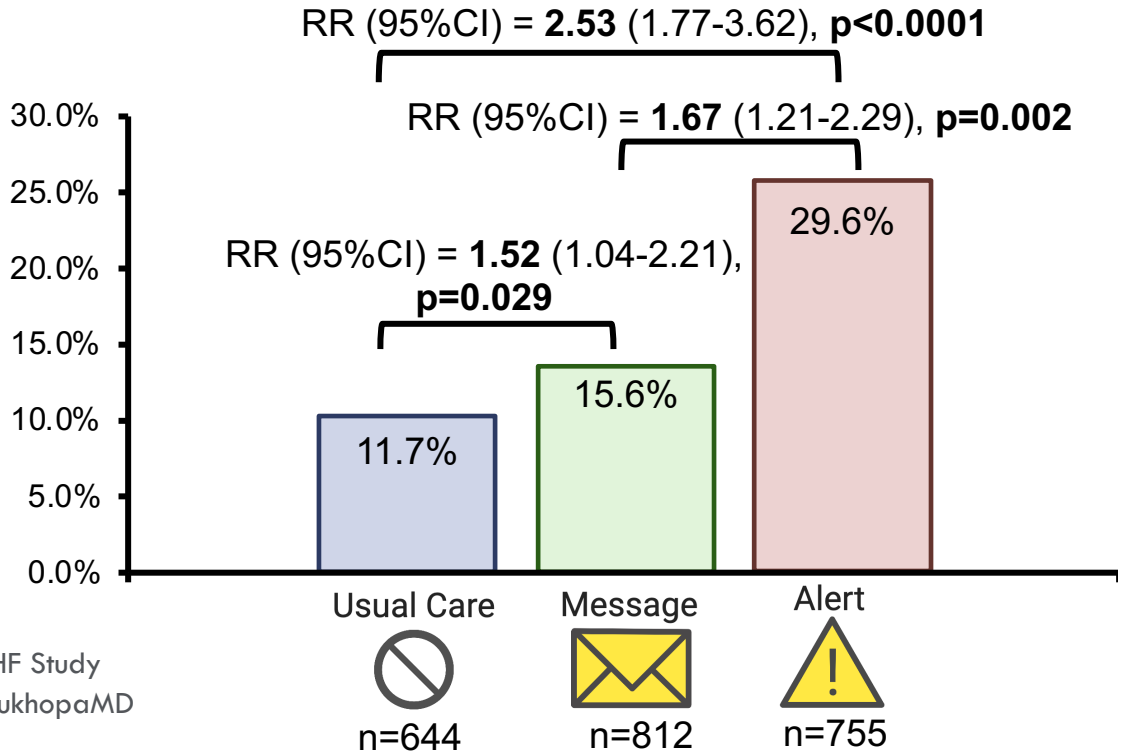
- Sample size
  - In order to detect at least a 10 percentage point difference between each two-way comparison with 80% power and two-tailed alpha = 0.05, with Bonferroni adjustment, we required 1,503 patients, which we estimated would require a 6 month study period.
- Pre-specified, intention-to-treat analysis
  - Generalized linear mixed effects model with binomial distribution, log link function, and random intercept by cardiologist to account for clustering at the provider level.

Patient Characteristics (N=2,211)

Median age: 73 years	Sex: 71% male	Race: 69% White	Ethnicity: 11% Hispanic
Insurance: 69% Medicare	Background BB therapy: 80%	Background ACEI/ARB/ARNI: 74%	Seen by General or HF: 75%

Primary Outcome

Percent of MRA-eligible patients with newly prescribed MRA



Number of patients needed to result in one prescription:
Alert: **5.6**
Message: **25.6**

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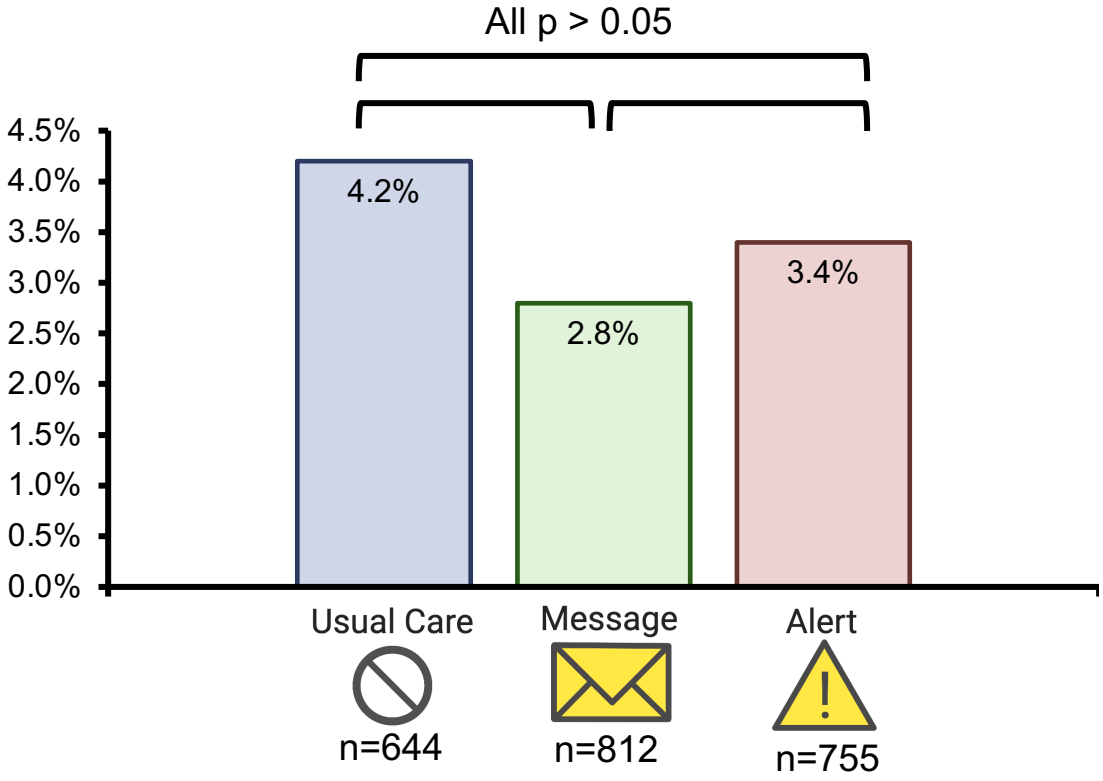
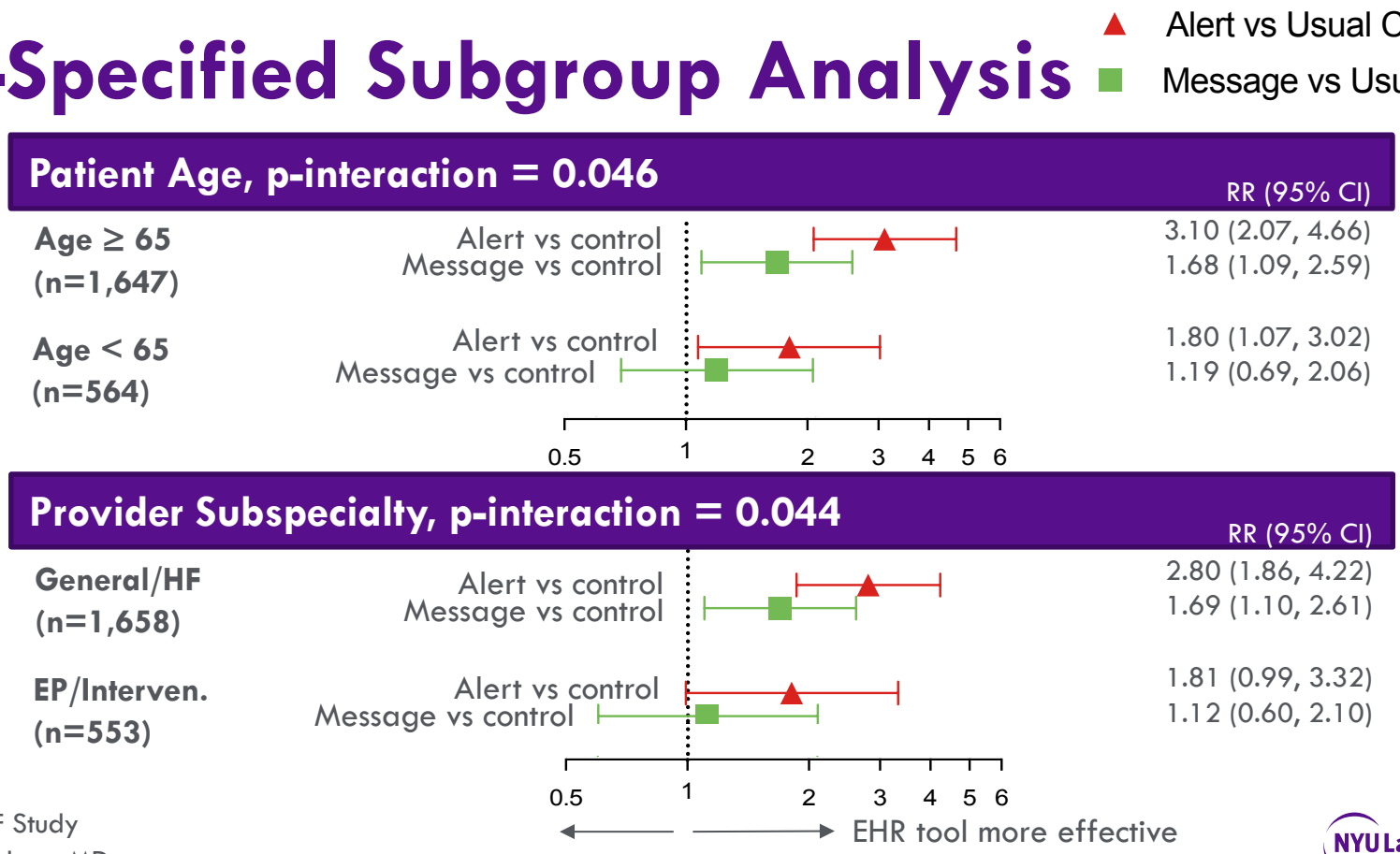
Secondary Outcome

Percent of patients with newly prescribed BB, ACEI, ARB, or ARNI



Pre-Specified Subgroup Analysis



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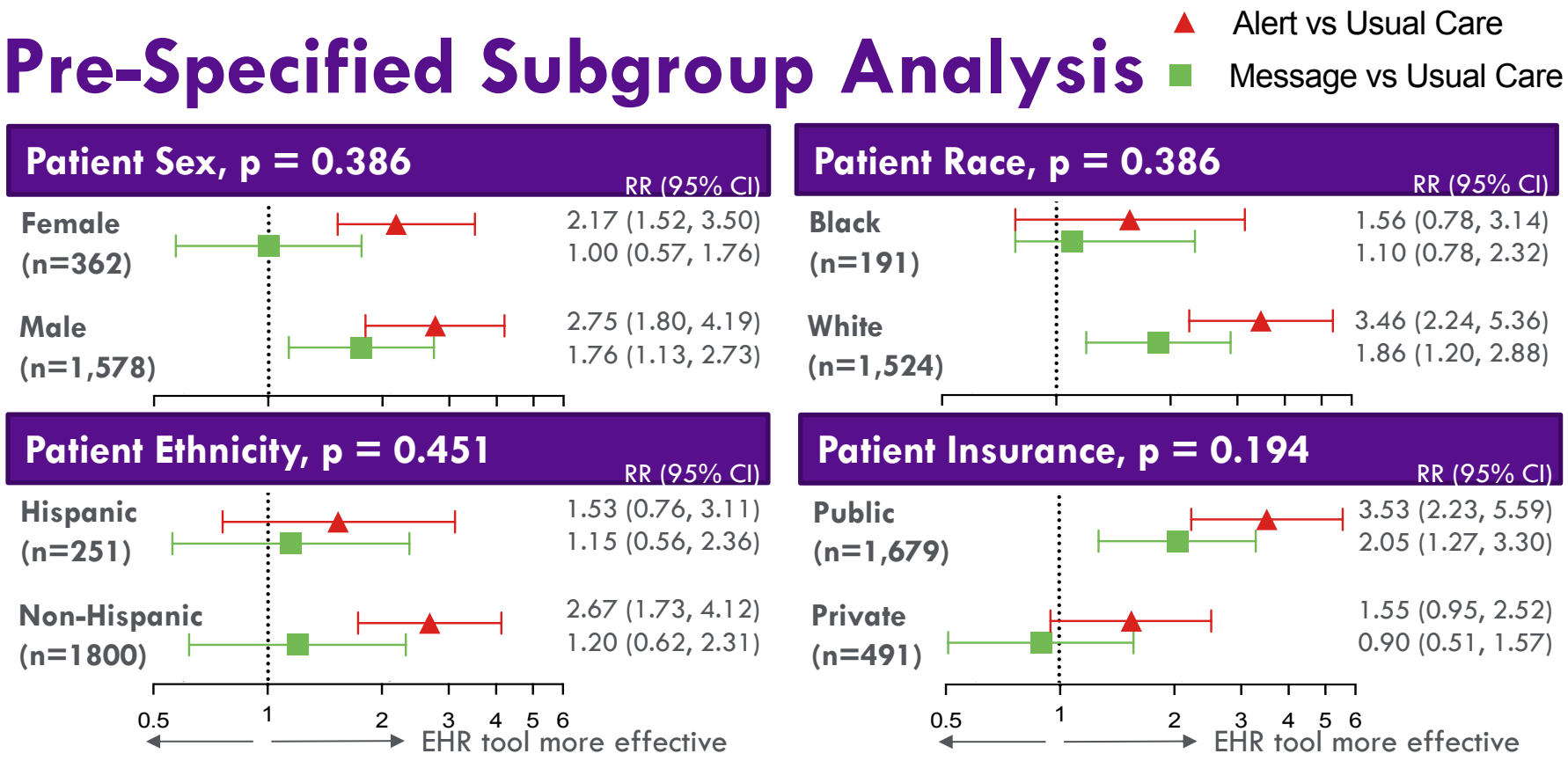

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Limitations

- Generalizability
- Targeted to cardiologists
- Specific and selective for MRA
- Sustainability and interaction with other decision support tools is unknown

Conclusions

- An automated, EHR-embedded, tailored, and selective alert delivered at the time of visit **more than doubled** prescribing of MRA as compared to usual care.
- The message also increased prescribing as compared to usual care, but was not as effective as the alert.
- EHR-embedded tools can be a rapid, low-cost, and high-impact method to increase prescription of life-saving therapies across large populations.

Final Results Now Available Online

JACC
JOURNAL OF THE AMERICAN COLLEGE OF CARDIOLOGY

Thank you!

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