



AI for End-of-Life Care: A New Frontier for Patient Identification and Program Evaluation

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Speakers



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Disclosures

- The following faculty of this continuing education activity have no relevant financial relationships with commercial interests to disclose:
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Agenda

- 2:10 – 2:20 PM Intro and Background**
- 2:20 – 2:45 PM MGB/Radial Partnership, Lessons Learned**
- 2:45 – 2:55 PM Q&A**

Intro and Background

Why Do We Need Palliative Care?

- Our population is aging
 - 10,000 baby boomers will turn 65 every day for the next eight years; over 65 population to increase by 39% by 2040
- Chronic Conditions and Disability are on the rise
- By 2030, 80% $\geq$ 1 chronic conditions; 50% $\geq$ 2 chronic conditions
 - Half of community-dwelling Medicare beneficiaries are homebound in year before death
 - 40% 2-year mortality rate among homebound persons
- Healthcare costs and utilization are increasing

Palliative Care Needs in the Home

- 5% of patients drive over 50% of health care spending
- These patients are disproportionate users of 911 calls, ED visits and hospital admissions
 - Especially for those that are too frail to easily access more routine primary care resources
- Despite this high utilization, much of the care they receive is low-value and not aligned with their goals and values

Home-Based Palliative Care

- Value of the home visit
 - immersed in how a patient is living and functioning
 - care for whole physical and emotional person within their surrounding supports and family.
- Interdisciplinary team focused on supporting the evolving goals and care needs of a person with serious illness

Home-based Palliative Care improves care for the highest-need (and highest-cost) patients

- **Expert symptom management and psychosocial support**
 - Provided by multidisciplinary team of MDs, NPs, RNs and SWs
- **Patient and caregiver education**
 - With clear anticipatory guidance of how to manage worsening symptoms, and 911 alternatives to receive after-hours support
- **Care coordination and advance care planning**
 - Completion of MOLST or advance directives
 - Improve continuity of care and maintain goal-concordant care through transitions in care

Home-based Palliative Care improve outcomes and decrease costs

- Increase in hospice utilization and earlier hospice referrals
 - 35% increase in hospice enrollment
 - 240% increase in median LOS on hospice
- Reduction in costly ED visits and hospital admissions
 - Estimated cost savings of 36.3% across 11 studies
 - These ED visits and hospital admission also often include distressing, non-goal concordant care

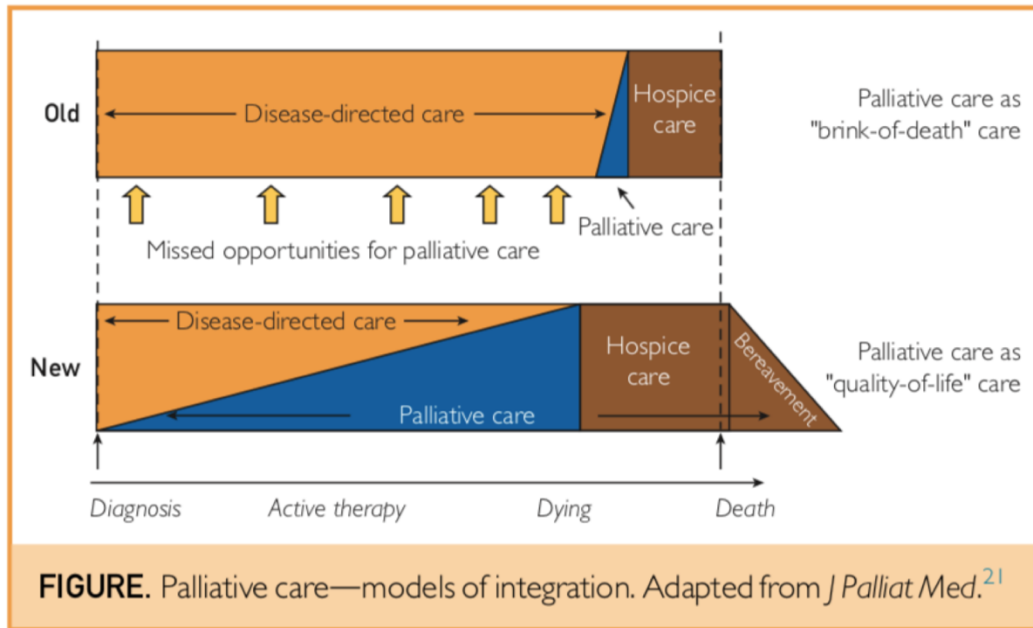
Lustbader D, Mudra M, Romano C, et al. The impact of a home-based palliative care program in an accountable care organization. *J Palliat Med*. 2017 Jan;20(1):23–28. doi:10.1089/jpm.2016.0265. Epub 2016 Aug 30.

Home-based palliative care is the apex of high-quality, patient-centered care

- Reduction in symptom burden
- Increase in patient and caregiver satisfaction
- **More compassionate, affordable, and sustainable high-quality care**

(Roberts, 2021, Roter, 2018, Twaddle 2023)

The science: timely end-of-life care benefits patients



Journal of Clinical Oncology

“Better quality-of-life, survival, and mood”^{1,2}

Mayo Clinic Proceedings

“More likely to be home at end-of-life”³

The New England Journal of Medicine

“Fewer avoidable end-of-life hospitalizations”⁴

Journal Of Pain And Symptom Management

“Improved experience for bereaved family”^{5,6}

¹Bakitas MA, Tosteson TD, Li Z et. al. Early Versus Delayed Initiation of Concurrent Palliative Oncology Care: Patient Outcomes in the ENABLE III RCT. *J Clin Oncol.* 2015; 33(13): 1438-1445.

²Smith TJ, Temin S, Alesi ER et. al. American Society of Clinical Oncology Provisional Clinical Opinion: The Integration of Palliative Care into Standard Oncology Care. *J Clin Oncol.* 2012; 20(8): 880-887.

³Buss MK, Rock LK, McCarthy EP. Understanding Palliative Care and Hospice: A Review for Primary Care Providers. *Mayo Clin Proc.* 2017; 92(2): 280-286.

⁴Temel JS, Greer JA, Muzikansky A, et al. Early palliative care for patients with metastatic non-small-cell lung cancer. *N Engl J Med.* 2010;363(8):733-742.

⁵Schockett BR, Teno JM, Miller SC et. al. Late Referral to Hospice and Bereaved Family Member Perception of Quality of End-of-Life Care. *J Pain Symptom Manage.* 2005; 30: 400-407.

⁶Teno JM, Shu JE, Casarett D et.al. Timing of Referral to Hospice and Quality of Care: Length of Stay and Bereaved Family Members' Perceptions of the Timing of Hospice Referral. *J Pain Symptom Manage.* 2007; 34: 120-125.

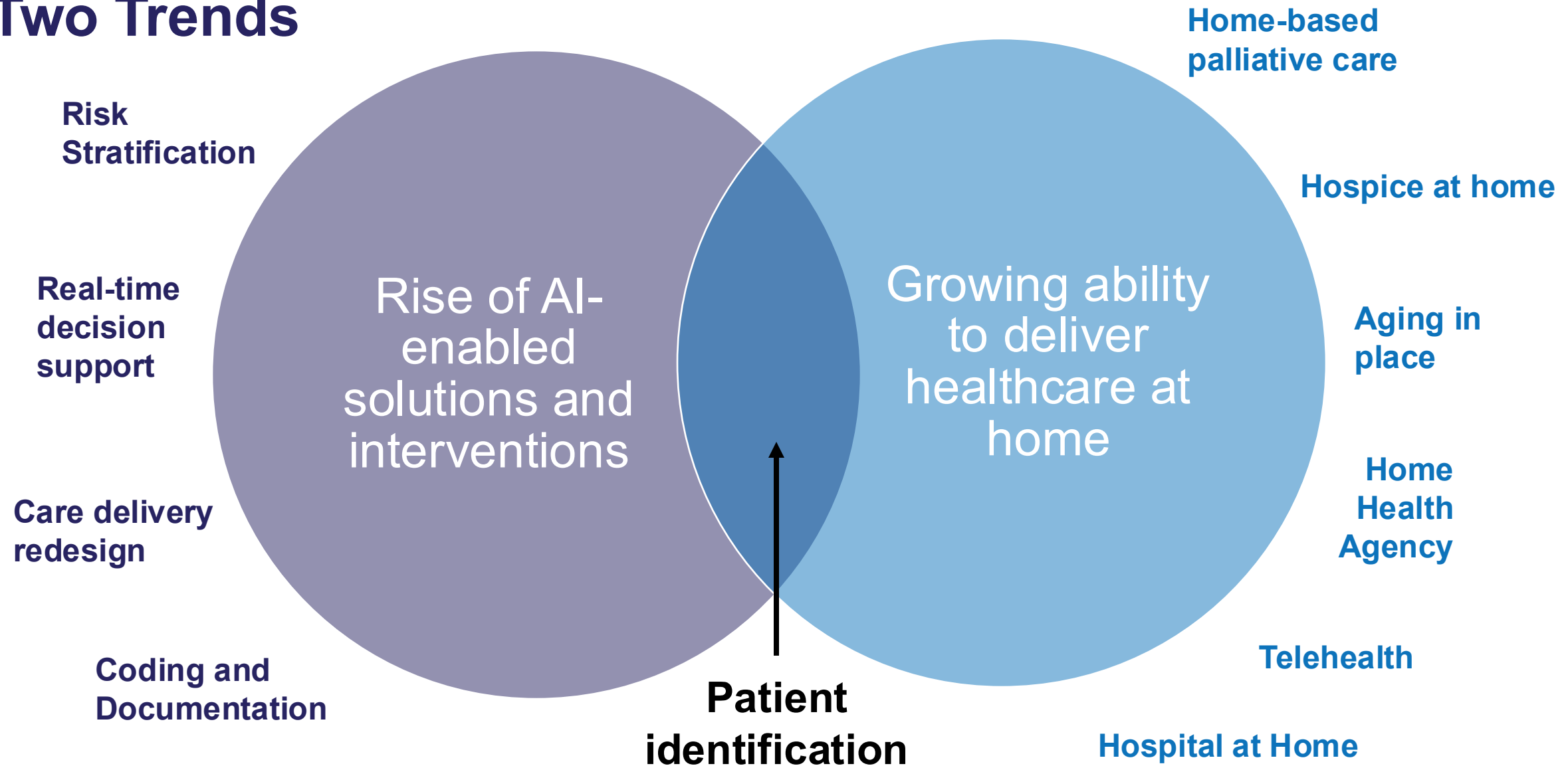
Barriers to adoption of HBPC

- Many systems struggle to identify optimal candidates in a timely fashion
- Operationalizing and scaling a program requires institutional support
- Most programs do not have bandwidth or technical skills needed to demonstrate ROI of HBPC programs to internal and external stakeholders

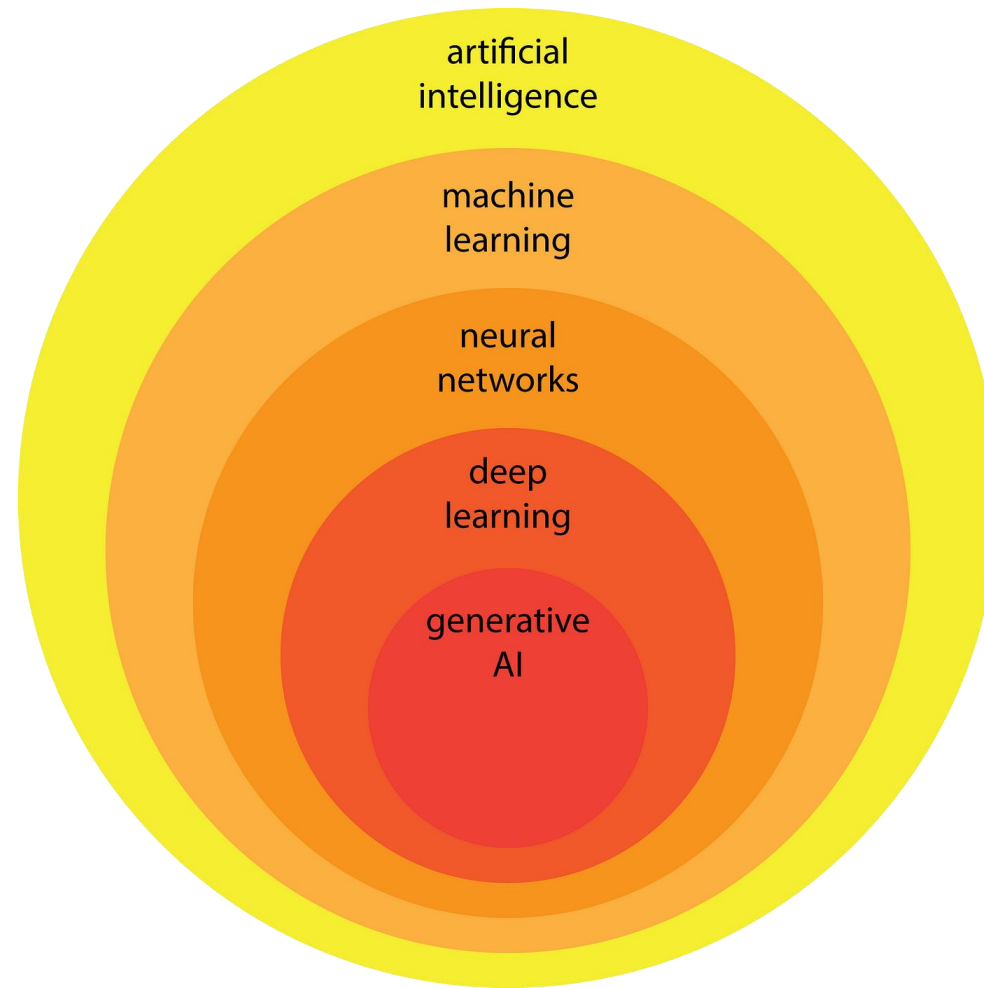


This session will focus on how MGB partnered with Radial to:
1) Enable robust patient identification through an AI solution
2) Demonstrate ROI of its HBPC program.

Two Trends



What exactly do we mean by AI?



Source: Di Samo L, Caroselli A, Tonin G, Graglia B, Pansini V, Causio FA, Gatto A, Chiaretti A. Artificial Intelligence in Pediatric Emergency Medicine: Applications, Challenges, and Future Perspectives. *Biomedicine*. 2024; 12(6):1220. <https://doi.org/10.3390/biomedicine12061220>

Palliative Performance Score

Background

- Validated mostly in outpatient populations
- Primary end point was **median survival in days**
- AUROC: 0.67-0.74

Key Inputs

- Ambulatory status
- Daily activity level
- Oral intake
- Mental status
- Self-care assistance
- Physician estimate of survival

Limitations

- 81% of patients in this study had cancer
- Insufficient to track disease progression in patients with advanced dementia, non-malignant disease, or high frailty
- At least one highly subjective input



F. Anderson, G. M. Downing, J. Hill, L. Casorso, and N. Lerch, "Palliative performance scale (PPS): a new tool," J. Palliat. Care, vol. 12, no. 1, pp. 5-11, 1996.
G. Linklater, S. Lawton, S. Fielding, L. Macaulay, D. Carroll, and D. Pang, "Introducing the Palliative Performance Scale: todinicians; the Grampian experience," BMJ Support. Palliat. Care, vol. 2, no. 2, pp. 121-126, Jun. 2012, doi: 10.1136/bmjspcare-2011-000133.

Levine Prognostic Index

Background

- Validated retrospectively in 6,382 patients aged 65+
- Primary end point was **one-year mortality**
- AUROC: 0.7

Key Inputs

- Age
- LOS
- Prior discharge to a nursing home
- Metastatic cancer
- Comorbidities

Limitations

- No assessment of functional decline
- Single site study: skewed demographics, non-representative nursing home utilization
- No accounting for severity of comorbidities



S. K. Levine, G. A. Sachs, L. Jin, and D. Meltzer, "A prognostic model for 1-year mortality in older adults after hospital discharge," *Am. J. Med.*, vol. 120, no. 5, pp. 455–460, May 2007, doi: 10.1016/j.amjmed.2006.09.021.

Other tools

- Palliative Prognostic Score
- Palliative Prognostic Index
- Surprise Question
- EMR-embedded indices



Key Limitations:

- Over-representation of oncologic patients
- Focus on short-term survival
- Subjective inputs
- Data source limitations – EMR vs. claims etc.

Provano M, Maltoni M, Nanni O, Marinari M, Indelli M, Zarinetta G, Petrella V, Bani S, Zecca E, Scarpi E, Labianca R, Amadori D, Luporini G. A new palliative prognostic score: a first step for the staging of terminally ill cancer patients. Italian Multicenter and Study Group on Palliative Care. J Pain Symptom Manage. 1999 Apr;17(4):231-9. doi: 10.1016/s0885-3924(98)00145-6. PMID: 10203875
Morita T, Tsunoda J, Inoue S, Chihara S. The Palliative Prognostic Index: a scoring system for survival prediction of terminally ill cancer patients. Support Care Cancer. 1999 May;7(3):128-33. doi: 10.1007/s005200050242. PMID: 10335930
Gupta A, Burgess R, Drozd M, et al. The Surprise Question and clinician-predicted prognosis: systematic review and meta-analysis. BMJ Supportive & Palliative Care. 2025;15:12-35.

Machine learning: a path forward



Leverage diverse and large data sets in real time: claims data, HIE, HL7 feeds, SDOH data (ADI, SVI)



Seamlessly analyze **multiple mortality end points** separately and in combination

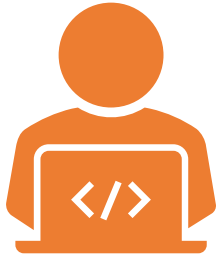


Analyze and combine hundreds of objective variables separately and in combination to **maximize predictive value and clinical relevance**



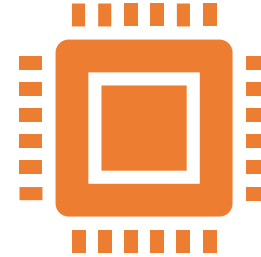
Simplify workflows using automated processes with zero data entry

Machine Learning in Palliative Care



Makar, *et al.* (BWH)

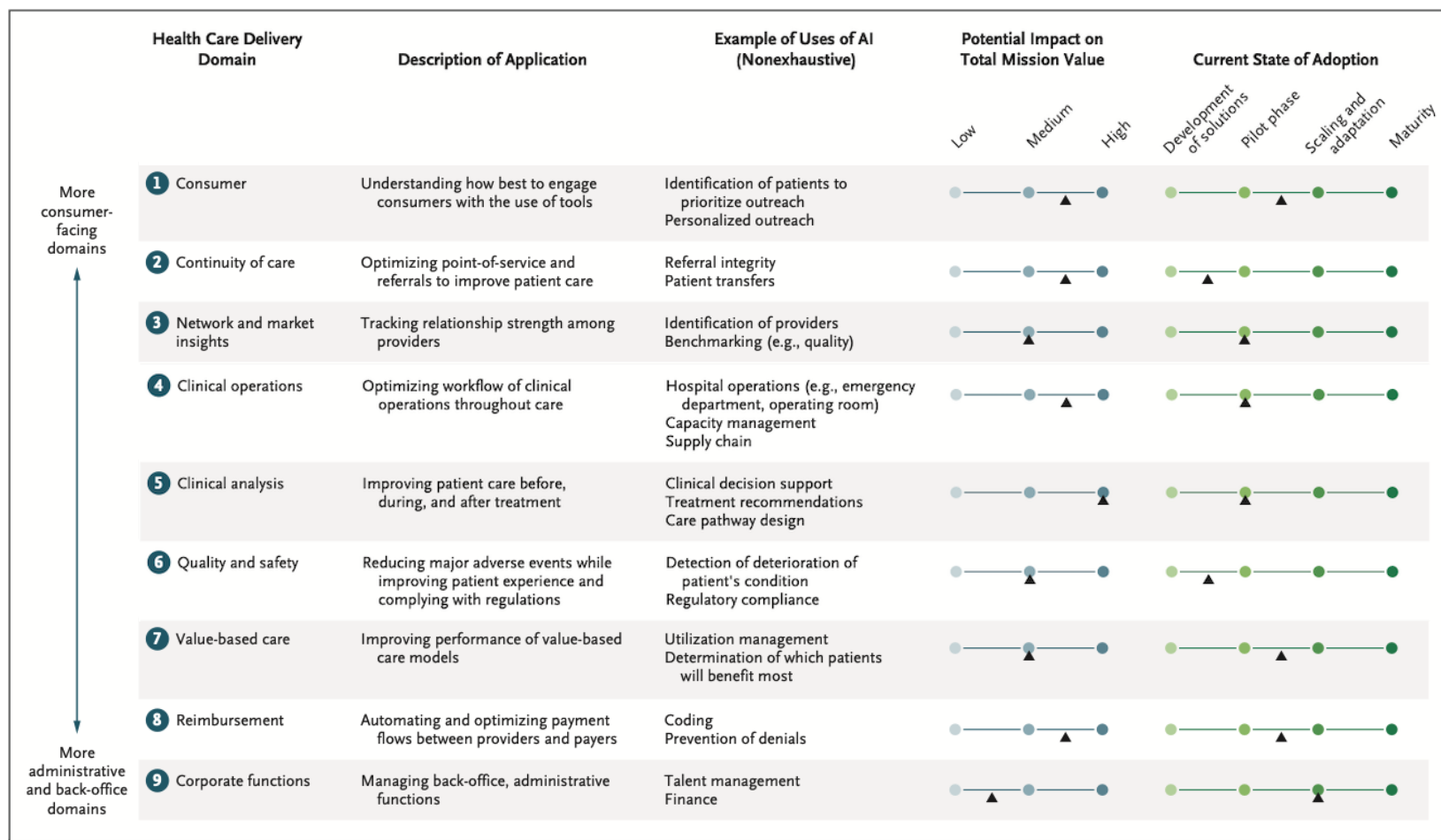
End point: 6-month mortality
Automated screening tool using
Medicare claims data
Supervised machine learning model
AUROC 0.82



Avati, *et al.* (Stanford)

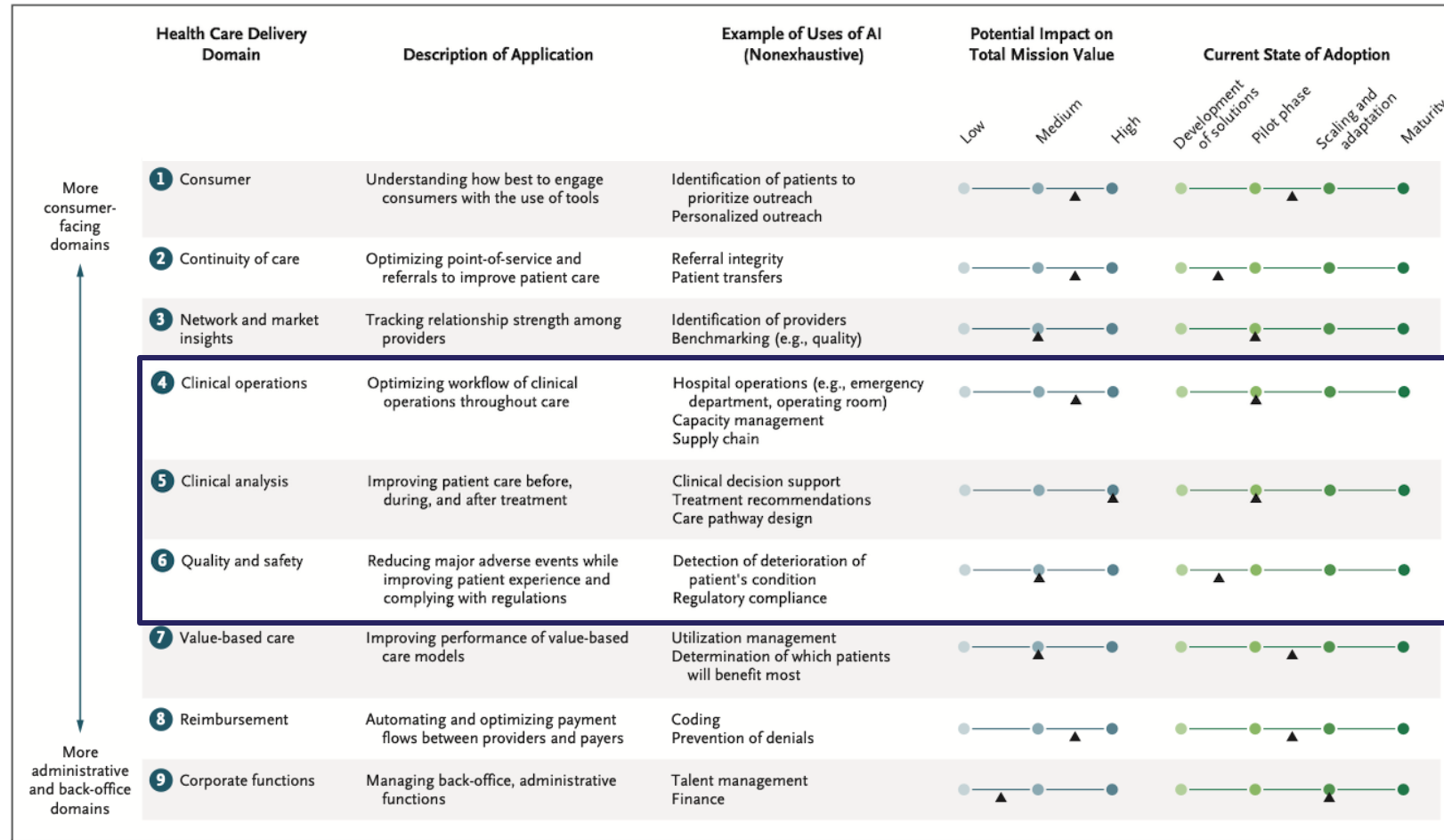
End point: 3-12 month mortality
Automated screening tool using EHR
data
Deep neural network
AUROC 0.87

Impact and adoption of AI varies across use cases



Source: N Engl J Med 2023;389:34-8-358

Opportunity: High impact uses of AI with poor adoption



Source: N Engl J Med 2023;389:34-8-358

Radial

“AI decision support for better care”

- Funded in part by National Science Foundation and NIH
- Focus is leveraging machine learning to:
 - Standardize implementation of evidence-based care
 - Support the shift from volume to value-based care
 - Centralize more of the right care at home
 - Facilitate use of innovative care delivery modalities



MGB/Radial Partnership

Proof-of-concept

Newton-Wellesley Hospital (NWH) Pilot: Timely in-patient palliative care referral as proof of concept



MGB's Pop health strategic priorities

- *Right Patient, Right Place, Right Time*
- Boost timely access to palliative and hospice care
- Decrease Total Medical Expenditure

Opportunity to increase palliative/hospice referrals among patients with repeat SNF stays

- MGB data showed over 10% of MSSP ACO members were dying within 30 days after discharge from a SNF
- For patients with 3+ SNF stays, 90-day mortality approaches 30%

NWH ideal pilot site

- Pre-existing staffing and Population Health programming was in place
- MGB ACO and hospital teams were actively managing care across the continuum, including post-acute and end-of-life

Intervention: AI Decision Support to identify more of the right candidates for palliative care

Assessing **baseline** disease control and **trends**

Comprehensive longitudinal claims:

- Utilization History
- Chronic comorbidities
- Frailty
- Patient reported symptoms



Identifying **inflection points** in the patient's trajectory

EMR, live feed, ADI, SVI:

- Demographic/ administrative data
- SDOH data
- Diagnosis/DRG
- Other EMR data

Pilot Results

Qualitative feedback:

- Clinicians more likely to use the surprise question
- Improved collaboration with case management
- Clinicals less likely to cite barriers to palliative care involvement

Quantitative Results

24% boost in inpatient palliative consults, increase in both outpatient palliative and hospice referrals

Potential TME savings of \$850K for ~1,500 hospitalized patients

Pilot Results: key takeaways

- AI-driven solutions can facilitate more timely palliative and hospice referral
- Automated patient identification through AI tools can be leveraged to identify patients specifically appropriate for palliative care vs. hospice
- Key question remained: can we achieve better scale in palliative and hospice referrals by leveraging home-based palliative care?

“Many of the patients identified would benefit from home-based palliative care” –quote from user feedback survey

MGB/Radial Partnership

Home-Based Palliative Care

Expanding Radial from NWH to MGH

- Initial discussions with clinical leaders to utilize Radial to proactively identify patients with PC needs in the ED
- The MGH ED has an integrated palliative care program, that includes an embedded dyad model (1 RN + 1 MD or NP) that started in 2020 during COVID
- The ED program already had a robust triage process involving the prioritization of real-time clinical data and frequent communication with ED clinicians
- Despite being a poor fit for this context, MGH leaders recognized a much better fit with our HBPC program

Creation of Palliative Care Score

- Radial's Palliative decision support score automates the process of highlighting members who may be eligible for Palliative Care referral
- Radial and MGB collaboration:
 - Random sample of 1,000 members from MGB ACO population was taken and “rank” ordered based on actionability, using Radial Palliative Score
 - For each member, Palliative appropriateness score with relevant insights provided
 - Goals: promote efficiency among care teams, especially when resources are limited; identify “non-obvious” candidate in the community for palliative care; reach the most appropriate patients for HBPC services

Strategic Pivot

From Patient Identification to Program Evaluation

- As we started to consider how to operationalize patient identification into new clinical workflows, we had to consider our current program status
 - Our census (both quantity and complexity) had been stretching our capacity for the past year
 - We are about to start a hybrid model with virtual visits to try and decrease our in-home visit volume
- We had an open and transparent discussion with Radial leadership.
 - We shared our program goals, and how we thought they could be helpful
 - The reviewed and came to us with a proposal for a thorough program evaluation

Program Evaluation Methodology

- Data Source: MGB MSSP ACO claims from 2020-2025
- Identification of MGB HBPC enrollee:
 - HBPC enrollees who died from 2021-2025
 - At least one visit by HBPC in the last 180 days of life (or died on hospice)
 - At least one year of claims run out prior to HBPC enrollment and extending until date of death
- Characteristics for each HBPC enrollee:
 - Enrollment month/year
 - Sex
 - Binned age range in 5-year buckets (65-69, 70-74, ... 100+)
 - **Hierarchical disease group***
 - **Claims-based frailty index (CFI)**

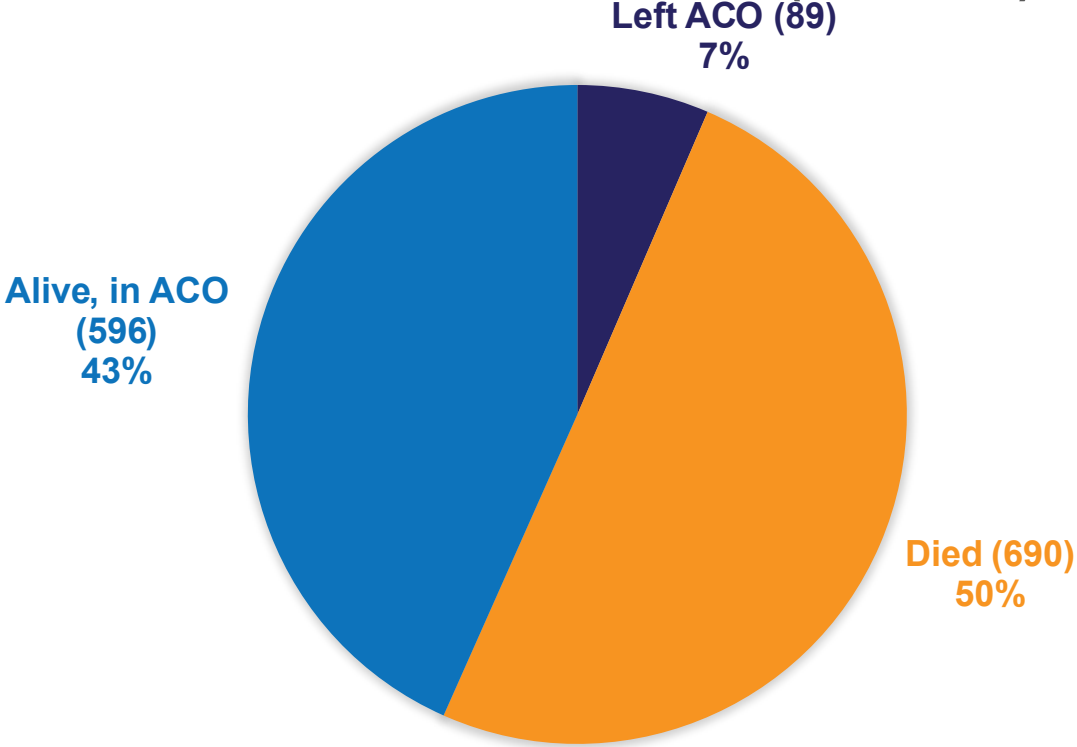
*Hierarchical disease group

Sequence Order	Disease Group
1	Lung or colorectal cancer -> Cancer Group
2	HF AND CKD -> CKM Group
3	Dementia AND Pressure Ulcer -> Dementia Group
4	COPD -> Pulm Group
5	Alzheimer's OR PD -> Dementia Group
6	Liver Disease -> Liver Group
7	Other Cancers -> Cancer Group
8	Stroke/TIA -> CVA Group
9	HF -> CKM Group
10	CKD -> CKM Group
11	Dementia -> Dementia Group
12	All remaining -> Other Group

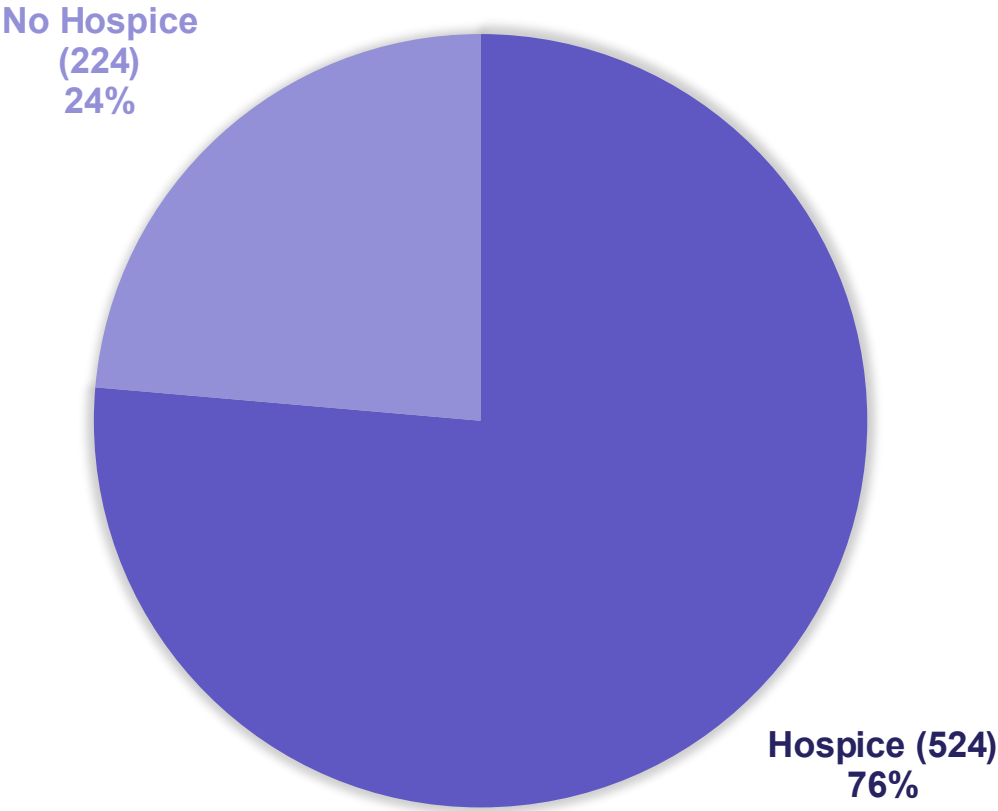
Identifying a Control Population

- Goal: match control member to pair with each HBPC enrollee from the population who were never enrolled in HBPC program
- For each HBPC enrollee, identified all non-HBPC members with at least one year of claims runout prior to HBPC enrollee's enrollment month
- Of this population, we identified those with matching:
 - Sex
 - Binned age
 - Hierarchical disease group
- From these potential matches, we identified best match based on:
 - Best matching CFI (reflecting smallest % difference vs the HBPC enrollee's CFI)

TOTAL HBPC PATIENTS (N=1,375)



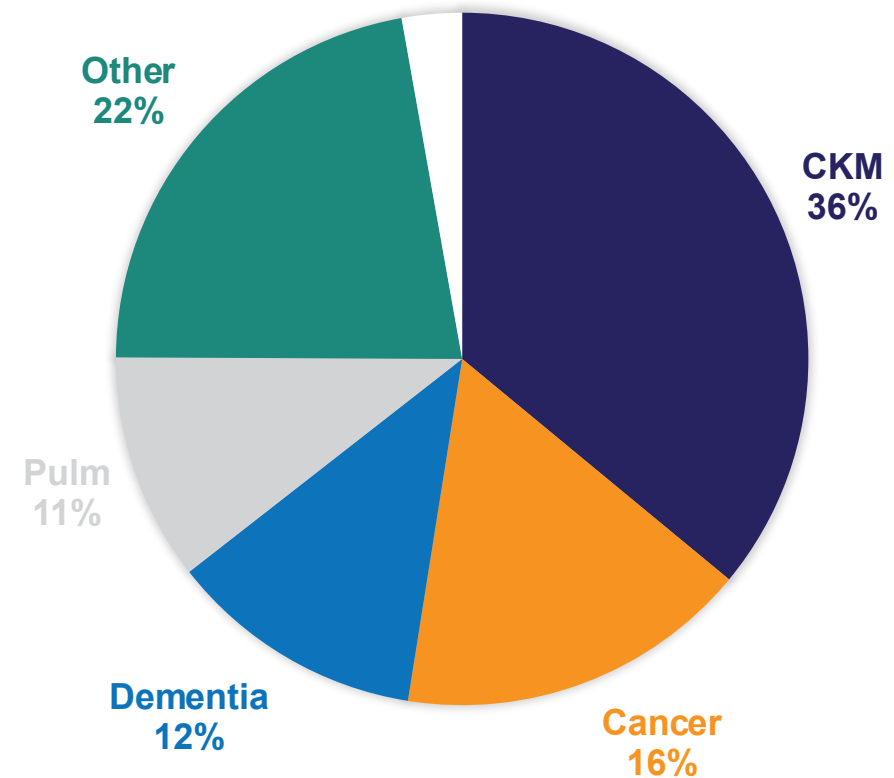
DECEASED HBPC PATIENTS (N=690)



HBPC Intervention Group: 690 patients who died either on hospice or saw HBPC within 180 days before death

- Age (at death) = 86.5 (SD 9.4)
- Sex
 - F: 62% (n=428/690)
 - M: 38% (n=262/690)
- Code Status
 - DNR = 84.2% (n=581/690)
 - No DNR = 15.8% (n=109/690)
- Total HBPC Visits = 4.3 (SD 4.0)
- Prior MGB Home Care
 - Yes: 81.5% (n=562/690)
 - No: 18.5% (n=128/690)

PRIMARY DX



Control Group

- Matched by:
 - Age range (5-year intervals)
 - Gender
 - CFI (Claims-based Frailty Index)
 - Disease Group
 - Died within study period
 - (January 2021 – May 2025)

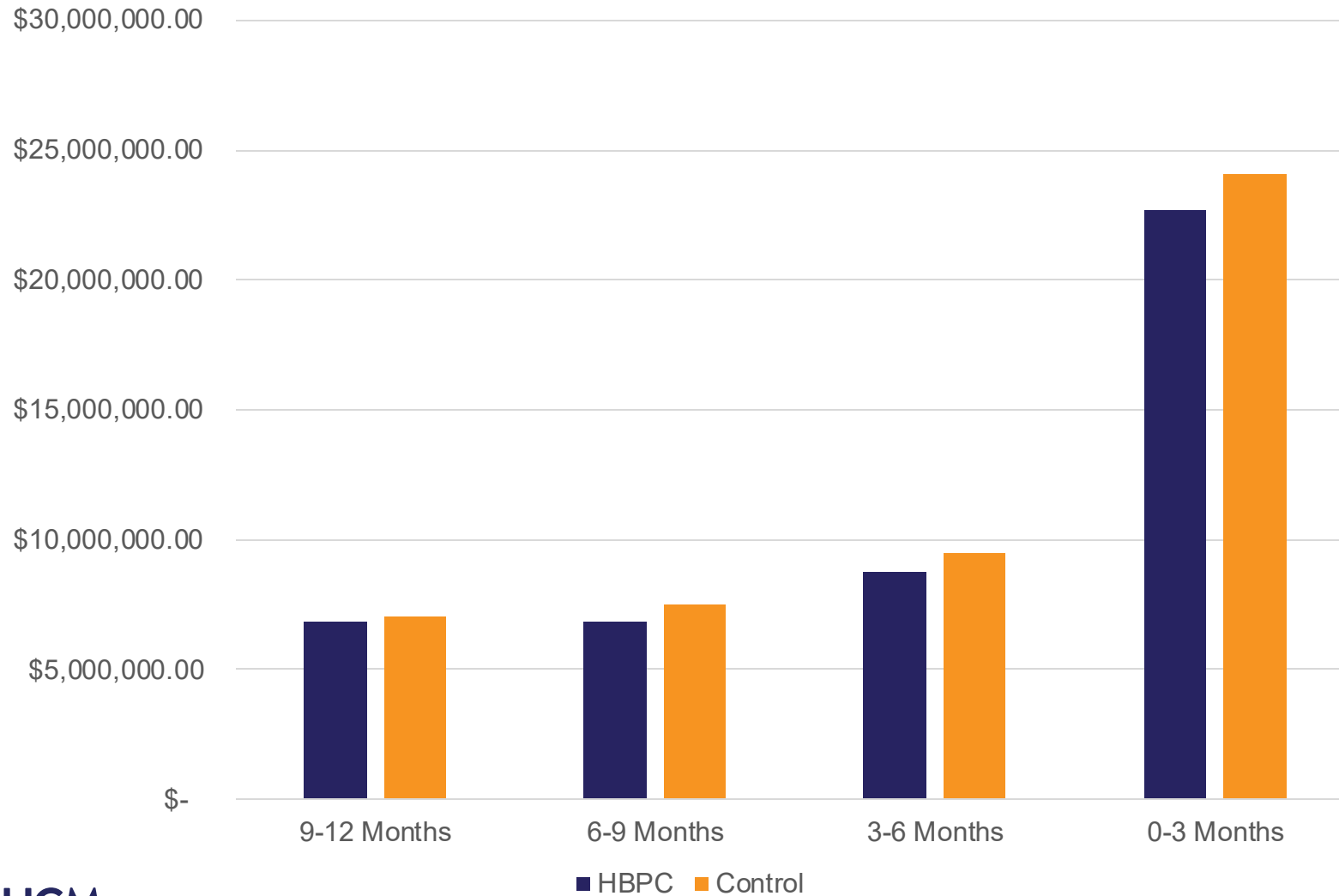
	HBPC	Control Group
Age (at Death)	87.3	87.5
Gender	62% Female	62% Female
CFI	.2366	.2361
DNR Present	84.2%	77.2%
ACP Present	64.9%	64.9%
History of Falls	66.8%	64.2%
MGB Home Care	82.9%	61.3%

Hospice Utilization

- 76.3% of HBPC enrolled with hospice before death
- 20,863 more days on hospice in comparison to the control group
- Hospice median LOS 12 days longer than the national median (NHPCO)

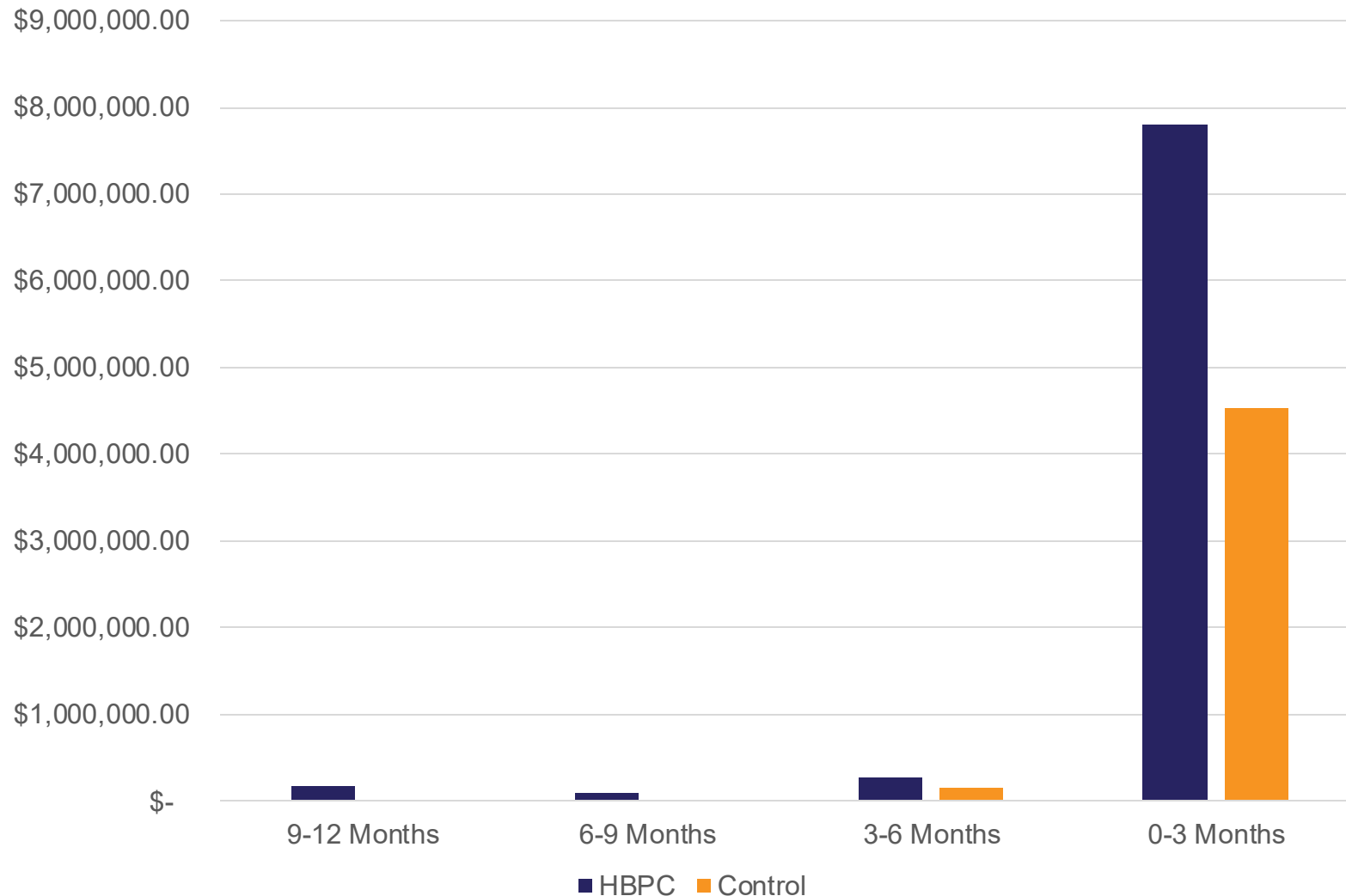
	HBPC	Control Group	National Average (NHPCO Data)
Hospice Use	527 (76.3%)	433 (62.7%)	
Mean LOS	88.1	59.1	92
Median LOS	30	19	18
Total Hospice Days	46,447	25,584	

Total Medical Expenses



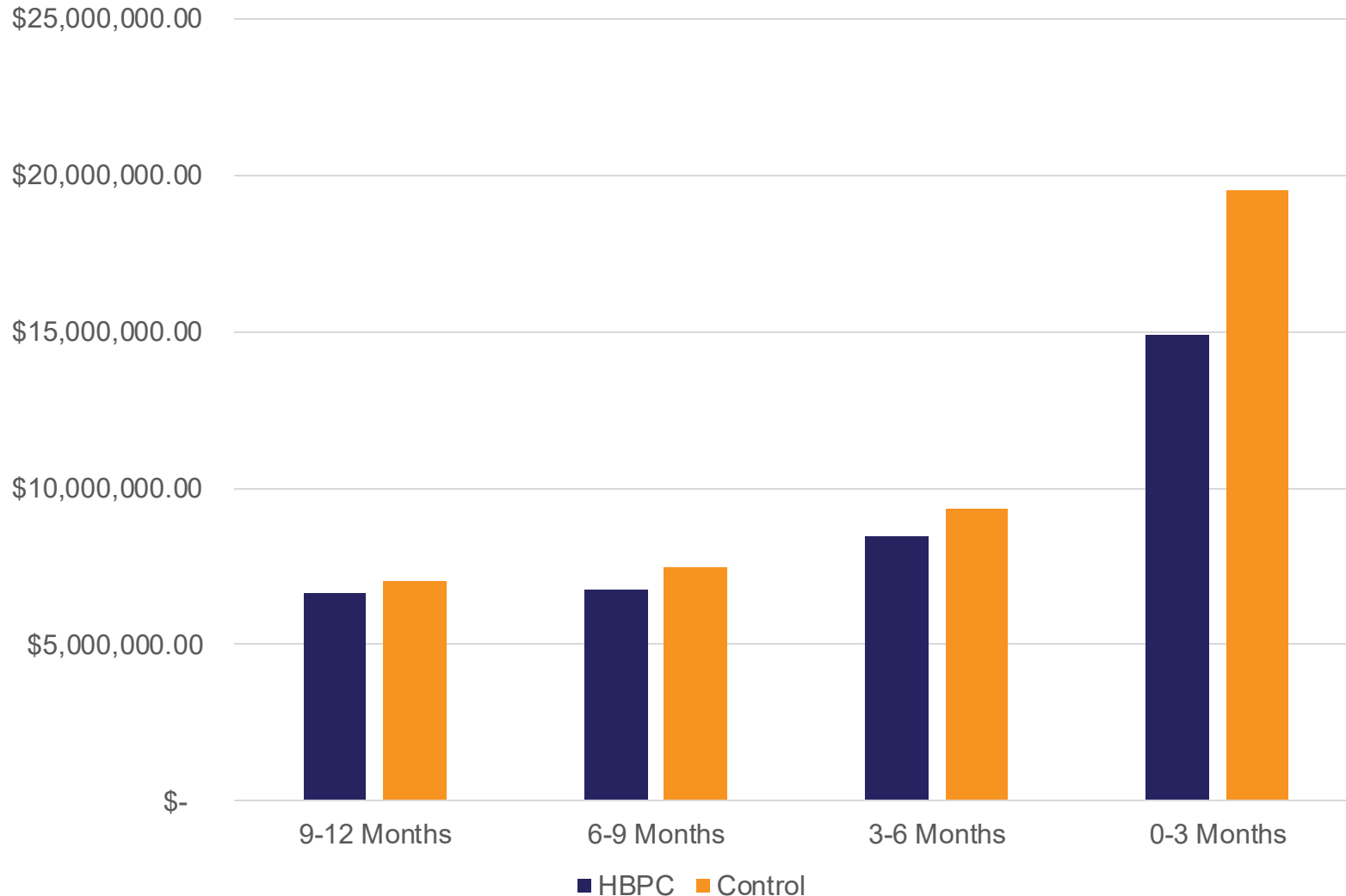
- \$2,280,559 lower total medical expenditure in the final 12 months of life
- \$1,358,453 of this was in the final 3 months of life)

Total Hospice Expenditure



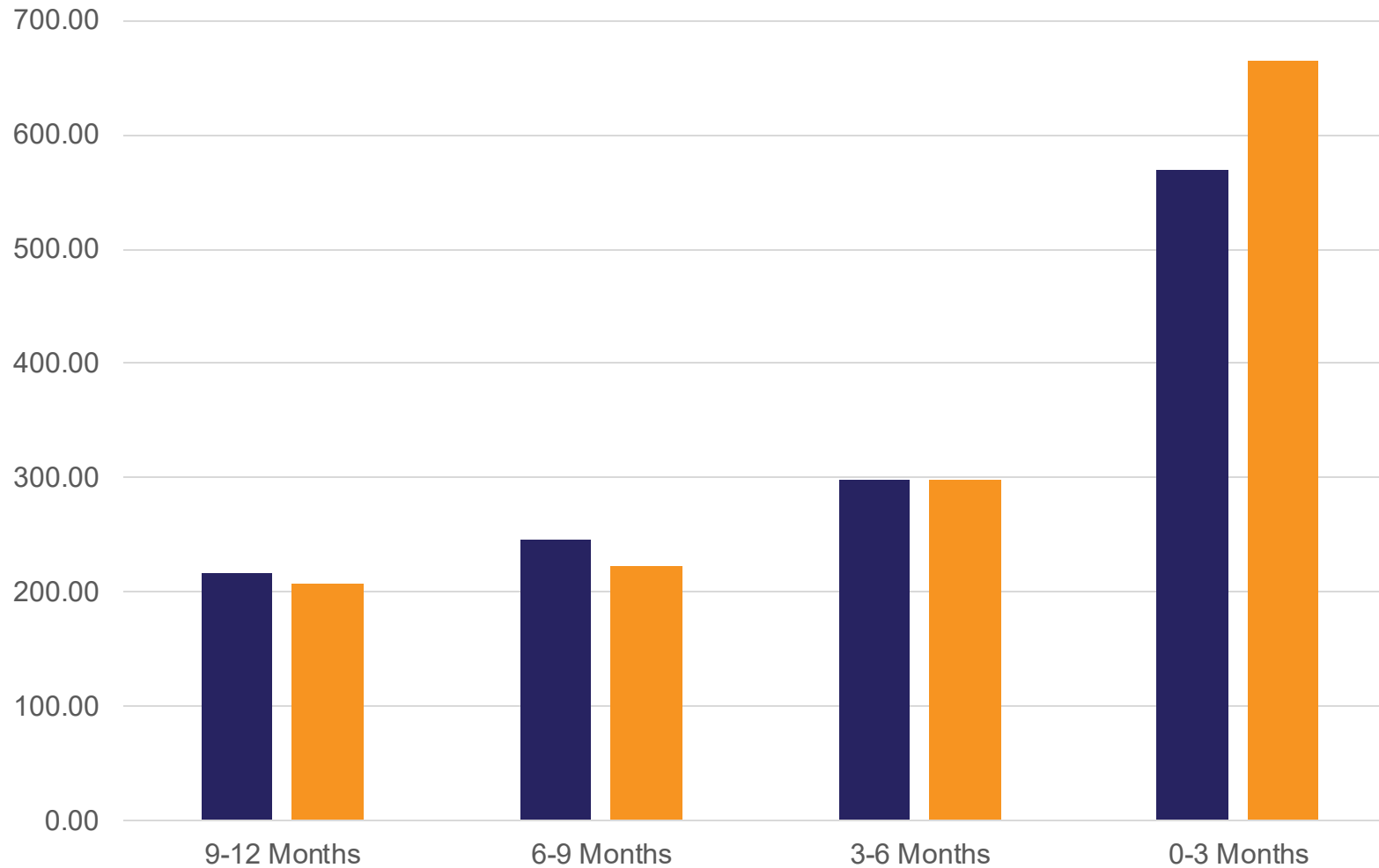
- \$3,460,175 higher hospice expenditure in the final 12 months of life
- \$3,263,787 of this was in the final 3 months of life

Total Non-Hospice Medical Expenses



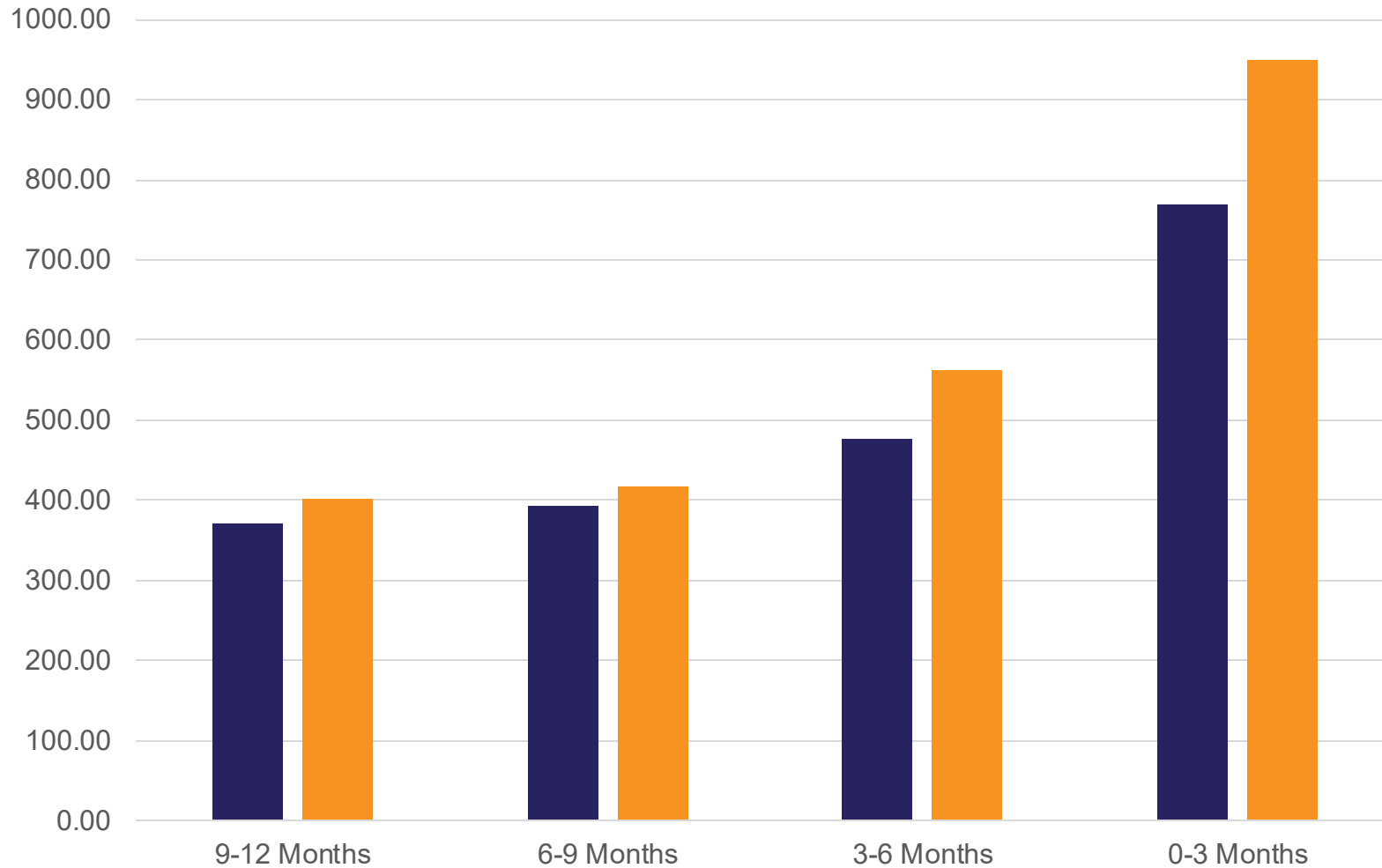
- \$6,405,482 lower non-hospice total medical expenditure in the final 12 months of life
- \$4,622,240 of this was in the final 3 months of life
- Total savings:
 - \$9,283 per patient
 - \$120,858 per month of the program

Total Acute Inpatient Admissions



■ 96 fewer admissions in the final 3 months of life

Total Emergency Room Visits



- 182 fewer ED visits in the final 3 months of life
- 308 fewer ED visits in the final 12 months of life

Disease Sub-Group Analysis – DNR and Hospice

DNR Present

GROUP	CONTR OL	HBPC	CHANGE
CKM	81.6%	88.1%	6.5%
Cancer	73.2%	90.2%	17.0%
Other	74.0%	78.7%	4.7%
Dementi a	75.3%	77.8%	2.5%
Pulm	75.0%	81.9%	6.9%
CVA	94.7%	73.7%	-21.0%
Liver	66.7%	91.7%	25.0%

Hospice LOS

GROUP	CONTROL	HBPC	CHANGE	CONTRO L	HBPC	CHANGE
	Median LOS			Total Days		
CKM	15.5	30	14.5	8310	14415	6105
Cancer	21	31	10	3185	7663	4478
Other	25	28	3	7571	10538	2967
Dementi a	19	26	7	4371	5715	1344
Pulm	18.5	39	20.5	1395	6269	4874
CVA	13	36	23	304	1593	1289
Liver	17.5	8	-9.5	448	254	-194

Conclusions

- Over 4.5 years (January 2021 – May 2025), the HBPC program cared for 690 ACO patients who died
 - This only represents around 50% of our total patient population (Exclusions include non-ACO patients, patient's who left the ACO before death, and dual-eligible patients)
- In comparison to the control group:
 - Hospice use increased from 62.7% to 76.3%, resulting in 20,863 more days on hospice
 - An estimated 96 hospital admissions and 182 ED visits were prevented
 - A total of \$6,405,482 was saved in non-hospice medical expenses in the final 12 months of life
 - \$4,622,240 of this was in the final 3 months of life

Next Steps for MGB HBPC

- This was the most comprehensive and impactful program evaluation in the 10-year history of the HBPC program
- The results are now the backbone of the core slide deck we use to highlight the value of our program to internal and external stakeholders
- We are now in the design phase of building a novel home-based intervention for geriatric HF patients
- This collaborative work with Radial has unlocked multiple opportunities for future growth and increased support

Lessons Learned

From the health system perspective:

- 1) External partnerships can be powerful opportunities for innovation and growth, when they are managed via transparent, bi-directional communication
- 2) Health systems should feel empowered to be honest and transparent about their needs—especially when these needs might change over time

From the perspective of AI innovations:

- 1) An AI-driven approach has the potential to safely and effectively identify more of the right patients appropriate for palliative care referral.
- 2) Partnerships can be very helpful if goals are clear and aligned:
 - Accelerate development and implementation of innovative AI-enabled solutions
 - Standardize use of data-driven and evidence-based risk stratification
 - Fill a gap in internal resourcing around demonstrating an ROI and operationalizing a solution