Appendix A: Detailed Methods

Details of Data Sources and Searches

We conducted focused searches of MEDLINE via PubMed, the Cochrane Clinical Trials Central Register, CINAHL, Embase, PsycINFO, Web of Science, Academic Search Premier, and Scopus from January 1, 2000, to September 7, 2019. Medical subject headings were used as search terms when available and keywords when appropriate, focusing on terms to describe relevant populations. Our search strategy identified HNHC patient populations with a combined approach of text terms of "high utilizer/medically complex/high needs" and similar terms and terms for identifying multiple chronic conditions or similar terms limited to individuals with functional limitations, behavioral factors, or social risk factors.

Targeted searches for unpublished literature were conducted by searching ClinicalTrials.gov, SIREN Evidence Library, HSRProj, National Academy of Medicine, Center for Health Care Strategies, Centers for Medicare & Medicaid Services, Camden Coalition, Commonwealth Fund, Robert Wood Johnson Foundation, California HealthCare Foundation, Institute for Healthcare Improvement, Centers for Disease Control and Prevention, Health Resources and Services Administration, Social Work Abstracts, Kaiser Family Foundation, Milbank Memorial Fund, and Patient-Centered Outcomes Research Institute. A targeted search for dissertations was also conducted by searching ProQuest. The search strategy was developed by an experienced librarian with inputs from the study investigators. To supplement electronic searches, we conducted snowball searches by reviewing the reference lists of included studies, identified if included studies are cited in newer articles, and searched for related studies such as those suggested by PubMed. We also consulted content experts to help identify relevant literature. A Federal Register notice was posted on December 16, 2019, as well as a request for supplemental evidence and data on January 16, 2020. We will update the literature search during the public posting period of the draft report.

Study Selection

Appendix Table A-1 lists inclusion and exclusion criteria.

Appendix Table A-1. Inclusion/exclusion criteria

PICOTS	Inclusion	Exclusion
Population	KQs 1, 2, and 3: Noninstitutionalized adults, 18 years of age or older KQ 1: Six or more months of potentially preventable or modifiable high healthcare cost and/or use KQs 2 and 3, two groups: a) HNHC patients with 6 or more months of potentially preventable or modifiable high healthcare cost and/or use b) HNHC patients with 6 or more months of potentially preventable or modifiable high healthcare cost and use AND either 2 or more chronic physical health conditions, or a combination of 1 or more chronic physical health conditions and 1 or more behavioral health conditions	Patients receiving a high level of healthcare services that are considered appropriate for their condition OR high level of healthcare services are measured for less than 6 months OR end-of-life care

PICOTS	Inclusion	Exclusion
Intervention	KQ 1: Not relevant, interventions not necessary for inclusion KQs 2 and 3: Alternative delivery models (e.g., ACOs, coordinated care organizations, health homes, home-based primary care, behavioral health integration) System- or practice-level interventions (e.g., ED alerts, hotspotting) Patient supportive services (e.g., community health workers, social workers, patient navigators, care coordinators, case and care managers, intensive primary care support, medication management, health reliance specialists, self-management instruction, and peer-to-peer support) Social determinants of health-related interventions (e.g., transportation, health literacy, housing support, caregiver support)	KQs 2 and 3: Interventions for which the relevance for and impact on HNHC patients cannot be determined
Comparator	KQ 1: Comparison population or no comparator KQ 2: Any intervention, treatment as usual, or no comparator intervention KQ 3: Any intervention or treatment as usual	KQ 3: No comparator
Outcomes	KQ 1: Population characteristics described or predicted KQs 1, 2, and 3: Healthcare use: decreases in ED visits, EMS use, and hospitalizations; changes in primary care or specialist visits or other necessary and appropriate types of care (e.g., care manager visits, telephone followup) and use of support services Patient health behavior (e.g., treatment adherence, empowerment, knowledge, self-care) Patient health outcomes: all-cause mortality, disease and condition-specific outcomes, health indicators, quality of life Patient satisfaction with care Physicians' and health professionals' satisfaction with clinical practice Costs Patient and health professional harms such as increased barriers to necessary care, clinician time, or resource trade-offs of other duties	All other outcomes, including behavioral health outcomes
Time frame	Potentially preventable or modifiable high cost healthcare use measured for 6 months or more KQ 3: Measurement of outcomes at 6 months or more after implementation of the intervention.	Shorter time periods
Settings	Healthcare and support services delivery settings, including outpatient, ED, the broader healthcare delivery environment, community characteristics related to social determinants of health United States	Institutional care settings, such as hospitals, skilled nursing, long-term care facilities, and prisons or jails

PICOTS	Inclusion	Exclusion
Study design	KQs 1 and 2: All study designs except reviews summarizing across original studies or interventions and univariate descriptive studies KQ 3: Randomized controlled trials, cluster randomized trials, cohort studies, case-control studies, quasi-experimental designs with a comparison group	KQs 1 and 2: Descriptive studies that do not control for potential confounding KQ 3: All other designs
Language	Studies published in English	Studies published in languages other than English
Publication type	All publications that allow abstraction and interpretation of findings	Abstract-only publications

ACO = Accountable Care Organization; ED = emergency department; EMS = emergency management services; HNHC = high-need, high-cost; KQ = Key Question; PICOTS = population, intervention, comparator, outcomes, time frame, settings

We imported all citations identified through searches and other sources into EndNote v.X9. Independent reviewers screened the titles and abstracts of all citations using the inclusion and exclusion criteria using Abstrackr software. Studies included by either reviewer were retrieved for full-text screening. Independent reviewers then screened the full-text version of eligible references. Discrepancies between the reviewers were resolved through discussions and consensus or consultation with a third senior reviewer. In relation to studies included for the realist review, in keeping with realist review principles, we evaluated articles for their relevance and robustness in answering KQ 2 and their contribution to theory building and testing.[1] Excluded studies are listed in the Results Appendix.

Each Key Question (KQ) used a different review methodology approach. We used "best fit" framework synthesis methodology for KQ 1, realist review methodology for KQ 2, and systematic review methodology for KQ 3.

Data Abstraction

We developed and pilot tested standardized data extraction forms for each KQ. For KQ 1 included exposure studies, we extracted study characteristics, including study goal, design, methodological approach, data source setting, sample size, inclusion and exclusion criteria; population characteristics, including characteristics on service use, healthcare costs, clinical health conditions, behavioral conditions, social risk factors, demographic conditions, and health system; and key outcomes of interest. For KQ 3, we abstracted study characteristics, population characteristics, intervention characteristics, intervention effectiveness, subgroup intervention effectiveness, and study risk-of-bias assessment. Trained reviewers abstracted the relevant data from each included article into the evidence tables; a second member of the team reviewed all data abstractions for completeness and accuracy for KQ 1 and KQ 3.

To answer the realist review question, KQ 2, data items were driven by our purpose to refine our program theories through context-mechanism-outcome configurations. The team developed the initial program theory by identifying categories of interventions for HNHC patients from an initial scan of the literature and articulating the underlying theory that supports those interventions. Subsequently, we refined the initial program theory into a realist program theory by creating a map of a patient journey, with corresponding lists of mechanisms operating at the patient and provider levels. We then identified additional theoretical frameworks that could inform our program theory by explaining mechanisms of both patients and providers and that drew from a variety of health behavior theories, most notably the Theory of Planned Behavior. Data were abstracted in NVivo software using a coding framework grounded in our initial program theory of context-mechanism-outcomes. Coding of all included studies using the coding

framework proceeded as both an inductive and deductive process; that is, we continued to identify and add to the coding framework as we proceeded.

Assessment of Methodological Risk of Bias and Risk of Rigor of Individual Studies

KQ1

We did not assess the risk of bias or strength of evidence for studies relevant to KQ 1. The studies we included for KQ 1 were mostly observational exposure studies and fewer were cluster analyses or qualitative studies. No validated tool is available for evaluating the risk of bias of cross sectional exposure studies or cluster analysis studies.[2] However, we limited included exposure studies to those using a multivariate design that controlled for confounding.

KQ 2

For KQ 2, the studies also included for KQ 3 received a risk-of-bias assessment. Specific to KQ 2, to keep with realist review principles, we used RAMESES project standards to guide our judgments in quality appraisal tasks.[1, 3-5] More specifically, data were appraised based on relevance (whether included articles can contribute to theory building and testing), trustworthiness (whether the data in a study have been obtained empirically, using methods that are clearly stated and whether the information could be found in more than one source), plausibility of the argument underlying the theory (the coherence of the argument, including its breadth in explaining the data, its simplicity and fit with existing theory), and rigor (whether included articles are methodologically credible with regard to outcomes reported and methods used for testing propositions).

KQ 3

The criteria set forth by the Agency for Healthcare Research and Quality's *Methods Guide for Comparative Effectiveness Reviews* guided our assessment of methodological risk of bias for KQ 3. To assess the risk of bias (i.e., internal validity), we used the ROBINS-I[6] tool for observational studies and the Cochrane RCT[7] tool for randomized controlled trials (RCTs). For both observational studies and RCTs, risk-of-bias assessment included questions to assess selection bias, confounding, performance bias, detection bias, and attrition bias; concepts covered include those about adequacy of randomization (for RCTs only), similarity of groups at baseline, masking, attrition, whether intention-to-treat analysis was used, method of handling dropouts and missing data, validity and reliability of outcome measures, and treatment fidelity.[8]

For each study included for KQ 3, two independent reviewers assigned risk-of-bias ratings for each study with disagreements resolved by discussion and consensus. Reviewers assigned a rating of low risk of bias (study met all criteria), some concerns (study met some criteria), high risk of bias (methodological shortcomings leading to high risk of bias in one or more categories), or unclear risk of bias (methods not reported clearly).

Data Synthesis

We summarized all included studies for KQs 1 and 3 in narrative form and in summary tables that tabulate the important features of the study populations, design, intervention, comparison, outcomes, setting (including geographic location), and results.

Describing HNHC population (KQ 1): To achieve our aim of describing the approach to identifying the HNHC population, we conducted a "best fit" framework synthesis.[9] Consistent with this approach, we began from an a priori identified framework that we used to sort evidence into themes across included studies (i.e., the distinguishing characteristics and reasons why some patients are HNHC). During our review of the evidence, we used an iterative process to consider new themes that were not captured in the initial framework. In the end, we present a summary of the data and syntheses of the evidence and our conclusions within a framework corresponding to our final conceptual model.

We began the synthesis using the taxonomy developed by the National Academy of Medicine in their report *Effective Care for High-Need Patients: Opportunities for Improving Outcomes, Value, and Health* as our a priori framework.[10] This taxonomy groups HNHC patients first based on their clinical and functional characteristics. Among the six patient groups presented in the taxonomy, four met the inclusion criteria for this review: nonelderly disabled, multiple chronic conditions, major complex chronic condition, and frail elderly. (The additional two categories, children with complex needs and individuals with advancing illness/end-of-life care, are outside the scope of the review.) Within these assigned groups, the taxonomy proposed additional, cross-patient group assessment based on behavioral health factors and social risk factors that are believed to influence how individuals use healthcare and increase the risk of receiving fragmented care. Behavioral health factors included serious mental illness, substance use disorder, cognitive decline, and chronic toxic stress. Social risk factors included low socioeconomic status, low health literacy, social isolation, community deprivation, and housing insecurity.

Understanding interventions for HNHC patients (KQ 2): To gain a greater understanding of the complex alternative payment and delivery models, social interventions, and health programs that are used to address healthcare utilization among HNHC patients, we used a realist review approach. Consistent with this approach, our goal is to explain what works (or fails), for whom, under what circumstances, and why.[11] We sought to identify, elucidate, and refine several underlying theories that could explain the approach of different complex interventions, explore implementation chains, assess intermediate outcomes, and examine modifications or adaptations applied in various circumstances.[11]

Review of the evidence supporting the effectiveness of HNHC interventions (KQ 3): To further support the goal of producing actionable information, we also used traditional Evidence-based Practice Center systematic review methods to synthesize the evidence of the overall effectiveness of the included interventions. We conducted a quantitative synthesis of results by calculating a pooled treatment effect when 3 or more samples with the same study design had similar treatment and comparison groups and reported the same outcome measure within a setting. We used STATA® 16 (StataCorp, College Station, TX) to calculate effect sizes and associated 95 percent confidence intervals. Because of the diversity of intervention designs and outcomes, most results were synthesized qualitatively.

Grading the Strength of Evidence

For KQ 3, we graded the strength of evidence based on the guidance established for the Evidence-based Practice Center Program.[12] Developed to grade the overall strength of a body of evidence, this approach incorporates five key domains: study limitations (includes study design and risk of bias), consistency, directness, precision of the evidence, and reporting bias. This approach requires looking beyond statistical significance alone, even when studies are consistent

and of high quality and outcomes are direct and clinically relevant. It emphasizes the adequacy of the sample size to rule out spurious associations and results that are not clinically relevant. It also considers other optional domains that may be relevant to increasing the strength of evidence for some scenarios, such as a dose-response association, plausible confounding that would decrease the observed effect, and strength of association (magnitude of effect).

Appendix Table A-2 describes the grades of evidence that can be assigned. Grades reflect the strength of the body of evidence to answer KQs on the benefits and harms of the interventions included in this review. Two reviewers assessed each domain for each key outcome with differences resolved by consensus.

Appendix Table A-2. Definitions of the grades of overall strength of evidence[12]

Grade	Definition
High	High confidence that the evidence reflects the true effect. Further research is very unlikely to change our confidence in the estimate of effect.
Moderate	Moderate confidence that the evidence reflects the true effect. Further research may change our confidence in the estimate of the effect and may change the estimate.
Low	Low confidence that the evidence reflects the true effect. Further research is likely to change our confidence in the estimate of the effect and is likely to change the estimate.
Insufficient	Evidence either is unavailable or does not permit estimation of an effect.

Assessing Applicability

We assessed the applicability of individual studies as well as the applicability of a body of evidence following guidance from the *Methods Guide for Effectiveness and Comparative Effectiveness Reviews*.[13] For individual studies, we examined conditions that may limit applicability based on the PICOTS (population, intervention, comparisons, outcomes, timing, and setting) structure. The assessment of applicability is integral to a realist review through its consideration of context within context-mechanism-outcome configurations. We indicated patterns across studies and when the context does not appear to operate similarly in particular settings.

Peer Review and Public Commentary

To be completed after public review

Search Strategy

Management of High-Need, High-Cost Patients: A Realist and Systematic Review Published Literature Searches

PubMed

09-07-2019

Search	Query	Items Found
#1	Search (((“high utilizer” OR “high utilizers of health care” OR “high utilizing” OR “super utilizers” OR “super utilizing” OR “frequent utilization” OR “frequent utilisation” OR “frequent utilizers” OR “heavy utilization” OR “heavy utilizers” OR “high attenders” OR “repeat users” OR “hyperusers” OR “revolving door patients” OR “hyperutilization” OR “overutilization” OR “recividism”)) OR “frequent users”) OR “frequent user” OR “medically complex” OR “high need” Sort by: Best Match	3545
#2	Search (“Africa”[Mesh]) OR “India”[Mesh] OR “Developing Countries”[Mesh])) Sort by: Best Match	398504
#3	Search (#1 NOT #2) Sort by: Best Match	3506
#4	Search (#1 NOT #2) Sort by: Best Match Filters: Publication date from 2000/01/01; Humans; English; Adult: 19+ years	1332

Cochrane Clinical Trials Central Register

09-07-2019

Search	Query	Items Found
#1	Search (“high utilizers” OR “high need” OR “complex patients”)	40

CINAHL

09-07-2019

Search	Query	Items Found
#1	Search (“high utilizers” OR “high need” OR “complex patients”)	27

Embase

09-07-2019

Search	Query	Items Found
#1	Search (“high utilizers” OR “high need” OR “complex patients”)	28

PsycINFO

09-07-2019

Search	Query	Items Found
#1	Search (“high utilizers” OR “high need” OR “complex patients”)	27

Web of Science

09-07-2019

Search	Query	Items Found
#1	Search (“high utilizers” OR “high need” OR “complex patients”)	194

Academic Search Premier

09-07-2019

Search	Query	Items Found
#1	Search (“high utilizers” OR “high need” OR “complex patients”)	25

Scopus

09-07-2019

Search	Query	Items Found
#1	Search (“high utilizers” OR “high need” OR “complex patients”)	61

Gray literature searches for Management of High-Need, High-Cost Patients: A Realist and Systematic Review:

ClinicalTrials.gov results = **5**
SIREN Evidence Library = **5**
HSRProj = **18**
National Academy of Medicine = **3**
Center for Health Care Strategies = **10**
Centers for Medicare and Medicaid Services = **4**
Camden Coalition = **2**
Commonwealth Fund = **61**
Robert Wood Johnson Foundation = **9**
California HealthCare Foundation = **8**
Grey Literature Report= **94**
Institute for Healthcare Improvement = **3**
Centers for Disease Control and Prevention = **3**
Human Resources Services Administration = **0**
Social Work Abstracts = **2**
Kaiser Family Foundation = **3**
Milbank Memorial Fund = **0**
Patient-Centered Outcomes Research Institute = **2**

Search Strategy for all Gray Literature

09-2019
“high utilizers” OR “high need” OR “complex patients”

Search Strategy for all Gray Literature

10-2019
“high utilizers” OR (“high need” AND “high cost”) OR “complex patients”

Appendix B: Results

Results of Literature Searches

The electronic search, grey literature, and reference mining identified 2,015 citations. After title and abstract screening, 621 citations were retrieved for full-text review. A total of 94 studies (100 articles) met eligibility criteria. A total of 94 studies (100 articles) were included in the analyses.

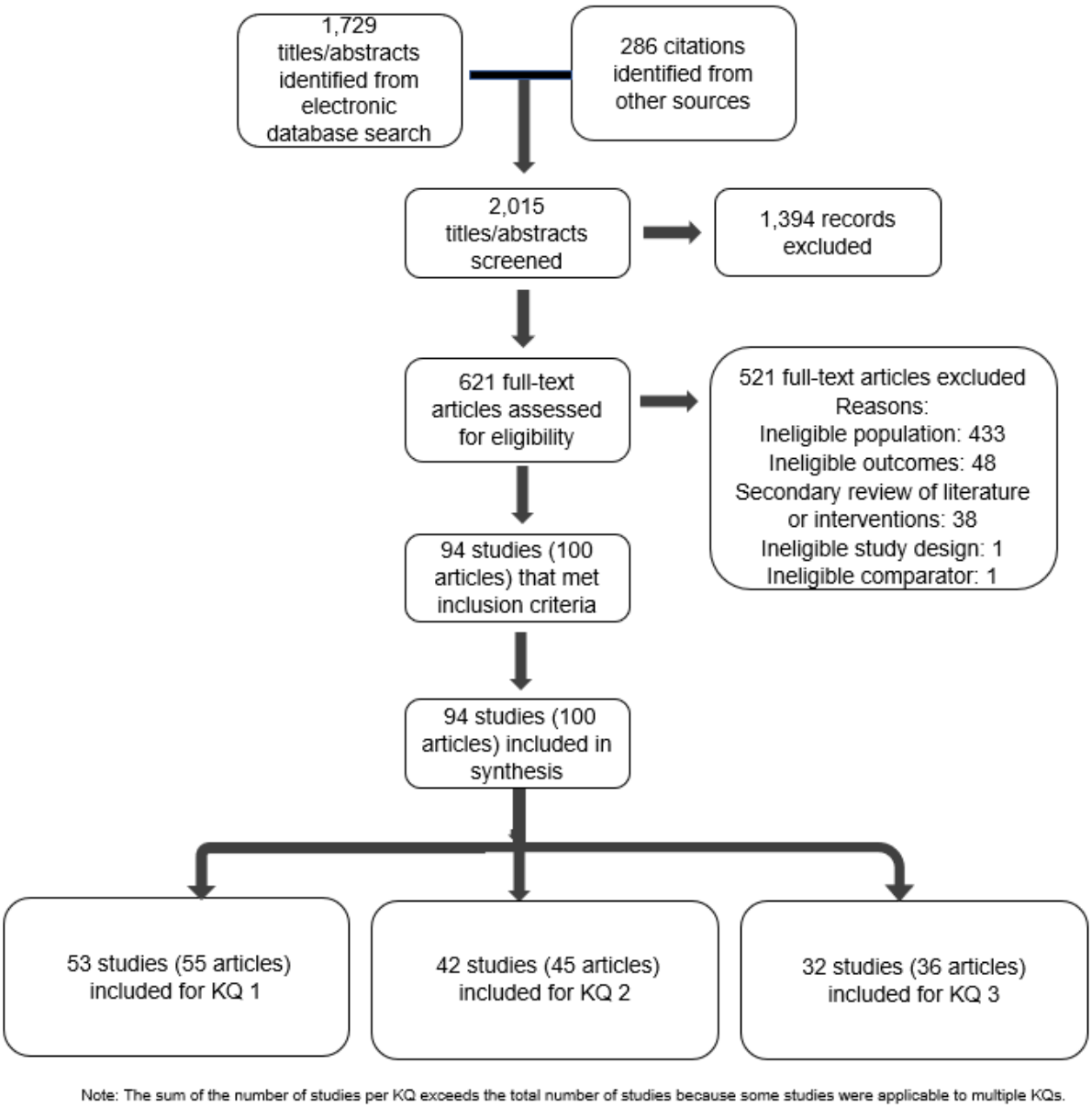
Description of Included Studies

For KQ 1, we identified 53 studies (55 articles), of which 27 were cross sectional, 6 latent class, 15 predictive, and 7 qualitative.[14-68]

For KQ 2, we identified we identified 42 studies (45 articles).[10, 15, 20, 21, 27-29, 31, 51, 57, 59, 60, 63, 66, 67, 69-98] As for unique KQ 2 includes, we identified 9 studies (9 articles).[10, 69, 81, 83, 84, 94-97]

For KQ3, we identified 14 trials and 18 observational studies (36 articles). Three RCTs were assessed as having low risk of bias and 11 RCTs (12 articles) were assessed as having some concerns for bias,[70-73, 75, 78, 80, 87, 89, 99-101] No observational studies were assessed as having low risk of bias, 12 observational studies (14 articles) were assessed as having some concerns for bias, and 6 observational studies (7 articles) were assessed as having high risk of bias.[74, 76, 79, 82, 85, 88, 90-93, 98, 102-111]

Figure B-1. Article flow diagram



Note: The sum of the number of studies per KQ exceeds the total number of studies because some studies were applicable to multiple KQs.
KQ = Key Question

Excluded Studies

X1: Ineligible Population

X2: Ineligible Intervention

X3: Ineligible Comparator

X4: Ineligible Outcome

X5: Ineligible Time Frame

X6: Setting/Country

X7: Secondary Review of Literature or Interventions

X8: Not Original Research for KQ 3

X9: Study Design

X10: Not English

X11: Irretrievable

1. Magellan initiative targets high utilizers in private plans. Mental Health Weekly. 2000;10(32):1. PMID: 3493535. Exclusion Code: X1.
2. Hand-held devices ease burden of behavioral health assessment. Dis Manag Advis. 2002;8(10):152-6, 45. Exclusion Code: X1.
3. Medicaid best buys: improving care management for high-need, high-cost beneficiaries. Hamilton, N.J.: Center for Health Care Strategies, Inc.; 2008. Exclusion Code: X4.
4. Medicaid best buys: critical strategies to focus on high-need, high-cost beneficiaries. Hamilton, N.J.: Center for Health Care Strategies, Inc.; 2010. Exclusion Code: X1.
5. Building the national care service. Norwich: Great Britain Stationary Office; 2010. Exclusion Code: X1.
6. ED diversion: multidisciplinary approach engages high utilizers, helps them better navigate the health care system. ED management : the monthly update on emergency department management. 2011;23(11):127-30. Exclusion Code: X1.
7. CM program keeps high utilizers out of hospital. Hosp Case Manag. 2012;20(7):108-9. PMID: 104470969. Language: English. Entry Date: 20120711. Revision Date: 20150711. Publication Type: Journal Article. Journal Subset: Nursing. Exclusion Code: X1.
8. Hospitals collaborate to reduce ED overuse. Hosp Case Manag. 2012 Oct;20(10):151-3. PMID: 23084509. Exclusion Code: X1.
9. Patient navigation for Medicaid frequent ED users. Yale University. 2013. https://www.cochranelibrary.com/central/doi/10.1002/central/CN-01579091/full. PMID: CN-01579091. Exclusion Code: X4.
10. Identifying high utilizers of surgical care after colectomy. J Surg Res. 2014;186(2):495-. doi: 10.1016/j.jss.2013.11.036. PMID: 93484679. Exclusion Code: X1.
11. Programs focusing on high-need, high-cost populations. [Trenton, N.J.]: Center for Health Care Strategies, Inc.; 2016. Exclusion Code: X1.
12. Understanding the needs of different types of high-need patients and their caregivers. Commonwealth Fund; 2019. Exclusion Code: X1.
13. Ackroyd-Stolarz S, Read Guernsey J, Mackinnon NJ, et al. The association between a prolonged stay in the emergency department and adverse events in older patients admitted to hospital: a retrospective cohort study. BMJ Qual Saf. 2011 Jul;20(7):564-9. doi: 10.1136/bmjqs.2009.034926. PMID: 21776300. Exclusion Code: X1.

14. Acosta AM, Lima MA. Frequent users of emergency services: associated factors and reasons for seeking care. Rev Lat Am Enfermagem. 2015 Feb-Apr;23(2):337-44. doi: 10.1590/0104-1169.0072.2560. PMID: 26240244. Exclusion Code: X1.

15. Adler-Milstein J. Assessing the impact of Medicare advantage on high-cost, high-need beneficiaries and exploring an intervention to improve outcomes. Michigan: Commonwealth Fund; 2017. Exclusion Code: X1.

16. Agarwal G, Lee J, McLeod B, et al. Social factors in frequent callers: a description of isolation, poverty and quality of life in those calling emergency medical services frequently. BMC Public Health. 2019 Jun 3;19(1):684. doi: 10.1186/s12889-019-6964-1. PMID: 31277151. Exclusion Code: X1.

17. Agarwal G, McDonough B, Angeles R, et al. Rationale and methods of a multicentre randomised controlled trial of the effectiveness of a Community Health Assessment Programme with Emergency Medical Services (CHAP-EMS) implemented on residents aged 55 years and older in subsidised seniors' housing buildings in Ontario, Canada. BMJ Open. 2015 Jun 11;5(6):e008110. doi: 10.1136/bmjopen-2015-008110. PMID: 26206441. Exclusion Code: X1.

18. Aird P, Hansford P, O'Brien R, et al. The impact of frequent users of OOH services. Br J Gen Pract. 2001 Jun;51(467):494-5. PMID: 15094029. Exclusion Code: X1.

19. al Yousif N, Hussain HY, El Din Mhakluf MM. Health care services utilization and satisfaction among elderly in Dubai, UAE and some associated determinants. Middle East Journal of Age & Ageing. 2014;11(3):25-33. PMID: 96513555. Exclusion Code: X1.

20. Alghanim SA, Alomar BA. Frequent use of emergency departments in Saudi public hospitals: implications for primary health care services. Asia Pac J Public Health. 2015 Mar;27(2):Np2521-30. doi: 10.1177/1010539511431603. PMID: 25547107. Exclusion Code: X1.

21. Allen CG, Escoffery C, Satsangi A, et al. Strategies to improve the integration of community health workers into health care teams: "a little fish in a big pond". Prev Chronic Dis. 2015 Sep 17;12:E154. doi: 10.5888/pcd12.150199. PMID: 26875022. Exclusion Code: X1.

22. Althaus F, Paroz S, Hugli O, et al. Effectiveness of interventions targeting frequent users of emergency departments: a systematic review. Ann Emerg Med. 2011 Jul;58(1):41-52 e42. doi: 10.1016/j.annemergmed.2011.03.007. PMID: 21689565. Exclusion Code: X1.

23. Althaus F, Stucki S, Guyot S, et al. Characteristics of highly frequent users of a Swiss academic emergency department: a retrospective consecutive case series. Eur J Emerg Med. 2013 Dec;20(6):413-9. doi: 10.1097/MEJ.0b013e32835e078e. PMID: 25139183. Exclusion Code: X1.

24. Altman D. A small group of patients account for a whole lot of spending. Axios. 2019. https://www.axios.com/drug-prices-health-care-costs-spending-employers-63a65abc-0148-4f98-bd39-b30e4d3c9caf.html. Exclusion Code: X7.

25. Amarasingham R, Xie B, Karam A, et al. Using community partnerships to integrate health and social services for high-need, high-cost patients. Commonwealth Fund. 2018. https://www.commonwealthfund.org/publications/issue-briefs/2018/jan/using-community-partnerships-integrate-health-and-social. Exclusion Code: X1.

26. Anderson GM. Program delivery for high-needs, high-cost populations: international perspectives on the way forward, phase I. University of Toronto, Faculty of Medicine, Institute of Health Policy, Management and Evaluation 2017. https://hsrproject.nlm.nih.gov/view_hsrproj_record/20191229. Exclusion Code: X7.

27. Andrews G, Sunderland M. Telephone case management reduces both distress and psychiatric hospitalization. Aust N Z J Psychiatry. 2009 Sep;43(9):809-11. doi: 10.1080/00048670903107617. PMID: 17515738. Exclusion Code: X1.

28. Angelelli J, Gifford D, Intrator O, et al. Access to postacute nursing home care before and after the BBA (Balanced Budget Act). Health Aff (Millwood). 2002 Sep-Oct;21(5):254-64. doi: 10.1377/hlthaff.21.5.254. PMID: 12450957. Exclusion Code: X1.

29. Bagnall AM, South J, Forshaw MJ, et al. Self-care in primary care: findings from a longitudinal comparison study. Prim Health Care Res Dev. 2013 Jan;14(1):29-39. doi: 10.1017/s1463423612000199. PMID: 24568286. Exclusion Code: X1.

30. Baker JM, Grant RW, Gopalan A. A systematic review of care management interventions targeting multimorbidity and high care utilization. BMC Health Serv Res. 2018 Jan 30;18(1):65. doi: 10.1186/s12913-018-2881-8. PMID: 29382327. Exclusion Code: X1.

31. Balfour ME, Zinn TE, Cason K, et al. Provider-payer partnerships as an engine for continuous quality improvement. Psychiatr Serv. 2018;69(6):623-5. doi: 10.1176/appi.ps.201700533. PMID: 129890973. Language: English. Entry Date: In Process. Revision Date: 20180609. Publication Type: Article. Journal Subset: Biomedical. Exclusion Code: X1.

32. Barsky AJ, Ahern DK, Bauer MR, et al. A randomized trial of treatments for high-utilizing somatizing patients. J Gen Intern Med. 2013;28(11):1396-404. doi: 10.1007/s11606-013-2392-6. PMID: CN-00909578. Exclusion Code: X1.

33. Becker T, Steffen S, Puschner B. Discharge planning, an intervention study - and where to go next? Eur Psychiatry. 2011;26. doi: 10.1016/S0924-9338(11)73744-0. PMID: CN-01782093. Exclusion Code: X1.

34. Beesley VL, Smithers BM, O'Rourke P, et al. Variations in supportive care needs of patients after diagnosis of localised cutaneous melanoma: a 2-year follow-up study. Support Care Cancer. 2017 Jan;25(1):93-102. doi: 10.1007/s00520-016-3378-9. PMID: 26389982. Exclusion Code: X1.

35. Bellon JA, Rodriguez-Bayon A, Luna JD, et al. Successful GP intervention with frequent attenders in primary care: randomised controlled trial. Br J Gen Pract. 2008 May;58(550):324-30. doi: 10.3399/bjgp08X280182. PMID: WOS:000256654700006. Exclusion Code: X1.

36. Bergeron P, Courteau J, Vanasse A. Proximity and emergency department use: multilevel analysis using administrative data from patients with cardiovascular risk factors. Can Fam Physician. 2015 Aug;61(8):e391-7. PMID: 26747456. Exclusion Code: X1.

37. Bergh H, Marklund B. Characteristics of frequent attenders in different age and sex groups in primary health care. Scand J Prim Health Care. 2003 Sep;21(3):171-7. doi: 10.1080/02813430310001149. PMID: WOS:000185314100010. Exclusion Code: X1.

38. Berghofer A, Hartwich A, Bauer M, et al. Efficacy of a systematic depression management program in high utilizers of primary care: a randomized trial. BMC Health Serv Res. 2012 Sep 3;12:298. doi: 10.1186/1472-6963-12-298. PMID: 25527472. Exclusion Code: X1.

39. Berghöfer A, Roll S, Bauer M, et al. Screening for depression and high utilization of health care resources among patients in primary care. Community Ment Health J. 2014;50(7):753-8. doi: 10.1007/s10597-014-9700-4. PMID: 103896118. Language: English. Entry Date: 20140924. Revision Date: 20151001. Publication Type: Journal Article. Exclusion Code: X1.

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Detailed Results Tables

Key Question 1: What criteria identify or can be used to predict that patients will be HNHC and why?

KQ 1a: How do criteria incorporate patient clinical characteristics?

Appendix Table B-1. Descriptive multivariate, ED visits outcome (n=13)

Author, Year	Population	Arthritis	Cancer	[a]Cerebrovascular Disease	[a]Congestive Heart Failure	[a]COPD	[a]Cardiovascular Disease	[a]Dementia	[a]Diabetes	[a]Heart Disease	Hep C	Hepatobiliary Disease	HIV Seropositive	Hypertension	Pancreatic Disease	Pulmonary Circulation Disorder	Seizure	Sickle Cell	[a]Vascular Disease	Condition	CCI	Charlson Comorbidity Index	Charlson Severity Index	General Health Score	Global Physical Health Score	Health Status	Hierarchic Categorical Condition Score	Morse Fall Score	Quan-Charlson Score
Buhumaid, 2015[32]	Hospital/health system																				+								
Hasegawa, 2014[36]	Hospital/health system					+			+								+												
Hasegawa, 2014[37]	Hospital/health system				+		+		+						+														
Chang, 2014[42]	Hospital/health system									NS		+				NS				NS									
Chukmaitov, 2012[112]	Hospital/health system																							+					
Milbrett and Halm, 2009[44]	Hospital/health system	NS																											
Mandelberg, 2000[48]	Hospital/health system	+				+					+						+	+	+										
Vinton, 2014[35]	Population based	+	+	+			+		+					NS													+		
Hunt, 2006[45]	Population based																												+
Friedman, 2009[46]	Population based																											+	
Zuckerman and Shen, 2004[49]	Population based																										+		
Thakarar, 2015[33]	Single Program										+	+																	
Doran, 2013[64]	VA				+	+											+				-			+					

+ denotes significant positive association, - denotes significant negative association, NS denotes no significance, and a blank cell denotes not included in the model. Five multivariate studies—Behr and Diaz,[30] Hasegawa et al.,[39] Doran et al.,[40] Lie et al.,[41] and Ruger et al.[47]—observed ED visits but did not include any of the clinical conditions above in their models to answer KQ 1a.

CCI = Charlson Comorbidity Index; COPD = chronic obstructive pulmonary disease; ED = emergency department; HIV = human immunodeficiency virus; NS = not statistically significant; VA = Veterans Administration; n = number.

Appendix Table B-2. Predictive, ED visits outcome (n=3)

Author, Year	Population	Arthritis	[a]Congestive Heart Failure	[a]COPD	[a]Dementia	[a]Diabetes	Hypertension	Renal Disease	Condition	CCI	Hierarchic Categorical Condition Score
Billings and Raven, 2013[43]	Medicaid									-	
Colligan, 2016[31]	Medicare	+	+	+	+	+	+	NS	-		+
Brannon, 2018[20]	Hospital/health system								+		

+ denotes significant positive association, - denotes significant negative association, NS denotes no significance, and a blank cell denotes not in the model. One predictive study, Hwang et al.,[52] observed ED visits but did not include any of the clinical conditions above in their models to answer KQ 1a.
CCI = Charlson Comorbidity Index; COPD = chronic obstructive pulmonary disease; ED = emergency department; NS = not statistically significant; n = number.

Appendix Table B-3. Descriptive multivariate, IP visits outcome (n=2)

Author, Year	Population	Condition	CCI	Morse Fall Score
Bell, 2017[16]	Hospital/health system	+		
Porter, 2019[54]	Hospital/health system	+	+	+

+ denotes significant positive association, - denotes significant negative association, NS denotes no significance, and a blank cell denotes not included in the model.
CCI = Charlson Comorbidity Index ; IP = inpatient; n = number.

Appendix Table B-4. Predictive, IP visits outcome (n=3)

Author, Year	Population	Arthritis	Cancer	[a]Chronic Kidney Disease	[a]Congestive Heart Failure	[a]Cardiovascular Disease	[a]Diabetes	Hypertension	Condition
Hempstead, 2014[68]	Hospital/health system								+
Leininger, 2014[34]; Leininger, 2015[53]	Medicaid								+
Chang, 2019[58]	VA	+	+	+	+	+	+	+	

+ denotes significant positive association, - denotes significant negative association, NS denotes no significance, and a blank cell denotes not included in the model. Two predictive studies, Billings and Mijanovich[67] and Raven et al.,[65] observed IP visits but did not include any of the clinical conditions above in their models to answer KQ 1a.
IP = inpatient; VA = Veterans Administration; n = number.

Appendix Table B-5. Descriptive multivariate, all visits outcome (n=2)

Author, Year	Population	Charlson Severity Index	Global Physical Health Score
Rohrer, 2008[18]	Hospital/ health system	+	
Blumenthal, 2017[50]	Hospital/ health system		+

+ denotes significant positive association, - denotes significant negative association, NS denotes no significance, and a blank cell denotes not included in the model. One multivariate study, Levinson and Druss,[23] observed all visits but did not include any of the clinical conditions above in their models to answer KQ 1a.
n = number .

Appendix Table B-6. Predictive, all visits outcome (n=3)

Author, Year	Population	[a]COPD	[a]Diabetes	Hypertension	Condition	CCI	Other
Meek, 2000[24]	Commercial (including HMO)	+	+	NS			
Wherry, 2014[38]; Leininger and Avery, 2015[53]	Population based					+	
Reichard, 2015[22]	Population based				+/NS		Disability +

+ denotes significant positive association, - denotes significant negative association, NS denotes no significance, and a blank cell denotes not included in the model. +/NS denotes performance across multiple models within the study, ranging from a positive significant association to no significance.
CCI = Charlson Comorbidity Index; COPD = chronic obstructive pulmonary disease; HMO = health maintenance organization; NS = not statistically significant; n = number.

Appendix Table B-7. Descriptive multivariate, cost outcome (n=2)

Author, Year	Population	Cancer	[a]Cerebrovascular Disease	[a]Cardiovascular Disease	[a]Diabetes	Condition	General Health Score	Quan-Charlson Score	Other
Bayliss, 2016[61]	Commercial (including HMO)					+			+
Robinson, 2016[17]	Commercial (including HMO)	NS	NS	+	-		NS	+	

+ denotes significant positive association, - denotes significant negative association, NS denotes no significance, and a blank cell denotes not included in the model. Two multivariate studies, Commonwealth Fund[55] and Sterling et al.,[19] observed cost but did not include any of the clinical conditions above in their models to answer KQ 1a.
HMO = health maintenance organization; NS = not statistically significant; n = number.

Appendix Table B-8. Predictive, cost outcome (n=1)

Author, Year	Population	[a]Diabetes	Hypertension	Pulmonary Circulation Disorder
Yang, 2018[25]	Medicaid	+	+	+

+ denotes significant positive association, - denotes significant negative association, NS denotes no significance, and a blank cell denotes not included in the model. One predictive study including Yang et al.[21];Yang et al.[57] observed cost but did not include any of the clinical conditions above in their models to answer KQ 1a.
n = number.

KQ1b: How do criteria incorporate patient health behaviors and sociodemographic characteristics (e.g., age, social determinants of health, insurance status and source of coverage, and access to the healthcare system)?

Appendix Table B-9. Multivariate descriptive and predictive results

Author, Year	Outcome	Population	Gender	Age	Demographics	Depres-sion	Severe Mental Illness	Other Mental Illness	Sub-stance Use	Alcohol Use	Home-less-ness	Employ-ment	Other Social Risk Factors
Bayliss, 2016[61]	Cost (top 25%)	Commercial (including HMO)	Female +	Over 55+		+							
Robinson, 2016[17]	Cost (top 10% of all-cause total costs)	Commercial (including HMO)	NS	NS		NS		NS/+	+	NS		NS	
Sterling, 2018[19]	Cost (top 20%)	Commercial (including HMO)						+					Any financial burden +
Walker, 2003[55]	Cost (adjusted annual cost ratios of median healthcare costs)	Commercial (including HMO)	NR	NR	NR			PTSD+					
Behr, 2016[30]	ED visits (2+, 3+, 4+, 5+)	Hospital/health system	Female+		Black +/NS			+	+			Employed +	
Bell, 2017[16]	Inpatient visits (3+)	Hospital/health system	NR	NR	NS				+	+	+		Community-level income <48k NS
Blumenthal, 2017[50]	All utilization (ED visits, acute hospitalizations)	Hospital/health system	NR	NR	NR			Lowest quartile in Global Mental Health score NS					
Buhumaid, 2014[32]	ED visits (4+)	Hospital/health system	Male NS	Age (40+) NS	Black +				-	+	+		
Chang, 2014[42]	ED visits (4+ in 12 months)	Hospital/health system	NS	NS	Not in Model			Personality dx +	SUD dx NS Positive cocaine screen+	NS	+		

Author, Year	Outcome	Population	Gender	Age	Demographics	Depres-sion	Severe Mental Illness	Other Mental Illness	Sub-stance Use	Alcohol Use	Home-less-ness	Employ-ment	Other Social Risk Factors
Chukmaitov, 2012[112]	ED visits (1+, 1-3, 4+)	Hospital/health system	Female +	Age (30-39) - (40-49) NS (50-64) + (65-74) + (75-84) + (>85) -	Black + Hispanic + Other -								
Doran, 2014[40]	ED visits (3+)	Hospital/health system	NR	NR	NR								
Hasegawa, 2014[36]	ED visits (3+ ED, 30-day ED revisit, IP visit)	Hospital/health system	Male +	Age (<74) +	Black + Hispanic + Other NS	+			+				Quartiles for median household income of patient's zip code 1 (lowest) and 2 + 3 NS
Hasegawa, 2014[37]	ED visits (3+)	Hospital/health system	Male +	Over 54+	+/NS	+	+		+				Lowest quartile median income +
Hasegawa, 2014[39]	ED visits (0, 1-2, 3-5, 6+)	Hospital/health system	Male NS/+	40-54 NS/+	NS								Lowest quartile median income NS
Liu, 2013[41]	ED visits (4+, 4-7, 8-18, 19+)	Hospital/health system	NR	NR	NR			+	+	+			
Mandelburg, 2000[48]	ED visits (5+)	Hospital/health system	Male NS	Age (30-59) +	Black + Hispanic - Native American + Asian - Other -					+	+		
Millbrett, 2009[44]	ED visits (>6)	Hospital/health system	Male+		Nonblack +		NS					Part-time employment retired/ unemployed, +	
Porter, 2019[54]	Inpatient visits (3+)	Hospital/health system	NR	Under 40+	NR			+	+				
Rohrer, 2008[18]	All utilization (27+ outpatient visits)	Hospital/health system	NS	Age NS	Not in model								

Author, Year	Outcome	Population	Gender	Age	Demographics	Depres-sion	Severe Mental Illness	Other Mental Illness	Sub-stance Use	Alcohol Use	Home-less-ness	Employ-ment	Other Social Risk Factors
Ruger, 2004[47]	ED visits (1, 2, 20+)	Hospital/health system	NR	NR	Not in model								
Thakarar, 2015[33]	ED visits (2+)	Hospital/health system (single program)	Female NS	55+ NS	Minority NS			NS	NS	NS			More than 1 housing change NS
Freidman, 2009[46]	ED visits (4+)	Population based		NS		NS							Income <$40k + <$90k NS
Hunt, 2006[45]	ED visits (1-3, 4+)	Population based			NS			+					Income by poverty threshold 200-399% + 100-199% + Below threshold +
Vinton, 2014[35]	ED visits (0, 1-3, 4-9, 10+)	Population based	Female +	>44-	Black + Hispanic - Asian - Other NS			+		NS		Currently employed -	Poverty–income ratio (Ref is >=4) +
Zuckerman, 2004[49]	ED visits (3+)	Population based			Black + Hispanic NS Asian NS								Near poor and poor + Single parent +
Doran, 2013[64]	ED visits (0, 1, 2-4, 5-10, 11-25, >25))	VA	Male+			+	+	+	+	+	+		
Levinson, 2005[23]	All utilization (3+ ED; 2+ specialty clinic visits)	VA	NR	NR	NR								

+ denotes significant positive association, - denotes significant negative association, NS denotes no significance, NR denotes not reported, and a blank cell denotes not include in the model.

HMO = health maintenance organization; dx = diagnosis; ED = emergency department; NR = not reported; NS = not statistically significant; PTSD = post-traumatic stress disorder; SUD = substance use disorder; IP = inpatient; k = thousand; VA = Veterans Administration; Ref = reference group .

Appendix Table B-10. Predictive results

Author, Year	Outcome	Population	Gender	Age	Demographics	Depres-sion	Severe Mental Illness	Other Mental Illness	Substance Use	Alcohol Use	Homeless-ness	Employment	Other Social Risk Factors
Meek, 2000[24]	All utilization (6+ visits in 6 months)	Commercial (including HMO)	Female +	Under 40 -	NR			+/NS/-					
Brannon, 2018[20]	ED visits (1+, 2+, 3+, 4+, 5+)	Hospital/ health system		Age + but not defined									Zip code+ but not defined
Hempsted, 2014[68]	Inpatient visits (1+, 2, 3+)	Hospital/ health system	Male +	Age (Ref is 80+) 18-34 + 35-49+ 50-64 + 65-79 +	Race/ethnicity (Ref is white) Asian/PI - Black - Hispanic - Other +			+	+				HH income < $34.999k +
Hwang, 2014[52]	ED visits (4+ visits in both years; 4+visits either year; <4 visits in both years)	Hospital/ health system	Male +		Nonwhite+	NR				NR			Low median household income+
Billings, 2007[67]	Inpatient visits (1+ hospital admission in next 12 months)	Medicaid	NR	NR	NR		+	+	+				
Billings, 2013[43]	ED visits (3+)	Medicaid			Not in model								
Leninger, 2014, 2015[34, 53]	Inpatient visits (1+ inpatient hospitalization)	Medicaid	NR	NR	NR			+	+		+		
Raven, 2008[65]	Inpatient visits (1+ readmission)	Medicaid											
Yang, 2017[21, 57]	Cost (persistent top 10% decile)	Medicaid	NR	NR	NR								
Yang, 2018[25]	Cost (top 10% expenditures in next 12 months)	Medicaid	NR	NR	NR								

Author, Year	Outcome	Population	Gender	Age	Demographics	Depres-sion	Severe Mental Illness	Other Mental Illness	Substance Use	Alcohol Use	Homeless-ness	Employment	Other Social Risk Factors
Colligan, 2016[31]	ED visits (0, 1-3, 4+)	Medicare		<=64 + >=75 +	Race (Ref is white) Black + Asian - Hispanic - Native American + Unknown/other -			+					
Kanzaria, 2017[28]	ED visits (4+ visits in 12 months)	Population based			Black +/NS Hispanic + Other -/NS	+/NS	-/NS	+/NS	+/NS	+/NS			Poverty indicator NS
Reichard, 2015[22]	All utilization (≥75th percentile)	Population based	NR	NR	NR								
Wherry, 2014[38, 53]	All utilization (top decile)	Population based						NS					
Chang, 2019[58]	Inpatient visits (persistently high risk, intermittent, or low risk in 2 years)	VA	Male +	Over 45+	Race (ref Hispanic) White - Black - Other - (p<0.05)			+	+ (tobacco)		-		Number of zip code changes + Urban+

HMO = health maintenance organization; ED = emergency department; NR = not reported; NS = not statistically significant; VA = Veterans Administration; PI = Pacific Islander; HH = household; Ref = reference group.

Key Question 2: What are the mechanisms that lead to reductions in potentially preventable or modifiable healthcare use and result in improved health outcomes and cost savings in interventions serving HNHC patients?

Appendix Table B-11. Full list of CMO configurations and supporting data for Program Theory 1: Identifying and targeting HNHC patients for inclusion in interventions

CMOs	Relevant data extracts/summary information from included literature
Summary: Identifying and targeting HNHC patients for interventions intended to reduce potentially preventable or modifiable healthcare use and costs [O] requires capturing their complexity [M] based on a combination of prior use of healthcare services [C], chronic disease [C], nonmedical barriers to accessing care [C], experience with the healthcare system [C], clinician judgment [C], and patient willingness to participate [C].	
Identifying patients who are HNHC and who would benefit from an intervention necessitates consideration of multiple patient characteristics	Theory and guidance from National Academy of Medicine report: "Determining an ideal definition for a high-need patient requires a delicate balance. A highly constrained definition will risk missing people, potentially depriving them of needed resources. On the other hand, casting an overly broad definition might include people who are not high-need and do not need additional resources. Abrams noted that basing identification of high-need patients exclusively on cost will miss many people, and if the focus is exclusively on chronic conditions, a large number of people may be identified whose chronic conditions are under control."[10]
CMO 1.1. Information obtained from claims and other electronic health records, identifying prior cost and/or use of healthcare services, are a necessary but insufficient component ("broad brush information") [C] for predicting [M] similar healthcare use in the future [O].	The Summit participants unanimously agreed that access to real-time information—such as notifications of ED visits or inpatient admissions—and a strong analytics team provide a critical foundation for super-utilizer programs. One leader referred to data as "oxygen for our program." Programs place a high priority on developing a robust data repository that can be mined to identify groups of patients that might respond well to complex care management.[51] Rely on more than 1 type of data-because it may be vulnerable to inaccuracies: One program said they use predictive modeling so that they are not "held hostage waiting for claims to come down the road." Washington State uses predictive modeling to begin to identify the target population. Using its Health Service Encounter algorithm, the state examines 15 months of integrated health care claims to determine future medical costs and inpatient risk scores. The state has found that conditions such as diabetes, cardiovascular disease, MH and substance abuse are common among the superutilizing subset of patients. It uses different approaches to further stratify subgroups for complex care management including identifying individuals with extreme emergency department utilization (e.g., approximately 80 to 130 ED visits in 15 months), high expected future medical costs (predicted by high utilization and costs in the past), high prospective inpatient risk scores, and sign gaps in care and quality indicators.[51] The programs represented at the Summit generally use historical claims data as a foundation to understand the size and scope of super-utilization. Claims analysis is an iterative process and includes identifying areas of high cost and high utilization, and/or identifying groups of recipients with a high number of diagnoses. With this initial broad brush information, programs are able to further shape and define the target population. For example, Community Care of North Carolina (CCNC), which includes 14 regional networks that manage the care of Medicaid beneficiaries, will analyze at least 12 months of data in order to understand which chronic illness and mental health indicators are contributing to a high number of ED visits.[51]

CMOs	Relevant data extracts/summary information from included literature
	"After an individual's records were linked across data sets, the process of flagging individuals as ''high utilizers'' began. Instead of using charges or receipts to define high utilizers, the decision was made to rely on the number of emergency department (ED) and inpatient visits made by an individual over the prior 12-month period."[69]
	"From the best-fit synthesis we conducted to answer KQ 1, we identified some characteristics that are often available through electronic databases that can be used to help identify patients." (Discussion section of this report. Also see full results for KQ 1)
	During the first site visit, physicians at both sites reported that they were initially very enthusiastic about the Health Buddy® program, because it offered a promising way to effectively support patients with chronic disease….. Once the physicians received the list of patients who were eligible for the Health Buddy® program, they reported that they became frustrated with the project because they felt that many of the patients selected would not benefit from participating. Further, physicians reported disappointment that many of the patients they believed could be helped by the program were not eligible to participate in the program because they had not been identified through the claims based algorithm developed by HHN.[71]
	Risk assessments of the TST participant population were conducted to inform the development of individualized care plans and assign participants to one of three risk categories to determine the level of service to be provided to each participant….TST reported that the high-risk intervention was provided to approximately 5% to 7% of the TST participant population that had depression and/or potentially critical health problems that required immediate attention....What might explain the lack of success in TST's demonstration? Ineffective Targeting. One explanation may be the inability to accurately target beneficiaries at greatest risk of intensive, costly, service use (as distinct from the need for general care management). ...When TST learned that one of its participants was admitted to the hospital, it reassigned this individual to its high-risk intervention, and when appropriate, a care manager visited the beneficiary in the hospital to determine the cause of the hospitalization and identify any new health or social issues to be addressed. Not surprisingly, TST adopted a strategy of targeting beneficiaries at greatest risk of a hospitalization and higher costs. Their targeting strategy was unsuccessful—and costly. The program was unable to predict future complications with any precision for those with initially stable, less costly, conditions. Lacking direct access to patients' medical records, the health coaches often began working with beneficiaries with incomplete information.[70]
	There are two key elements to the success of these new efforts to target and improve care for high-cost Medicaid cases. First, it is essential to be able to identify in advance patients who are likely to have high costs in the future. Many high-cost occurrences (such as injury, acute illness, or cancer) might be episodic, and high spending in one year might not mean high spending in subsequent years.[67]
	We conducted a retrospective analysis of secondary data from the Medicare program and other linked sources. We used 3 databases, including the Chronic Condition Data Warehouse, hierarchic categorical condition scores, and timeline files. The Chronic Condition Data Warehouse includes fee-for-service billing history for services reimbursed under Medicare Parts A, B, and D, as well as data about beneficiary demographic characteristics, linked at the beneficiary level with a unique identification number.[31]
	We used data from three health systems to develop, evaluate, and implement a model for the prediction of high ED utilization in Washtenaw and Livingston counties: Michigan Medicine and St. Joseph Mercy Health System (operators of all EDs in Ann Arbor and Livingston County) and Integrated Health Associates (IHA), a multispecialty medical practice with clinical sites in both counties.[20]

CMOs	Relevant data extracts/summary information from included literature
	Administrative data from DH's data warehouse were used to obtain demographic, medical, psychological/behavioral health and service utilization and claims data. The tight administrative and clinical integration among all care settings facilitates data capture across the continuum of care.[74] After an individual's records were linked across data sets, the process of flagging individuals as ''high utilizers'' began. Instead of using charges or receipts to define high utilizers, the decision was made to rely on the number of emergency department (ED) and inpatient visits made by an individual over the prior 12-month period. This step eliminated potential variability related to differences in treatments and payers. Rather than assigning an artificial cutoff, the nuances of the local population were allowed to set the threshold for what constituted high utilization. The Coalition defined high utilization as ''any individual with total emergency or inpatient visits greater than 1.5 standard deviations above the mean.'' This definition resulted in any individual with 3 or more inpatient visits, or 6 or more ED visits, being flagged in the database as a high utilizer.[69] The site for this study was the Duke Outpatient Clinic (DOC), a large primary care safety net clinic in Durham, North Carolina. Patients at the DOC have a high prevalence of multimorbidity, mental illness, and socioeconomic challenges. Beginning in 2012, the clinic initiated an extensive redesign process to better meet complex population health needs and reduce avoidable utilization of ED and inpatient care. This study was conducted to direct further quality improvement efforts. Multiple methods were applied, including both retrospective quantitative analysis of clinical data and an in-depth chart review. The study team extracted electronic health record data for all patients enrolled at the DOC between July 1, 2014, and June 30, 2015. The team matched these data to ED encounter data for the same year period from 2 local hospitals within the Duke University Health System, where DOC patients receive a vast majority of their emergency and hospital care. Lastly, the team conducted 30 chart reviews for 10 of the highest ED utilizers for each of the 3 leading chief complaints to uncover additional details surrounding their frequent ED use patterns.[15] The literature contains varying definitions for super-utilizer. The definition used for this analysis was adapted from the work of Johnson, et al. and defined super-utilizers as adult patients (≥ 18 years of age) who, along with having an admission (analysis index admission) during the requisite timeframe, had at least two other admissions in the year prior, or at least one other admission along with a serious mental health diagnosis… In order to focus the analysis on cost savings that could be linked to our interventions, patients on chemotherapy, patients with orthopedic complications, patients diagnosed with HIV, and patients who had repeated admissions for emergency dialysis were excluded from analysis.[74]

CMOs	Relevant data extracts/summary information from included literature
Identifying and targeting HNHC patients for interventions intended to reduce potentially preventable or modifiable healthcare use and costs [O] requires capturing their complexity [C] based on a combination of prior use of healthcare services [C], chronic disease [C], nonmedical barriers to accessing care [C], experience with the healthcare system [C], clinician judgment [C], and patient willingness to participate [C].	
CMO 1.2 Capturing the patient's use of services in "real time," [C] particularly while the patient is still hospitalized [C] captures the urgent need for the intervention [M] and avoids initiating an intervention during a later period when there is a reduction in service use (regression to the mean) [O]	Eligible patients were identified through real-time automated methods and recruitment occurred while patients were still hospitalized. Patient intake included an in-depth patient assessment to determine nonmedical barriers to improved health.[74] Over the course of the first year of operations, CLM reported that they modified their program in an effort to identify, in real time, participants whom they believed would most benefit from their interventions by changing how they stratified beneficiaries into levels of visit urgency.[75] This "real time" approach of using a hospital admission as a triggering event was perceived as useful for two reasons. First, patients with a hospital admission are much more likely to have a subsequent admission in the next twelve months than patients without an admission, which improves the potential case-finding capacity of the algorithm. But, equally important, effective discharge planning is likely to be a critical component of any intervention strategy for high-cost, highrisk patients. However, because of limited resources and lag time in acquiring data, our experience in other environments has suggested that some providers and payers are interested in non–"real time," retrospective analyses. Accordingly, we also examined patients with any claims in 2000–2003, to predict subsequent admissions in 2004 (regardless of whether they had a hospital admission in 2003 or any prior year). This "archival" approach to case finding is somewhat less robust (it finds fewer patients) than the "real time" method and only brief findings for this approach are presented for comparative purposes.[67] What might explain the lack of success in the Phase II KTBH Demonstration? One explanation may be the targeting of beneficiaries at greatest risk of intensive, costly, service use (as distinct from the need for general care management). Responding to KTBH's request, CMS staff selected a very costly, complex set of Medicare beneficiaries for their intervention and comparison groups. As a result, the comparison group exhibited substantial regression-to-the mean (RtoM) effects. While the randomized experimental design should cancel out RtoM effects and isolate a pure intervention effect, the large churning of beneficiaries from lower (higher) to higher (lower) cost groups over time adds considerable statistical noise to the test of savings.[73] Risk assessments of the TST participant population were conducted to inform the development of individualized care plans and assign participants to one of three risk categories to determine the level of service to be provided to each participant….TST reported that the high-risk intervention was provided to approximately 5% to 7% of the TST participant population that had depression and/or potentially critical health problems that required immediate attention....What might explain the lack of success in TST's demonstration? Ineffective Targeting. One explanation may be the inability to accurately target beneficiaries at greatest risk of intensive, costly, serviceuse (as distinct from the need for general care management). ...When TST learned that one of its participants was admitted to the hospital, it reassigned this individual to its high-risk intervention, and when appropriate, a care manager visited the beneficiary in the hospital to determine the cause of the hospitalization and identify any new health or social issues to be addressed. Not surprisingly, TST adopted a strategy of targeting beneficiaries at greatest risk of a hospitalization and higher costs. Their targeting strategy was unsuccessful—and costly. The program was unable to predict future complications with any precision for those with initially stable, less costly, conditions. Lacking direct access to patients' medical records, the health coaches often began working with beneficiaries with incomplete information.[70]

CMOs	Relevant data extracts/summary information from included literature
	What might explain the lack of success in the Phase II KTBH Demonstration? One explanation may be the targeting of beneficiaries at greatest risk of intensive, costly, service use (as distinct from the need for general care management). Responding to KTBH's request, CMS staff selected a very costly, complex set of Medicare beneficiaries for their intervention and comparison groups. As a result, the comparison group exhibited substantial regression-to-themean (RtoM) effects. While the randomized experimental design should cancel out RtoM effects and isolate a pure intervention effect, the large churning of beneficiaries from lower (higher) to higher (lower) cost groups over time adds considerable statistical noise to the test of savings. Even still, we would have considered the Phase II original intervention to be a success if it had saved 5.4% of costs. Large increases in demonstration period costs in less costly beneficiaries in the base period make it very difficult for intervention staff to target those at highest financial risk. It is much easier to target beneficiaries during the intervention period who actually incur major flare-ups and hospitalizations. Unfortunately, these beneficiaries have already incurred major expenditures by the time they receive intensive disease management services.[73] Eligible patients were identified through real-time automated methods and recruitment occurred while patients were still hospitalized. Patient intake included an in-depth patient assessment to determine nonmedical barriers to improved health.[74]
CMO 1.3. The accuracy of predicting (M) which patients will have future high use/cost (O) is improved by considering patients' multiple chronic conditions (C), functional limitations (C) and heightened clinical severity scores (C).	Three categories of high-cost users—beneficiaries who had multiple chronic conditions, were hospitalized, or had high total costs—were identified by CBO for study of persistence of Medicare expenditures over time. Beneficiaries that were selected based upon hospitalization or being in the high total cost groups had baseline expenditures that were four times as high as expenditures for a reference group. Beneficiaries selected based upon presence of multiple comorbid conditions had baseline expenditures that were roughly twice as high as expenditures for a reference group. Subsequent years of costs remained higher for all three cohorts than the reference group; however, total expenditures declined the most for those beneficiaries who were identified as high cost due to a hospitalization followed by beneficiaries who had had high total costs in the base year. Subsequent costs were virtually unchanged for beneficiaries with multiple chronic conditions.[72] Denver Health reported challenges in using utilization data alone to find patients at chronic high risk of acute care use—but identifying these patients was important for the success of 21st Century Care. That is, Denver Health assumed that 21st Century Care could reduce service use (such as hospitalizations and ED visits) by identifying patients with chronic care needs and then delivering preventive care to preempt higher-cost acute care later on. (See the theory of action in Section III.A.4.) Over the course of the award, however, Denver Health learned that many of its highest-cost patients were only temporarily high cost, suggesting that many of them would have returned to moderate- or low-cost status even without intervention. For example, under its risk stratification algorithm, Denver Health identified so-called super utilizers—all of whom were Tier 4—as people with three or more hospital admissions in a 12-month period, or two or more admissions and a mental health diagnosis. These people accounted for about 30 percent of adult facility costs. By analyzing pre-intervention data, however, research staff at Denver Health showed that, even without special intervention, fewer than half of these super utilizers at a single point in time were still in the category seven months later, and only 28 percent were in the category at the end of 12 months (Johnson et al. 2015b). Because of this challenge using utilization data alone to find chronic high-risk patients, Denver Health, as noted previously, added clinical information (in the form of both CRGs and clinical data such as lab results) to its second and third iterations of the risk-stratification algorithm (although lab results were later removed in subsequent algorithm iterations). Denver Health reported that each revision to the algorithm helped to identify patients who would benefit most from 21st Century Care's intensive services.[76]

CMOs	Relevant data extracts/summary information from included literature
	Denver Health recognized that people with exceptionally high service use at one time did not necessarily continue to have exceptional service use in the future. Over the course of the award, Denver Health integrated clinical information into its risk-stratification algorithm to try to better identify patients who would benefit from intervention.[76] Key Finding #1: Several vulnerable subpopulations of Medicare FFS beneficiaries were less likely to agree to participate in the CLM demonstration program. Of all CLM intervention beneficiaries, 65% verbally consented to participate in the CMHCB demonstration at some point during the intervention period. We found that Medicaid enrollees and institutionalized beneficiaries were less likely to be participants; both groups are costly and high users of acute care services. In general, participants tended to be healthier than nonparticipants using baseline characteristics including the prospective HCC score. However, beneficiaries with higher concurrent HCC scores based on the first 6 months of the demonstration were more likely to participate than healthier beneficiaries. This suggests that CLM made some inroads into engaging those with acute clinical deterioration. Further, as CLM's program matured, they appeared to be more successful engaging sicker and more costly beneficiaries based on baseline health status; however, those with Medicare/Medicaid dual enrollment and the institutionalized were still less likely to become participants. These findings suggest alternative recruiting and outreach strategies are needed to reach dual Medicare/Medicaid enrollees and beneficiaries who are institutionalized.[75] Key Finding #1: The HBC program was able to engage beneficiaries who were at higher risk of acute clinical deterioration as measured by the concurrent HCC score. Of the HBC original intervention beneficiaries, 45% verbally consented to participate in the CMHCB demonstration at some point during the intervention period; 40% of the refresh population agreed to participate. For the HBC program, we find that beneficiaries with medium and high concurrent HCC scores were more likely to be participants. Beneficiaries with higher prospective HCC scores and baseline Charlson comorbidity scores were less likely to be participants. This suggests that the HBC program was less able to engage the historically sicker Medicare beneficiaries but more able to engage those at higher risk of acute clinical deterioration as measured by the concurrent HCC score.[71] While the high-need patient population is diverse, a synthesis of analyses reported in the literature identified three criteria that could form a basis for defining and identifying this population: total accrued health care costs, intensity of care utilized for a given period of time, and functional limitations.[10] Medicare FFS beneficiaries with a primary residence in one of five designated counties including Boston, Massachusetts, and surrounding areas, and a high level of disease severity as indicated by Hierarchical Condition Categories (HCC) scores and high health care costs based on Medicare claims filed during calendar year 2005. Beneficiaries with HCC risk scores >=2.0 and annual costs of at least $2,000 or HCC risk scores >=3.0 and a minimum of $1,000 annual medical costs are eligible for the MGH's CMP.[77] Eligible patients were identified by using standard criteria: a risk score in the 90th percentile for 90-day hospitalization from a validated risk-prediction algorithm (13) and a recent hospitalization or emergency department visit.[78]

CMOs	Relevant data extracts/summary information from included literature
	Although high utilizers differed significantly from other patients in their medical and behavioral health needs, their presenting complaints were not categorically different from those of low utilizers—they simply had more visits for the same types of complaints utilizers were more likely to present to the ED multiple times for the same complaint. However, most high utilizers had 4 unique chief complaints, suggesting that these patients generally have several, rather than a few, reasons for seeking emergency care. No clearly defined pattern of complaints existed for high utilizers. High utilization in such patients is less likely to be caused by clearly defined disease processes and more by a complex mix of multiple chronic medical conditions and psychosocial factors, making it difficult to predict future utilization or identify specific patient needs based on their chief complaint.[15] Predictive modeling is a common tool used by super-utilizer programs to identify who might be at risk for super-utilizing in the future. One program said they use predictive modeling so that they are not "held hostage waiting for claims to come down the road." Washington State uses predictive modeling to begin to identify the target populations. Using its Health Service Encounter algorithm, the state examines 15 months of integrated health care claims to determine future medical costs and inpatient risk scores. The state has found that conditions such as diabetes, cardiovascular disease, mental health and substance abuse are common among the super-utilizing subset of patients. It uses different approaches to further stratify subgroups for complex care management including identifying individuals with extreme ED utilization (e.g., approximately 80 to 130 ED visits in 15 months), high expected future medical costs (predicted by high utilization and costs in the past), high prospective inpatient risk scores, and significant gaps in care and quality indicators.[51] Three categories of high-cost users—beneficiaries who had multiple chronic conditions, were hospitalized, or had high total costs—were identified by CBO for study of persistence of Medicare expenditures over time. Beneficiaries that were selected based upon hospitalization or being in the high total cost groups had baseline expenditures that were four times as high as expenditures for a reference group. Beneficiaries selected based upon presence of multiple comorbid conditions had baseline expenditures that were roughly twice as high as expenditures for a reference group. Subsequent years of costs remained higher for all three cohorts than the reference group; however, total expenditures declined the most for those beneficiaries who were identified as high cost due to a hospitalization followed by beneficiaries who had had high total costs in the base year. Subsequent costs were virtually unchanged for beneficiaries with multiple chronic conditions.[72]
CMO 1.4. The accuracy of predicting (M) which patients will have future high use/cost (O) is improved by considering patients' mental health (C) and substance use disorder (C) diagnoses and social needs (C).	The data on diagnostic history and characteristics of subsequent admissions may also provide some help in conceptualizing intervention design. The relatively high rates of chronic disease suggest the importance of a comprehensive, multidisciplinary approach to any intervention, using what we already know about improving chronic disease management (such as the chronic care model).But the extraordinarily high levels of substance abuse among high-risk patients and the history of mental illness even among the population without serious and persistent mental illness make clear that any intervention will have to take these factors into account. Whatever is on the shelf from chronic disease management vendors for commercial plans and Medicare will require a serious overhaul for adaptation to these populations.[67]

There are also other important questions that remain unanswered. From claims records we can say little about the social and personal characteristics of these patients. This is a population living in extreme poverty, and a broad range of factors (educational, behavioral, and coping capacity) likely complicate their lives. We have documented their mental illness and substance abuse problems, and there are also potentially high levels of homelessness and housing instability. Getting more and better information about these issues will require further work, but it is clearly critical to any intervention design. However, the potential impact of solving these problems may also be large, even for the most apparently daunting problems such as the high number of mental illness admissions. For some high-risk patients, an effective, supportive housing environment might be enough to tip the balance, allowing sufficient life stabilization to address previously intractable health and mental health problems. An emerging body of research indicates that these "social service" interventions can have a major impact on the use of health services. [67]

Our findings also show the importance of including patients with mental health disorders in an intervention program. John Billings and Maria Raven noted that more than a third of high utilizers have at least one claim with a mental health disorder diagnosis. Other studies have However, more than half noted that people with mental health disorders have higher rates of receiving ED and inpatient care.20 Most of the patients enrolled in our study had either depression or anxiety. While B2C did not target people with severe mental health needs (such as those recently hospitalized at a psychiatric facility), to our knowledge, the program is unique in having a behavioral health provider screen every enrollee for mental health disorders—and then address those conditions as appropriate.[79]

Participating super-utilizer programs reported a high prevalence of behavioral health diagnoses in high-utilizers through claims data. Indeed per capita Medicaid costs increase significantly with the addition of a mental health diagnosis, substance abuse diagnosis, or mental health plus substance abuse diagnosis[51]

All stakeholders identified poorly managed serious mental illness among HNHC patients as a significant driver of preventable high health care utilization. Patients often had inadequate access to mental-health and substance-abuse resources. This was because outpatient programmes did not exist, were inconveniently located or were not financially feasible to attend. This left patients without any options other than the ED for care. Additionally, several patients acknowledged that feeling depressed negatively impacted their care routines and contributed to missing provider appointments which, over time, compounded the severity of their diseases. Importantly, patients also pointed out that the stigma surrounding mental illness was detrimental to their desire to seek out treatment even if it were available. Some patients also felt that policies such as the Florida Mental Health Act (known as the Baker Act) and its equivalent in New York State (known as Kendra's Law),20,21 which allow for involuntary institutionalization and examination of an individual with possible mental illness for up to 72 hours, did not adequately address or help mitigate the root causes of substance abuse and mental-health disorders. This increased preventable ED and/or hospital utilization for psychiatric needs.[66]

"Most high utilizers had ≥4 unique chief complaints, suggesting that these patients generally have several, rather than a few, reasons for seeking emergency care. No clearly defined pattern of complaints existed for high utilizers. High utilization in such patients is less likely to be caused by clearly defined disease processes and more by a complex mix of multiple chronic medical conditions and psychosocial factors, making it difficult to predict future utilization or identify specific patient needs based on their chief complaint." Most high utilizer ED visits appeared to occur close together in clusters presenting complaints not categorically diff from low utilizers: more visits for same type of complaints. Most common complaint across utilizer groups: abdominal pain, chest pain, and shortness of breath. " The chart review in this study highlighted the inherent difficulty in determining whether patterns of high utilization for these 3 complaints are related more to medical conditions or social/behavioral factors. Although nearly all of the patients in the chart review had mental illness and/or substance abuse, far fewer visits than expected were clearly linked to these conditions.[15]

CMOs	Relevant data extracts/summary information from included literature
	The Camden Coalition conducts a cluster analysis to ID the various subpops. This involves sorting cases (usually by patient utilization history) into groups, or clusters, so that the degree of assoc is strong between people in the same cluster, and weak between members in diff ones. Some programs stratify the typologies by the diff social needs faced by the patients such as homelessness, joblessness, and language preference—further indicating what interventions would be the most effective.[51] Both the taxonomy developed by the Harvard T.H. Chan School of Public Health and the one developed by The Commonwealth Fund segment high-need individuals based on medical characteristics because this is a feasible starting point for most health care systems. Recognizing that a taxonomy focused on medical characteristics may neglect other factors that are key drivers of need, the taxonomy working group built on these efforts to offer a conceptual starter taxonomy that incorporates functional, social, and behavioral factors into a medically oriented taxonomy, not as independent segments but as factors that influence the care model or care team composition most likely to benefit particular patient segments (Figures S-2 and Table S-1). This starter taxonomy can provide guidance for health system leaders and payers on how to embed social risk factors, behavioral health factors, and functional limitations in a taxonomy for high-need patients. Patients would first be assigned to a clinical segment, with follow-on assessment of behavioral health issues and social services needs to determine the specific type of services that are required. Key behavioral health factors most likely to affect care delivery decisions include substance abuse, serious mental illness, cognitive decline, and chronic toxic stress and key social risk factors include low socioeconomic status, social isolation, community deprivation, and house insecurity.[10] In the early stages of the CMHCB demonstration, CMP leadership learned that many high-cost, complex patients have mental health issues that were not effectively addressed by the current model of health care delivery or its pilot program. As a result, the program allocated greater resources to support mental health, hiring a social worker to assess the mental health needs of CMP participants and support them in accessing psychiatric care as needed or provide treatment if appropriate.[77]
CMO 1.5 The accuracy of predicting (M) future use of high cost care (O) is improved by capturing patients' self-assessments of "subjective" characteristics about themselves (C).	Using the Medicare Health Risk Assessment, we explored two data-driven methods to segment a heterogeneous population of older adults with potentially complex care needs into clinically meaningful subgroups using self-reported information. Input variables for the segmentation analyses were patient-reported variables drawn from the Medicare HRA, a component of the Medicare Annual Wellness Visit designed to identify patient-reported modifiable risk factors and health needs [8]. Required elements include self-assessment of health status, psychosocial risks, depression, behavioral risks, and Activities of Daily Living and Instrumental Activities of Daily Living. Care delivery systems can add additional questions. The Medicare HRA is designed to help clinicians address patient-reported risks for preventable adverse outcomes. Although the HRA is most commonly applied at the point of care, if data are systematically collected, representative, and stored in extractable formats, they can be used to inform program development, population health, and outcomes research. Although content collected through patient-reported outcomes may duplicate content obtainable through more traditional clinical data such as ICD codes, ICD codes alone are unlikely to capture subjective responses to questions about pain, loneliness, and independent activities of daily living (for example). In this project, HRA data revealed meaningful subgroups that might not have been obvious from other electronic clinical data and could inform specific clinical interventions. Important differentiators included function, falls, perceived health status, emotional well-being, pain, and presence or absence of an advance directive. Two large subgroups comprised relatively healthy individuals who could benefit from watchful waiting and routine preventive care plus (for one group) life care planning. Much smaller subgroups could be targeted for more intensive and tailored care management. The size of these subgroups can inform resource allocation within delivery systems.[60]

CMOs	Relevant data extracts/summary information from included literature
	As we enrolled patients into the group we found that, despite a broad range of medical and behavioral health problems, the common feature they shared and what ultimately served to bring them together as a group was their status of being “on the fringe,” as they described themselves. Nearly every patient had experienced a number of barriers and frustrations in accessing medical care that the DIGMA team seems to have successfully addressed.[88] Traditional electronic data such as diagnostic codes and laboratory values may not capture essential information on factors that drive care needs, including function, personal preferences, and social resources, that can only be reported by individuals themselves. Identifying and characterizing complex needs subpopulations requires patient-reported information to help match care delivery to personal needs. Although newer data from electronic health records (EHRs) such as symptom assessments and ICD-10 codes that capture functional status can improve our ability to identify complex needs subpopulations, subjective information can add a level of specificity unlikely to be captured with objective coding.[60] Moreover, recognition that computer-based designations of being at risk for costly care (also decorously called predictive analytics) vary considerably, furnish no specific guidance, and are inaccurate is increasing. Most patients in the small, at-risk subgroup will not use such care, whereas care becomes relatively rationed for most patients not designated as such—including those who may require it.... Nevertheless, health care executives embrace the paradigm of high-risk intensive management despite its flaws....Meanwhile, many of its shortcomings can be remedied by a few standardized, patient-reported measures that forecast a patient's risk for costly care in a similar manner to predictive analytics, specifically the risk for direct services. For example, patients may simply indicate that they are only somewhat or not very confident that they can manage and control most of their health problems; have had moderate or severe pain during the past 4 weeks; have been bothered extremely or quite a bit during the past 4 weeks by emotional problems, such as anxiety, irritability, depression, or sadness; believe that the medications they are receiving may be causing illness; and have been prescribed more than 5 medications. Although some payers and providers may disagree with the specific metrics, none should assert that a patient's standardized self-report is an improper tool for guiding care. They may consider this method too old-fashioned or novel for implementation, but its modesty and low cost are remarkable.[78] Dr. Wasson notes the limitations of relying on risk scores derived from electronic data. We agree that patient-reported indices have many advantages. Electronic indices, such as the Veterans Health Administration's Care Assessment Needs Score (1), also have potential advantages as a screening method in health care systems in which such data can be calculated on a population level. Some high-risk patients identified by the Care Assessment Needs Score did not need or were unlikely to benefit from intensive management, and intensive management teams in our study spent substantial time triaging the heterogeneous populations by reviewing health records, contacting primary care providers, and having telephone or in-person visits. Our results suggest that selecting patients for intervention would ideally combine the use of algorithm-based risk scores with measures focused on such issues as those raised by Dr. Wasson, including whether patients believe that they are activated in managing their health or have difficulty managing their prescriptions.[78] Data were collected through computerized administrative databases and HRA questionnaires to measure outcomes for utilization, health risk scores, and self-efficacy.[80]

Social determinants of health. All stakeholders emphasized the importance of inadequate health literacy, unstable housing conditions, and lack of adequate social support in driving preventable high health care utilization. Low health literacy made it difficult for many HNHC patients to manage complex medical conditions on their own, adversely impacting their ability to follow through with day-to-day self-care regimens. They also felt that for some HNHC patients with unstable housing conditions, being in the ED or an inpatient care setting was desirable, as it was the only avenue, as one HNHC patient put it, to 'get a meal.. .have a television... stay overnight'. Finally, health system leaders as well as most physicians felt that the interplay between lack of social support and poor disease control was often a reason for presenting to the ED.

Physician: 'Health literacy and overall education level is probably the biggest impact on the ability to self-manage these conditions'.

Unstable housing: Physician: 'Eventually, [many] of them become homeless or [have] poor living conditions and those patients.. .arrive because of weather conditions or for other reasons to the ED to seek shelter and respite'.

Limited social support Health system leader: '[Workable solutions] probably have to do with…social support and reduction of isolation and helping them negotiate the complexities'.

Insurance challenges Patient: 'I have Medicaid and some of the doctors don't take [it], and so you say to yourself, well, even if I get an appointment, are they going to take me? So just go to the emergency room and let them handle it from there'.

Financial burden Patient: 'A lot of times [we're] on a fixed income and you need to see a specialist.. .You may have a co-pay with your specialist. It could add up if you go excessively. It's easier to go to the [ED] and get what you need'.[66]

Patient activation refers to an individual's knowledge, skills, and confidence related to self-management. The construct is commonly measured using the Patient Activation Measure, which is a thirteen-item interval-level scale with strong psychometric properties that generates a score between 0 and 100. A Patient Activation Measure level may be assigned based on the score, from level 1 (least activated) to level 4 (most activated). Studies show that Patient Activation Measure results are predictive of most health behaviors, clinical indicators, and hospital and emergency department (ED) use. Research also shows that less activated patients with chronic illness are more likely to experience care coordination problems, compared to more activated patients. Numerous studies also indicate that compared to more activated patients, less activated ones with chronic disease are less likely to effectively manage their conditions (for example, they are less likely to adhere to medication regimens), have healthy diets and get regular exercise, regularly monitor symptoms and clinical measurements, ask questions in the medical encounter, and report satisfactory care experiences.These findings suggest that less activated patients may benefit more from care coordination and care management services than patients who have equal disease burden but are more proactive about managing their health.[94]

In this study we used the four Patient Activation Measure levels. Level 1 indicates that a person does not yet understand the important role that patients play in determining their health, and level 4 indicates that a person is proactive about his or her health and engages in many positive health-related behaviors.Compared with lower-risk patients, high-risk patients were twice as likely to be sixty years or older and were somewhat more likely to be lower income (Exhibit 1). High-risk patients were also almost twice as likely to be depressed and more than twice as likely to be at the lowest Patient Activation Measure level. Furthermore, in 2011 high-risk patients were three times more likely to have had an ED visit and fourteen times more likely to have had a hospitalization. Fairview Health Services, a Pioneer ACO, uses the Patient Activation Measure to allocate its resources more efficiently to support patients. For example, Fairview's care coordinators and health coaches, who manage high-risk patients, use the Patient Activation Measure level to decide how intensely to follow and manage specific patients. Nurses supporting patients during care transitions use a similar approach, in which the Patient Activation Measure score determines the frequency and focus of their posthospital support efforts.[94]

CMOs	Relevant data extracts/summary information from included literature
	As we demonstrated in a previous article, although they are very sick, these patients remain surprisingly functional despite their illness(s) (Roberts et al., 2012). Additional important general observations include the following: these individuals are very resilient, highly resourceful, and are extraordinarily patient with the healthcare system. At enrollment, many are overwhelmed; disengaged; nontrusting; and lacking in a feeling of self worth or deserving of services (making it critical to have psychology expertise integrated into the team structure). Furthermore, this patient group wants to be perceived as agreeable (e.g., may know they will be unable to keep their next appointment for some reason but would not offer that unless asked).[81] "We found in our case series that trust was a key theme in the relationship between patients and their clinicians or the health system. Lack of trust in individual doctors or institutions, as well as unrealistically high expectations of the same, appeared to be an important driver of higher costs Patient trust seemed to be informed by both patient factors (prior experience, socioeconomic status, activation) and clinician factors (quality of care, communication skills). Among the five patients, trust appeared to mediate the interaction between patient activation and cost: higher activation was associated with lower costs when patients or families had trust in their clinicians or when needed care was low acuity or standard; however, higher activation (in particular, the confidence and ability to advocate for care) was associated with higher costs when trust seemed lacking, particularly when the stakes were high (in critical illness) and the course uncertain."…. Observations highlight challenges with trust in the setting of increasing medical complexity, specialization, and team-based care. Important to teach docs communication skills that earn trust, particularly around goals of care, and to better match patients to appropriate docs and care managers to ensure trusting relationships."[29]
CMO 1.6 The accuracy of predicting (M) future use of high cost care (O) is improved by capturing patients' self-assessments of health system-related risk factors and experience (C).	At enrollment, the concept of self-management is not familiar to most of them. Systems, like the Housing Authority, Medicaid, and health systems, often add to their burden. Examples include applications for benefits are frequently difficult to figure out and time consuming to file, applicants often feel disrespected or treated as if they were helpless, and agency staff are often not adequately sensitive to client issues regarding low/no literacy. In addition, for non-English speaking, translation services can be inadequate, cultural competency is a problem, and mailed annual reapplication notices (such as for Medicaid) are difficult to recognize as something official and may be disregarded.[81] Example from CSHP illustrating the program's theory of action "Patient A in Kansas City has multiple chronic conditions and poly-substance abuse, a history of homelessness, frequent ED visits, and no PCP [primary care provider]. At the initial contact with the care team, the patient stated that he would "never want to conform to the rules." The care team's strategy is to first establish firm trust. They accomplished this by identifying opportunities to provide basic help, such as involving family members in explaining the impact on diet of modifying cooking practices, supplying a scale and log to support the modification, organizing and explaining the purpose of medications, arranging for transportation and enabling the patient to do so, scheduling and accompanying patients to medical and social service appointments.[76] Long wait times Patient: 'When I go to the emergency room, they [say], "When you get out of here go see your GI doctor". But, that's not the way it works..Last time I called to get in the next day, they told me he had 17 patients, and couldn't see me. In three months, you don't know what could happen. So, the next thing is [back to] the ED'.[66]

CMOs	Relevant data extracts/summary information from included literature
	Mismatch arises from patients' social circumstances limiting access to services, behavioral issues interfering with care engagement, and lack of health system flexibility to address these barriers. A staff member reflected on the inability for a patient to receive services due to homelessness: "He was homeless when we made the referral and doesn't…fit into [the] standard hospice system.… Health care systems are designed for these neat packages of people that are housed, have family support, have access to other resources, are not actively using substances.…The services aren't really designed for complex folks, so that can be really frustrating and exhausting." (SUMMIT LCSW)[66] A few [stakeholders] even suggested that sometimes it felt easier to take an ambulance to the ED and access different services at the same place and time rather than arrange transport for multiple visits including PCP, specialists, bloodwork, etc.[66] Much of the work on utilisation of healthcare explicitly or implicitly assumes that non-utilisation is a direct reflection of non-offer. However, this type of normative analysis fails to acknowledge that people may choose to refuse offers. There is some evidence of patterns of resistance to offers. Referral implies that a GP has identified particular features of candidacy and is seeking to match those to a service that deals with that form of candidacy, but patients can resist being referred and can resist offers of medication.[113] Economic determinants of health care. Patients identified insurance-related factors and financial burden of upfront costs (such as co-payments) as reasons for frequent ED visits and hospitalizations. For example, several patients on Medicaid reported knowing that many physicians in their community did not accept their insurance. To avoid losing time by contacting multiple primary care offices, they would go to the ED directly. Also, for underinsured and uninsured patients, the ED was the only health care setting where they could receive health care without having to deal with implications of their insurance status or co-pays right away. Many patients also reported the negative impact of financial burden on their medication adherence as a driver of frequently presenting to the ED. They felt that some of these visits can be prevented if medications and essential medical devices were not so expensive.[66] Survey of frequent ED patients while in ED Barriers to care: % agree, could have multiple barriers It is easy for me to make time to get to necessary med appts: 78% I always remember to schedule my annual check-ups, tests, and/or screenings: 65% I feel like I receive better quality health care in the ED than I do in my usual place of care (PCP, clinic): 48% whether certain services would be helpful to the patient, in the event the ED or health system decided to offer the service: After-hours options for minor health issues besides the ED: 63% A nurse to work with you one-on-one to help manage health care needs: 53% Transportation to get to medical appointments on-time: 46% While 42% did not think that a PCP would be helpful, many said that they had one.[27]

CMO 1.6 The enrollment process (M) may require extended periods of outreach and trust building(C) to accurately gauge a potential participants willingness and ability to participate (O).	The purpose of community navigators in the Familiar Faces program is to bridge the gaps between their clients and the healthcare and social systems that are often fragmented and difficult to navigate. Furthermore, integration of community navigators into the healthcare system, specifically the information flow offered by EHRs, ensures that community navigators are able to engage with patients during acute episodes of care, when their needs are greatest. In addition to the expertise that community navigators provide to clients in navigating healthcare and social systems, they may build trust between clients and the healthcare system, as they live in the same communities as their Familiar Faces clients. Mistrust of the healthcare system is often high in minority and low socioeconomic populations and may result in delayed medical treatment and use of fewer preventive services…. Because the community navigator was simultaneously a member of the community and the healthcare system, it is possible that they were able to reach community members particularly mistrustful of the healthcare system and start to build a foundation of trust.(#10476} The outreach to ESRD beneficiaries, however, was entirely new in Phase II since ESRD was not part of the clinical focus in Phase I. KTBH program leadership found that when a nurse had an in-person contact with an ESRD beneficiary, the beneficiary was more than twice as likely to enroll in the program. As a result, KTBH program leadership decided to send a nurse to every dialysis facility with more than two eligible beneficiaries. Prior to the visit, the care manager sent a packet to the facility's administrator, placed a call to the administrator, and tried to make an appointment to conduct an informational breakfast or lunch session with the entire staff to introduce the KTBH program and assuage any concerns about the program. The goal of the informational sessions was to explain to staff that the care managers hoped to accomplish things with the beneficiary that would enable the intervention participants to better manage their condition. They tried to convey to staff that the care managers were not there to make their lives more difficult or to take the place of the existing staff that provided services to beneficiaries. KTBH staff reported receiving the biggest pushback from facility social workers. KTBH staff believed that there was a direct correlation between having the support of social workers and beneficiary participation in that when they received the support of the social workers, prospective participants were more likely to join the KTBH program.[73] That's been the difficult piece, finding people who are appropriate and they want our help at the same time. That's been the trickiest piece. CCM Nurse [84] CCM providers in our study actively looked for positive and negative indicators that patients were willing to engage in care. Providers often found these explicit signs to be inadequate for detecting patients' desire or readiness to engage in care and therefore looked for more subtle signs and tried to make intuitive assessments. [84] The enrollment criteria for the CCM programs included a willingness to engage in care.[84] CCM providers looked for indicators that patients were willing to engage during initial patient encounters and enrollment, and looked for signs of successful engagement in ongoing assessments of patients' communication and actions. When CCM providers first met patients, positive indicators that they were willing to engage included verbally agreeing to take part in the program, returning phone calls to the CCM team or answering the phone when CCM team members call, being receptive to a home visit, and showing up to an initial appointment. CCM providers continued to assess engagement over time by considering how frequently patients missed appointments, how well they adhered to medication and treatment regimes, how much progress they made towards behavioral changes such as reducing substance use or increasing exercise, and how candidly and regularly they communicated with the CCM team. A social worker said that she considers patients likely to engage over time when "we reach out to them by phone and we make an appointment and they show up."[84] We learned that for B2C to reduce the use of acute care, outreach to and enrollment of high utilizers had to happen in real time in the ED.[79]

CMOs	Relevant data extracts/summary information from included literature
	Judgment about whether the patient is amenable to management is based on an interview with the patient by the care team and a review of medical records. The assessment of whether the patient is entered into Care One is based on a judgment that the patient has a chronic medical condition, is at high risk for future hospitalization, and is willing to attend outpatient visits and comply with therapy. Other specific exclusions from the Care One program include a single high-cost medical event (e.g., a trauma), residence outside of the hospital's catchment area, and chronic alcohol or drug abuse.[82]
	Most deep-dive practices indicated that risk-stratification improved the organization and delivery of care. Clinicians and staff continued to report that risk-stratification increased their awareness of high-risk patients' needs and helped them better allocate staffing resources to different patient populations. For example, in a few practices, patients with a single chronic condition (such as patients with diabetes who needed basic monitoring and health education) received care management from a medical assistant. This enabled the care manager to focus on higher-risk patients (such as patients with poorly controlled diabetes and additional chronic conditions). Risk-stratification continued to help practices identify and prioritize high-risk patients and schedule longer appointments for them as needed. In contrast, respondents in one small deep-dive practice questioned the utility of risk-stratification; they perceived that clinicians knew their patients well enough to determine whether they were high-risk and they believed that the time they spent risk-stratifying patients would be better spent delivering direct patient care.[91]
	Text box III.1. Example from CSHP illustrating the program's theory of action "Patient A in Kansas City has multiple chronic conditions and poly-substance abuse, a history of homelessness, frequent ED visits, and no PCP [primary care provider]. At the initial contact with the care team, the patient stated that he would "never want to conform to the rules." The care team's strategy is to first establish firm trust. They accomplished this by identifying opportunities to provide basic help, such as involving family members in explaining the impact on diet of modifying cooking practices, supplying a scale and log to support the modification, organizing and explaining the purpose of medications, arranging for transportation and enabling the patient to do so, scheduling and accompanying patients to medical and social service appointments.[76]

C = context; M= mechanism; O = outcome

Appendix Table B-12. Full list of Context-Mechanism-Outcome (CMO) configurations with supporting data for Program Theory 2: Engaging HNHC patients in interventions to improve their management of their chronic conditions, supporting context-mechanism-outcome relationships

Patients' challenges to self-care prior to and during the intervention

CMOs	Relevant data extracts from included literature
CMO 2.1. Past experiences with the healthcare system including encountering barriers accessing medical care and disrespect from providers [C] cause patients to distrust the system and providers [M] which inhibit patients from accepting and seeking necessary help and medical care [O].	More than half of participants (n = 12) related stories of encounters that had upset them; several explicitly mentioned withdrawing from outpatient providers by choosing not to attend appointments with those providers as a result. Over a third of participants switched providers because of dissatisfaction with those relationships. Others who had not switched chose not to follow a given provider's instructions as a result of these negative interactions. Most of the stories of negative health care encounters focused on feeling disrespect from providers, while others specifically described feeling discriminated against by providers because of race or sex.[95] Several participants in this study expressed that they felt that their care sometimes was compromised by perceived disrespect from health care providers, citing race-, sex- or SES [socioeconomic status]-based discrimination.[95] When answering questions about trusting their health care providers, almost half (n = 9) of participants stated that they distrusted a particular (usually hospital-based) provider. Respondents generally expressed trust in their primary care providers.[95] Nearly every patient had experienced a number of barriers and frustrations in accessing medical care that the DIGMA team seems to have successfully addressed.[88] "Patient A in Kansas City has multiple chronic conditions and poly-substance abuse, a history of homelessness, frequent ED [emergency department] visits, and no PCP [primary care provider]. At the initial contact with the care team, the patient stated that he would "never want to conform to the rules."...His sister reflects, "He used to use the ER [emergency room] for everything...." [76]
CMO 2.2. Previous and current personal life circumstances and characteristics (e.g., mental illnesses, substance abuse, emotional or physical traumas, extreme poverty, and low literacy) [C] results in inhibitions in patients [M] that inhibit them from seeking help and medical care [O].	A predominance of the participants (n= 12) told stories of childhood instability...Significant subthemes included early life traumas, such as death of a parent or other loved one, and abusive relationships with primary caregivers throughout childhood. Some described state agencies as their primary caregivers. Transiency was noted, often in the context of escape from abusive relationships (n = 5), and often resulted in living on the streets or gang and drug involvement, even as children. Only 2 individuals specifically described how events in childhood affected their health during adulthood. Nevertheless, many participants related stories of how this instability may have manifested in health issues, especially with regard to mental health. For example, one woman described: ''I had sexual and physical abuse from my parents since I was a baby, since I was 3 or 4. Mother has been very abusive over the years. Every time we went somewhere she was hitting me, punching me, scratched me, and I'd cover it up.'' This individual described ongoing difficulty obtaining effective treatment for the post-traumatic stress disorder that repeatedly sent her to the ED. She reported being frequently ''suicidal'' and ''in crisis'' as a specific result of childhood abuse, for which she was ''in and out of hospitals too much.'' She reported a shared goal with her therapist of accessing consistent community-based mental health care

CMOs	Relevant data extracts from included literature
	rather than relying solely on the ED. Nearly half of the respondents (n = 8) named their mother or a mother figure as their most important primary caregiver. The other half referred to a variety of other caregivers, such as grandparents, other relatives, or the state, or they declined to answer; these situations were described by some participants as traumatic, and by others as a normal course of events. Of participants who described instability in childhood, half noted familial estrangement in adulthood (n = 6). When asked if there was someone they could depend on now for help, most participants spoke of having only 1 or 2 individuals that they could rely on, if any, suggesting a lack of social support in adulthood for nearly all of these respondents.[95] Patients may have a variety of barriers that prevent them from accessing traditional primary care venues, particularly those settings that do not allow patients to walk in at their convenience or patients who may need intensive services during a personal crisis. Patients with difficult life circumstances also may be more likely to not show for an appointment.[88] Patients in this quality improvement program tend to be younger than those targeted by previously described care transition models and many have unstable health insurance, a history of substance use, and significant mental illness. Nearly all are from socially disadvantaged communities plagued by poor health status, and low literacy is common. Many are struggling with difficult life circumstances such as an alarming number have been emotionally or physically traumatized;...and many have inadequate, or no, family and social support systems. At enrollment, the concept of self-management is not familiar to most of them.[81] There are two key elements to the success of these new efforts to target and improve care for high-cost Medicaid cases. First, it is essential to be able to identify in advance patients who are likely to have high costs in the future. Many high-cost occurrences (such as injury, acute illness, or cancer) might be episodic, and high spending in one year might not mean high spending in subsequent years. Second, and equally critical, is the ability to actually affect the care pathways and outcomes of these patients. Because of the circumstances that define their Medicaid eligibility (extremely low income and medical disability) and other factors that are likely to be associated with their social and personal environment (such as homelessness, substance use, or low educational achievement), these patients will undoubtedly present major challenges.[67]
CMO 2.3. System-level barriers including inadequate systemic support (e.g., Medicaid, translation services, housing) and lack of cultural competency [C] engenders feelings of distrust and marginalization among patients [M] that inhibit their ability to access appropriate healthcare services [O].	…some have no income while others have income that it is insufficient to meet basic survival needs making it challenging to pay even minimal co-pays for prescriptions; many live in unstable housing or in dangerous neighborhoods....Systems, like the Housing Authority, Medicaid, and health systems, often add to their burden. Examples include applications for benefits are frequently difficult to figure out and time consuming to file, applicants often feel disrespected or treated as if they were helpless, and agency staff are often not adequately sensitive to client issues regarding low/no literacy. In addition, for non-English speaking, translation services can be inadequate, cultural competency is a problem, and mailed annual reapplication notices (such as for Medicaid) are difficult to recognize as something official and may be disregarded.[81] Many participants faced a variety of barriers to appropriate care, including lack of stable income, health insurance, legal residency, English language proficiency, knowledge of the health system and chronic disease management, stable housing, social support, and transportation. Many also had issues with cultural barriers, mental illness and substance abuse (despite informal program eligibility criteria that excluded some patients with these conditions), and traumatic experiences that made stabilizing their chronic conditions more difficult.[76] Many patients are unable to afford even a minimal copayment that may be expected at time of a nonemergent outpatient visit and may choose to access the ED where a copayment may not be required.[88]

Relationship building with care providers

CMOs	Relevant data extracts from included literature
CMO 2.4. Care team members initially address patients' basic needs and explain things in lay terms [C] to establish trust with the patient [M] resulting in building a relationship with their patients [O]	Patients generally had positive impressions of their care managers. During semi-structured interviews with a sample of high-risk patients and caregivers from deep-dive practices, patients who reported having regular contact with their care manager or who were open to working with their care manager felt that the care manager was an asset to their team. Patients particularly valued care managers who listened to them and explained things in lay terms, helped to manage medications and chronic conditions, followed up after a hospitalization, and helped to navigate the health care delivery system and community resources.[91] "…The patients that have been on SUMMIT [Streamlined Unified Meaningfully Managed Interdisciplinary Team] for a while who have a really solid relationship with us, that makes a huge difference. They are able to call. They are telling us what their needs are. They can make it to appointments and…coordinate all of those needs a little bit better when they know that we're going to be reliable and [here] is where they can come for help." (SUMMIT Physician).[63] They [the program staff] expected that its program would have the greatest impact by preventing acute health care events among beneficiaries who were initially not having significant health issues; however, case managers found that they spent a lot of time dealing with urgent issues for patients who "spiraled out of control." Although initially some patients were skeptical about the MGH [Massachusetts General Physicians Organization] CMP [Care Management Program], overall, patients quickly formed relationships with case managers, including several who requested daily contact with their case managers to help them with their numerous issues. The care team's strategy is to first establish firm trust. They accomplished this by identifying opportunities to provide basic help, such as involving family members in explaining the impact on diet of modifying cooking practices, supplying a scale and log to support the modification, organizing and explaining the purpose of medications, arranging for transportation and enabling the patient to do so, scheduling and accompanying patients to medical and social service appointments. Within weeks, the patient has started scheduling transportation and keeping his appointments independent of the care team, and now states that he cares about his health. His sister reflects, "He used to use the ER [emergency room] for everything. Now he asks when his appointment is."[76]
CMO 2.5. When care managers support patients with medical and non-medical problems [C], patients are reassured [M1] and gain confidence [M2] in their ability to manage their own care [O].	Participants confirmed that the CM [case management] nurse was their preferred contact with primary care, as explained by a woman aged 72 years: "Since the V1SAGES program arrived…if I have a cold or whatever, I will call the nurse." (P [Participant identifier] 13) This access to the case manager was greatly appreciated and helped the participants feel well supported, as expressed by 1 spouse: "My partner and I, we really appreciated this; because we'd have a closer follow-up, we felt confident. And I worry a lot about my partner's health; therefore I felt reassured to know that there was a team there." (FG [Focus group identifier] 2) Some participants even talked about the advocacy role of the nurse: "The frustrations I had towards the doctor, sometimes I would not express them…but I would express them to the nurse and she would tell the doctor." (P25) Participants confirmed that, as their preferred contact with primary care, their CM nurse could inform, educate, support, and help them navigate in the health care system as well as advocate for them. The CM nurses actively involved them in developing and carrying out their individualized services plan with other health care partners.[96] Care management is a vital piece of the puzzle, pulling together community resources without which recovery would be impossible....Successful case management also includes assisting with teaching some of these patients basic life skills, for example, not to find housing for them, but rather direct them where to go to get housing assistance. These small, positive steps are then shared with the group, which further reinforces a growing sense of confidence.[88]

CMOs	Relevant data extracts from included literature
CMO 2.6. Actively involving patients in decision-making and developing care plans [C] help patients feel respected [M] resulting in greater motivation to carry out their care plans [O] and improve their health behaviors [O].	Participants said that they were actively involved in decision-making and felt that their choices were respected.[96] Participants confirmed that, as their preferred contact with primary care, their CM nurse could inform, educate, support, and help them navigate in the health care system as well as advocate for them. The CM nurses actively involved them in developing and carrying out their individualized services plan with other health care partners.[96]
CMO 2.7. Patients are more motivated [M] to improve their health behaviors [O] when they feel cared for by their providers and other support groups [C].	...participants reported that ‘‘caring’’ providers were particularly important in the trajectories of their illnesses and lives, emphasizing the compassion of the Care Management Team. Providers from the intervention were described as dependable, sensitive, and thoughtful, suggesting that these traits in providers may resonate for individuals whose childhoods lacked caregivers with these qualities.[95] Conversely, participants emphasized the importance of caring, trusting, and longitudinal relationships with providers, both on the Care Management Team and with primary care providers. Comorbid mental illness, especially depression, makes managing chronic illnesses such as diabetes more challenging.34–37 Consistent, positive relationships with primary care providers have been shown to decrease rates of hospitalization and ED use for complex patients who struggle with a combination of multiple chronic illnesses, mental illness, and psychosocial challenges.[95] Frequent, longer visits built relationships with the care team and other patients. The emotional support provided by the group seemed to be a key factor in assisting patients to find solutions to their health and social problems.[88] Half of participants indicated the importance of ‘‘feeling cared for’’ by providers (n = 10). This theme recurred throughout the interviews, especially during descriptions of the Care Management Team. When asked about the best part of the intervention, rather than describing specific services, most participants described the importance of the emotionally supportive interactions they experienced. These participants reported that the experience of feeling cared for was a motivation to improve their own health behaviors (n = 10) (Table 2). Diabetes, depression, and hypertension were the most commonly reported conditions. Despite the natural history of these complex chronic diseases and their tendency to reflect a pattern of deterioration over time, 7 participants reported improvements in their own perceived health status after the intervention. Five of those participants specifically attributed this improvement to the intervention. ‘‘They make you feel like you’re not alone, and they understand you and the things you’re going through. And they actually help explain why you’re going through these things…you don’t feel like just a patient.’’ - 24-year-old African American woman with depression and Type 1 diabetes.[95]
CMO 2.8. When intervention care providers build trusting relationships with patients [C], patients have confidence in their providers' desire to help [M] resulting in patients seeking advice from their intervention care provider before going to the ED/hospital [O]	During the early months of CLM’s [Care Level Management’s] program implementation, nurse care managers focused on building relationships with the patients during telephone contact between PVP visits, so that patients would be comfortable calling the nurses if health problems arose. Patients at highest risk were to receive calls on a weekly basis, whereas those at moderate and low risk were to receive calls on a monthly or bimonthly basis....Over the course of the first year of operations, CLM reported ...that they reorganized their patient care teams to include more nursing support. CLM believed that this arrangement would allow patients to bond with the nurse care manager over time, whereas CLM had observed that the clinical specialists were not able to forge a sufficient bond as evidenced by the fact that some of their participants were going to the hospital rather than calling the clinical specialists when problems arose.[75]

CMOs	Relevant data extracts from included literature
	In addition to connecting clients to health and social resources in their community, the community navigators focus on building trust between the client and navigator and subsequently with other healthcare entities and social systems in the community.[85] The care manager is an experienced, calm, trusted professional patients can call when they are frightened or in crisis between groups visits, which is often the difference between going to the ED to seek immediate care or waiting a day or 2 until the next group visit.[88] These participants articulated an appreciation for continuity in relationships with providers, including members of the Care Management Team. A majority of respondents (n = 14) described their preference for office-based primary care with their usual providers, reserving the ED for emergent medical necessity or after-hours needs. [95]

Individualized care for HNHC patients

CMOs	Relevant data extracts from included literature
CMO 2.9. Designing flexible interventions that could be tailored and individualized to specific HNHC patient's needs and circumstances [C] empowers providers [M] to be responsive to each patient's needs and circumstances.	Care transitions are normally linear and finite (e.g., from Provider A to Provider B), but in our care coordination programs, the number and nature of care transitions are circular, overlapping, and continual. They involve cross-sectoral care givers including social services, government workers, and church and community members—in addition to medical, social work, and behavioral health providers in one or more health systems—and they take place at multiple locations. Because the interventions need to be tailored to each patient individually, based on their medical and life situations, they are not predictable at the outset, and “model fidelity,” as required by most care transition models, is not feasible.[81] Specific interventions were tailored to each patient in collaboration with the patients and their family, reflecting the patient's unique needs.[102] Patient intake at IOC included an in-depth patient assessment to determine non-medical barriers to improved health. Care plans and activity to address needs were individualized.[74, 76] The ability to tailor care to patients’ individual needs was another ingredient staff members felt they provided to complex patients. A SUMMIT care coordinator described a strategy to assist patients with attending specialty appointments: “I’ll have appointments with patients just with myself if patients need help with scheduling outside the clinic and scheduling transportation.… If a patient chronically no-shows to a (specialty) appointment…I’ll make an appointment for them to come [see] me and we’ll schedule together and…give them an appointment planner or write up all their appointments for them.”[63] Each enrollee gets a tailored 60 day care plan and associated patient services they might need including assistance obtaining housing resources, insurance, disability benefits, refugee services, transportation, coordinating primary and specialty care; and filling prescriptions.[79]

CMOs	Relevant data extracts from included literature
CMO 2.10. Having interventions address underlying mental health conditions concurrently or before managing other health conditions [C] helps patients' ability to cope with their health conditions [M] and allows them to benefit from interventions addressing their chronic conditions [O].	Theme 3: Addressing Both Psychosocial and Clinical Needs Participants noted that it wasn't possible to separate provision of psychosocial support from traditional medical care. This can run counter to what occurs in usual care. "I spent an hour with a patient last week and we didn't talk about medical problems.… It was a therapeutic session. I'm not a trained therapist, but [that's] what it was. We didn't talk about diabetes. We didn't talk about her foot ulcers.…A lot of times we end up doing the work of social workers, but when you do primary care, you have to do that. It's not 'oh hold on,… I'm not getting into that. I'm only here for the medical stuff.' It all wraps up into one." (SUMMIT Physician)[63] But the extraordinarily high levels of substance abuse among high-risk patients and the history of mental illness even among the population without serious and persistent mental illness make clear that any intervention will have to take these factors into account.[67] In the early stages of the CMHCB [Care Management for High Cost Beneficiaries] demonstration, CMP [Care Management Program] leadership learned that many high-cost, complex patients have mental health issues that were not effectively addressed by the current model of health care delivery or its pilot program. As a result, the program allocated greater resources to support mental health, hiring a social worker to assess the mental health needs of CMP participants and support them in accessing psychiatric care as needed or provide treatment if appropriate.[77] Many participants faced a variety of barriers to appropriate care, including lack of stable income, health insurance, legal residency, English language proficiency, knowledge of the health system and chronic disease management, stable housing, social support, and transportation. Many also had issues with cultural barriers, mental illness and substance abuse (despite informal program eligibility criteria that excluded some patients with these conditions), and traumatic experiences that made stabilizing their chronic conditions more difficult.[76] ...the program is unique in having a behavioral health provider screen every enrollee for mental health disorders—and then address those conditions as appropriate.[79]
CMO 2.11. Connecting patients and supporting them in navigating services that cross medical sectors (e.g., geriatrics, substance disorder treatment) and non-medical sectors (e.g., employment, housing, transportation) [C] help patients gain the confidence [M] to learn how to navigate multiple systems for themselves [O].	Through the CMP, patients are assigned to a personal care manager who assists with access to social and medical resources, helps patients schedule PCP appointments, and helps bridge barriers between patients and the healthcare system. Enrolled patients are assigned to 1 of 3 outpatient primary care clinics. Components of the CMP include: goal creation/assistance in reaching goals, ranging from applying for benefits and receiving stable housing to losing weight and receiving specialty care appointments; assistance with care navigation (schedule appts, follow-up on referrals, and help refill medications); arranging for social services (make personal connections with staff at various agencies in the community and refer patients to appropriate services, including transportation resources, Legal Aid, homeless shelters, faith-based services, and substance abuse resources); care transitions (meet with patients daily while they are admitted and work with discharge planners to assist patients in receiving recommended follow-up care and understanding discharge instructions); and communication with providers (accompanying them to appointments, creating and prioritizing problems lists, coaching patients about questions to ask, and sitting with patients after their visit to explain follow-up instructions).[98]

CMOs	Relevant data extracts from included literature
	The team (1) conducted home visits, (2) scheduled and accompanied patients to initial primary and specialty care visits to ensure that such appointments are kept and that the patient understands any instructions given during the appointment, (3) coordinated follow-up care and medication management (medication reconciliations), (4) measured blood pressure and blood sugar levels when appropriate, (5) coached patients in disease-specific self care, (6) helped patients apply for social services (e.g. housing support, Social Security (including SSI), Supplemental Nutrition Assistance Program (SNAP), Temporary Aid for Needy Families (TANF), and General Assistance (GA)) and appropriate behavioral health programs. provides disease specific education, coaches the patient in self-care, and works to empower patients to manage their health issues. During subsequent home visits, the team evaluates the patient and team's progress. The care team works to connect the patient with stable, continuing, and appropriate primary and specialty care. Coalition staff may help schedule further medical appointments as necessary, continue to help organize transportation, accompany patients to medical appointments, check-in after medical appointments to help the patient implement the instructions given by the provider, and continue to organize medications. Home visits in later stages increasingly focus on self-care management skills, health care navigation skills, enhancement of self-efficacy and independence, care plan adjustment and coaching.[86] The most frequently used intensive management services were social work and mental health care, highlighting the importance intensive management teams placed on these services on the basis of their comprehensive assessments of patients' needs. The intensity of services varied greatly among patients assigned to the intervention group; patients who used more services tended to be older and to have more comorbid conditions, higher rates of baseline primary care utilization, and lower rates of substance use disorders and serious mental illnesses. These findings suggest that other models of intensive management may be more appropriate for patients whose mental health and substance use conditions are severe and are likely to prevent effective engagement with the intensive management team. By design, the intensive management programs seem to have facilitated referrals to home-based primary, palliative or hospice, geriatrics telephone, specialty mental health, and telehealth care. Because sites performed comprehensive assessment of patients' social issues, treatment plans, and care goals, our results suggest that the intensive management programs could identify unmet needs and connect patients to important resources. Home visits seemed to play a key role in patient assessments, because patients with more intensive services had an average of 1.5 home visits.[78] • Some patients with experience in residential or other intensive management programs need support when trying to complete programs, and need housing/support once programs end • Patients desire support when trying to return to school, find employment, or find housing: "I wish someone would help me navigate the system. I don't know what resources or programs are available to me."[97] Successful case management also includes assisting with teaching some of these patients basic life skills, for example, not to find housing for them, but rather direct them where to go to get housing assistance.[88]

CMOs	Relevant data extracts from included literature
CMO 2.12. Because patients' burden of coexisting chronic diseases and social and behavioral issues are heterogeneous, allowing the length of the intervention to vary across participants [C] helps patients feel supported [M] by providing them with sufficient time to demonstrate intervention goals (e.g., self-management behaviors) [O].	Patients are continually enrolled at different times, resulting in different lengths in the post-enrollment time frame. Patient diagnoses that are driving admissions, and their burden of coexisting chronic diseases, are heterogeneous. The natural history of these common chronic diseases is such that the patients have ever evolving health conditions intermixed with periods of disease decompensation. Length of time in the intensive intervention period is variable and determined by demonstrated need and functionality: socially, medically, and behaviorally. Our intervention is not administered by number of days exposed but instead is administered until the patient demonstrates the behavior criteria we have defined ("graduates"), the patient expires, or transitions. Because the patients are graduated according to demonstration of objective self-management behaviors (Figure 2), the resultant postgraduation time frames are also variable.[81] Participants' issues often took longer to resolve than the intervention's time line typically allowed.[76]

Barriers to HNHC patient change through interventions

CMOs	Relevant data extracts from included literature
CMO 2.13. Despite successful engagement with the HNHC intervention and relationships between members of the care team and HNHC patients [C], HNHC patients may prefer seeking primary care at the hospital or ED [M]. Therefore, HNHC interventions may not be able to achieve intervention goals such as reducing use of potentially preventable or modifiable healthcare services [O].	One challenge for the demonstration was that a sizable minority of beneficiaries and caregivers would prefer to visit the ED [emergency department]—instead of contacting the IAH [Independence at Home] practice—if they were unsure whether symptoms required emergency care (Table III.3). Beneficiaries provided a number of reasons for preferring to go to the ED, including that they or their caregivers thought it was the best place to receive care. Even though three-quarters of beneficiaries reported that the IAH practice visited about as often as the patient wanted them to visit (Appendix C, Table C.8), some beneficiaries' preference for the ED in uncertain situations might contribute to the demonstration's lack of an effect on outpatient ED visits.[93] Engagement with the program was high (95% of patients had at least three encounters with program staff), and patients received an intensive intervention (averaging 7.6 home visits), but two program goals related to the timing of services — a home visit within 5 days after hospital discharge and a visit to a provider's office within 7 days after discharge — were achieved less than 30% of the time. Challenges in reaching these goals included patients' lack of stable housing or a telephone and their behavioral health complexities and providers' few available appointments. The difficulties that this pioneering, data-driven organization had in achieving rapid assistance for patients may portend difficulties in achieving it at scale.[86] Patients randomized to PIM were more likely than patients in PACT to strongly agree that they have a VA healthcare provider whom they trust...Survey findings suggest that the program may have influenced some patients' experiences with patient-centered care and chronic illness care, and increased the number of patients who reported having a trusted provider, but did not influence satisfaction, perceived access, or most measures of care coordination.[87] Though the SUMMIT intervention was developed as a way to address high ED and hospital utilization, staff members did not mention reduced utilization as a marker of success. "We are dealing with a pretty sick population.…These are patients that maybe do need to be in the hospital.… A hospitalization is not necessarily a bad outcome for a lot of these patients." (SUMMIT Physician)[63]

CMOs	Relevant data extracts from included literature
CMO 2.14. Improvements in patients' experiences with their care providers through HNHC interventions [C] gradually rebuilds patients' trust in the health care system [M] that may lead to long-term benefits in health behaviors and clinical outcomes [O]	Furthermore, relationships are at the core of primary care, so this finding suggests that augmenting a medical home with an intensive management program may help fulfill the promise or primary care. In fact, analyses of satisfaction suggest that the program improved patients' experiences with primary care, but not with other services. Improving primary care processes could potentially have positive long term consequences, including changes in health behaviors and clinical outcomes.[87]

Appendix Table B-13. Full list of Context-Mechanism-Outcome (CMO) configurations with supporting data for Program Theory 3: Care provider engagement in interventions for HNHC patients

Gaining and maintaining support from physicians and other care providers

CMOs	Relevant data extracts from included literature
CMO 3.1. Strong leadership support that facilitates systemic coordination of the intervention and its components smooth the entry of care managers into practices [C] provides credibility of their services to existing practice staff [M], so care managers are more easily incorporated into primary care teams [O].	Once MGH [Massachusetts General Physicians Organization] had generated lists of CMP [Care Management Program]-eligible beneficiaries receiving care from each physician, the CMP medical director met with each practice to introduce the program and discuss which patients were at highest risk for acute events and should receive priority for enrollment. The medical director also met with specialty practices such as the oncology, cardiology, emergency, and orthopedics departments to explain the resources available through the program, because case managers would likely interact with these providers as they facilitated patient access to these services.[77] At the time of the program launch, strong integration support from MGH leadership afforded the case managers physical entry into the primary care practice settings whereby the case managers were co-located with the primary care physicians ultimately becoming a part of the beneficiaries' primary health care teams.[77]
CMO 3.2. Program leaders' use of tailored strategies and physician champions to explain intervention services [C] helps endorse the intervention [M] and results in physicians participating in the intervention [O].	A second round of focus groups was conducted with physician groups to specifically discuss how the CMP could add value to their practices. In addition to providing input about the design of the CMP, the capstone groups provided an opportunity to obtain physician buy-in to the PBCM [practice-based care management] program. Despite the fact that some physician practices already had case managers, CMP management observed that most physician practices were apprehensive about changes such as the introduction of new staff into their practice. CMP leadership used a tailored approach to discuss the project with each practice, offering positive anecdotes from the PBCM pilot project as appropriate. In addition, CMP leadership identified a physician champion for the CMP within each physician practice that had at least 25 or more CMP patients at the start if the project to further ease the transitions involved in the introduction of a case manager into the practice. During program implementation physician champions provided insight about the best way to incorporate case managers into the practice and encourage colleagues to take advantage of services available from the case managers.[77] Dr. Fishbane underscored the importance of establishing effective partnerships with the partner nephrologists during [Village Health's] Phase II and was optimistic about the efforts to secure physician champions, garner enthusiasm and support, and improve physician engagement at the first Medical Advisory Board meeting.[73]

CMOs	Relevant data extracts from included literature
CMO 3.3. Face-to-face outreach to physicians and their staff by program leaders and/or nurse care managers [C] effectively garners support of the intervention from existing care providers [O] by helping existing care providers understand the value of the intervention [M].	Case managers assigned to each practice met with physicians at the practices to describe the program, the skills that they bring to the physician practice, and their interest in collaborating to support patients in their efforts to manage their medical conditions. Case managers collected information from providers about how they could add value to the medical practice.[77] Acquiring buy-in from participating physician practices was viewed as very important. However, it was recognized early on that buy-in was needed on all levels. There was some concern among practice-based nurses, particularly at smaller practices, that there would be a duplication of effort. To obtain buy-in from the nurses, the CMP case managers spent time working with the practice-based nurses to educate them that the goal of the program was to augment and not to replicate their efforts.[77] In addition to distributing marketing materials and conducting group presentations, a TST [Texas Senior Trails] nurse with utilization management and provider relations experience visited the offices of the 250 doctors in the Lubbock and Amarillo areas with the highest numbers of CMHCB [Care Management for High Cost Beneficiaries] demonstration-eligible patients. This nurse was largely successful in gaining physician support for the program, often as a result of spending time with physician office staff and administrators who conveyed information about the program to the physicians…Similarly, the TST medical director in Amarillo had so much difficulty obtaining physician support via phone calls to these individuals that he ceased conducting these outreach calls. At the time of our site visit, the TST medical director and managing director were continuing to look for ways to market the program to providers who were not supportive initially. In particular, they were developing messages that conveyed the fact that the program can serve as a resource for physicians, by providing support for patients who are hard to manage because of mental health and/or social issues.[70]
CMO 3.4. Using a multi-pronged approach to provide physicians with information about intervention services [C] made it more likely to reach doctors to get their support and engagement [M] in the intervention necessary for the program to succeed [O]	The program only works well when physicians are highly engaged.[77] MGH enlisted physician support to help ensure the success of its CMP in providing high-quality care to patients. Physicians were asked to conduct the following activities: encourage beneficiaries to participate in the program and enroll them in the program when possible; collaborate with case managers to review initial assessment findings and develop care plans for each patient; inform case managers about patient events and refinements to patient care plans during the demonstration period; and discuss advance directives with enrolled patients...MGH physicians received information about the CMP from a variety of sources, including the program's medical director, the MGH electronic newsletter, and case managers assigned to each practice.[77]
CMO 3.5. When an intervention includes an insufficient number of patients the physicians [C], physicians do not fully engage and participate in the program [O] because they feel the intervention is not a good investment in time and resources [M].	The staff also suggested implementing a physician referral model to gain physician buy-in and to identify sufficient numbers of patients to make a financially viable care management program. A physician referral model could increase enrollment by more than 10 times, according to one physician's estimate, with which others agreed. Interviewed physicians and care managers felt that a physician referral model would increase the appropriateness of patients referred for care management services. It was recommended that patient-specific clinical or educational goals accompany an open physician referral model in order to ensure that participants have clearly identified goals against which to measure their progress.[71]

CMOs	Relevant data extracts from included literature
	Although most physicians were supportive of the outreach efforts, they generally only had one or two patients participating in the program. The program had greatest success with offices that had approximately 30 patients participating in the program...To the extent that patients were concentrated with providers, program staff felt that the physicians were better allies and facilitated the clinical interventions. "A couple things we've gotten a little bit smarter about—one is the alignment to the provider. . . One of the things I would definitely do differently is for ESRD [end-stage renal disease] patients, I would do DaVita only and see what kind of change we could drive there. Then if we had a great solution, we could think about how we could scale it. That was probably 70% of the operational hassle that didn't actually do anything for patients but took a lot of time and energy. The same is true on the CKD [chronic kidney disease] side with the nephrologists."[73] Although the nephrologists were very engaged initially, the program had less of a renal focus than anticipated given that the beneficiary population did not have the extent of CKD that was originally projected. As a result, the program did not maintain as high visibility among physicians during Phase I as the KTBH [Village Health's Key to Better Health] program leadership would have liked.[73] During the first site visit, physicians at both sites reported that they were initially very enthusiastic about the Health Buddy® program, because it offered a promising way to effectively support patients with chronic disease. The Health Buddy® technology coupled with telephonic care management support was viewed as an effective way to maintain and improve patient health and identify symptoms of complications early, so that timely medical intervention could be used to prevent serious problems requiring hospitalization. Once the physicians received the list of patients who were eligible for the Health Buddy® program, they reported that they became frustrated with the project because they felt that many of the patients selected would not benefit from participating. Further, physicians reported disappointment that many of the patients they believed could be helped by the program were not eligible to participate in the program because they had not been identified through the claims based algorithm developed by HHN [Health Hero Network]…Using information gleaned from its early experience with the program, the HBC [Health Buddy Consortium] made a series of changes and enhancements to its operations and as reported to us at our second site visit.[71]
CMO 3.6. Implementing a financially supportive system or model for physicians and their practice throughout the intervention [C] encourages and motivates physicians and other care providers [M] to continue supporting intervention activities [O].	The Care One program provides incentives to primary care providers by valuing a Care One patient as equal to 5 normal primary care patients when adjusting panel size.[82] MGH provided physicians with a $150 financial incentive per patient in Year 1 and $50 in Years 2 and 3 to help cover the cost of physician time for these activities.[77] Thus, for such team care to be sustainable, time needs to be carved out for the work involved and systems need to support the follow through.[92] The staff also suggested implementing a physician referral model to gain physician buy-in and to identify sufficient numbers of patients to make a financially viable care management program. A physician referral model could increase enrollment by more than 10 times, according to one physician's estimate, with which others agreed.[71]

Staffing arrangements in care management interventions

CMOs	Relevant data extracts from included literature
CMO 3.7. Reducing providers' workload and responsibilities associated with the implementation of complex intervention activities [C] will reduce provider stress [M] so providers are more satisfied [O1] and more willing and able to participate/engage in intervention activities [O2] such as attending care team meetings, and carrying out care plans.	At baseline, members were divided in the anticipated effect of team care on their workload and stress levels. At 3 months, one member noted a decrease in workload, and three perceived an increase. Two indicated that the intervention "increased my stress by adding to my many responsibilities." Getting to Care Team meetings on time was difficult for about half of the team members.[92] Some team members felt their work increased by participating in the team.[92] Early on, we determined that certain tasks the HC RNs [Health Coach Registered Nurses] and LCSWs [Licensed Clinical Social Workers] were performing could be offloaded as these did not require their level of licensure, training, and skill. By doing so, we could free up the HC RNs and LCSWs to serve more patients and increase their job satisfaction.[81] Respondents from both independent and system-owned practices described turnover that occurred because care managers felt overwhelmed with numerous responsibilities.[91]
CMO 3.8. Case managers, social workers, and high functioning administrative assistants in turn take on many time-consuming tasks (e.g., medication management, identifying community services) to help manage HNHC patients and their paperwork [C] so that providers can focus their efforts [M] on providing continuous, comprehensive care to patients [O].	Early on, we determined that certain tasks the HC RNs and LCSWs were performing could be offloaded as these did not require their level of licensure, training, and skill...To address this, we worked with the teams to identify tasks that could be done by high functioning Administrative Assistants (AAs) and we now use AAs for tasks such as maintaining telephone contact with patients to remind them of appointments, check up on them when they have not been heard from, and assist the team members in entering and retrieving data related to the patients they serve. This is effective as long as there are intermittent face to face opportunities for the patients with the HC RNs, LCSWs, and CCLs [Client-Community Liaison].[81] "…Case managers take care of things like preauthorization, gathering documentation, medication tracking and other time-consuming issues, allowing PCPs [primary care providers] to focus on the relationship with patients and provide real continuity of care.;…The program does what every PCP needs to be doing but cannot do anymore because of the medicine practice and reimbursement realities and primary care provider shortages.;…Both patients and physicians love the program as case managers take a lot of burden off both sides.;…Key value of the program is in the help they provide PCPs with medication review and management, the most difficult to resolve issue when PCPs do not have any help;…" [Summary from a focus group of multiple physicians][77] The care manager served primarily as an adjunct to the patients' primary physicians.[71] As in 2015, deep-dive practice respondents described approaches to improving support for care managers, to clarify their roles and enhance staffing resources to help them feel less overwhelmed...A few practices were monitoring care managers' caseloads to determine whether they needed more staff to support high-risk patients, or to reduce (or even eliminate) activities focused on lower-risk patients. These practices brought in social workers to help meet patients' social needs and medical assistants to assume logistical or administrative tasks.[91]
CMO 3.9. Providing training for staff members [C] gives them the confidence and skills [M] to function effectively as a care team [O1] and to understand and work with difficult patients [O2].	"…The program has done a remarkable job in training and cultivating case managers who are very good at breaking barriers and making it work for the most difficult patients;…" [Summary from a focus group of multiple physicians][77] ...our team members received minimal training in ways to decrease frequent attendance and did not follow a systematic approach in assessing the patient...A more systematic approach, however, would have improved the function of our team.[92]

CMOs	Relevant data extracts from included literature
CMO 3.10. When care managers have regular opportunities to talk across offices and health care systems [C], they are more emotionally and technically prepared [M] to work with the HNHC population [O].	As in 2015, deep-dive practice respondents described approaches to improving support for care managers, to clarify their roles and enhance staffing resources to help them feel less overwhelmed. In some practices affiliated with health systems, respondents described providing opportunities for care managers embedded in practices across the health system to meet regularly, share best practices, and offer one another support.[91] CMP leadership also emphasized team support and peer counseling by developing infrastructure that provided opportunities for mutual support among CMP case managers and peer counseling from the members of the mental health team as the emotional toll on staff of working with a highly frail and sick population are substantial.[77]
CMO 3.11. Having small care teams [C] helps teams members develop awareness of each HNHC patient's entire complex care [M] which can improve the coordination of patient care [O].	In addition, the ability for a team to be small and nimble was seen as a strength as it allowed for increased cohesion. “One of the issues with complex care is [it’s] spread out amongst a bunch of different people.… There’s a learning curve each time the patient meets with a different provider.… With SUMMIT [Streamlined Unified Meaningfully Managed Interdisciplinary Team], it’s a small team.… Everybody knows what’s going on with the patients in terms of their conditions and it really cuts through the confusion.” (Usual Care LCSW)[63]

Communication across the care team

CMOs	Relevant data extracts from included literature
CMO 3.12. Leadership-supported, regular communication across all staff [C] builds collaborative feelings among teams [M] that results in job satisfaction for care team members [O], and facilitates implementation success [O].	Team communication was important for program implementation, although sites had different levels of success in this area over time. Care teams with a solid supervisory structure and frequent collaboration across all levels of staff experienced greater implementation success and staff satisfaction.[76] Due to the complexity of the CMP demonstration population, CMP leadership felt that constant and good communication between all staff within the program was essential.[77]
CMO 3.13. Having transparent and supportive communication among care team members [C] fosters shared values and commitment [M] that results in stronger, more cohesive care team [O].	Team members caring for HNHC [high need, high cost] patients noted the importance of shared values and commitment, citing mutual respect for other disciplines and appreciation of the need for teamwork. “We respect one another’s clinical view.... We come at this from different backgrounds and feel like we get more out of our patient care experience if we hear what everyone else has to say.… We have a very supportive and inclusive team environment” (SUMMIT Physician) The importance of the team comes through particularly when patients aren’t faring as well as hoped: “They [other team members] really listen and they really care and we all really feel it when someone does fail…or something bad happens. It’s a very empathetic group of people....” (SUMMIT Nurse)[63] Our finding that staff members value a sense of unity and esprit de corps speaks to the value of cohesive multidisciplinary teams doing this work. As prior studies have shown, individual members of multidisciplinary teams may have different conceptualizations of which disciplines are part of a care team—often these are only a team in name.[63]

CMOs	Relevant data extracts from included literature
CMO 3.14. Regular, multidisciplinary care team meetings that include physicians and staff [C] gave care team members the openness [M] to discuss patient cases [O1] and the practices' performance on quality metrics, outcomes, and other performance goals [O2].	Our CHAs [Community Health Advocates] provide perspectives in huddles that often enlighten licensed staff and offer a better understanding for the team regarding the unique needs of the patients we serve.[81] VPA [Visiting Physicians Association] corporate medical directors conducted weekly company-wide, web-based meetings with all clinicians, and regional managers conducted individual meetings with IAH practices, to review clinicians' performance on IAH [Independence at Home] quality metrics and outcomes and consider broader implications for all of their patients.[93] Common themes and issues from the Virtual Rounds were also presented at bimonthly management meetings. The bi-monthly management meetings were used to review protocols, present resources, provide training, and identify issues and brainstorm solutions.[77] In addition to tracking metrics, most practices reported conducting care team meetings. Care team meetings provided a forum for clinical teams and staff to review quality metrics and progress toward performance goals, discuss an individual beneficiary's case, and receive information on clinical topics.[93]
CMO 3.15. Having regular care team meetings to discuss HNHC patients [C] may increase provider workloads [M] causing providers' to be arrive late for meetings [O1] and to not carry out care plans [O2].	The primary barriers to conducting regular Care Team meetings were the lack of time to meet and carry out the Care Plan and the difficulty of involving the patient...The team met for 40 min on a weekly basis to discuss one or two of the cases. The physicians were the most likely to arrive late and as noted by the chart review, were at times unable to follow through on the Care Plans.[92]
CMO 3.16. When providers are given practical, constructive feedback about patient care approaches [C], providers are provided with the clinical knowledge or resources they need [M] to improve the care they provide to their patients [O]	"[Care team meetings] give us an opportunity to look back upon our encounter with the patient and really be able to gauge, 'Was there a reason why the hospitalization happened, could it have been prevented, is there something that I missed?' … It can be a little bit unnerving … but it [has] actually … strengthened my practice quite a bit. Because you learn a lot from that feedback."[93] Clinicians valued receiving performance feedback and appreciated the opportunity to discuss cases with other clinicians and share ideas to improve care.[93] The CMP leadership implemented Virtual Rounds, regular e-mail reports that went to all staff, as a mechanism of providing feedback on a weekly basis. Case managers used Virtual Rounds to report on difficult patients and unnecessary admissions, and to describe both positive and negative events. Virtual Rounds were also used for case reviews with forms that staff filled out at the end of the week. These case reviews were then discussed with physicians in weekly face-to-face meetings.[77] Physicians in our study acknowledged their frustration in caring for frequent attenders, but also received specific, practical suggestions for changing their approach to care.[92] Peer consultation provides much needed perspective, more objective assessment and support for the difficulties of the case.[92]

CMOs	Relevant data extracts from included literature
CMO 3.17. Having patients who received care from providers in other healthcare systems or locations [C] creates challenges for care teams [M] to be able to effectively and efficiently communicate with the patient's providers [O].	TST staff reported that most participants had a primary provider that was associated with TTUHSC [Texas Tech University Health Sciences Center]; however, many patients, particularly in Amarillo, received care from additional providers that were not associated with the university. These providers typically operated independent practices, so TST care managers had to establish relationships with a number of different practices.[70] The second proposed improvement had to do with excluding beneficiaries from practices outside the care management organizations, if a systematic means of communicating with clinicians from these practices is not established.[71] Further, not all intervention beneficiaries had primary care physicians in the two study sites, therefore the care managers had to interact with community-based providers with whom they had little or no prior relationship. During our site visits, the care managers cited several challenges working with these physicians, in particular, because of communication barriers.[71]
CMO 3.18. Having co-located care team members [C] helps build strong working relationships [M] that improve team communication in support of coordination of patient care [O].	Our findings speak to the importance of co-located, embedded teams that "hear what everyone else has to say."[63] ...the Health Buddy® nurse care managers often were not in direct proximity to their beneficiaries' primary care physicians, thereby potentially affecting their interactions with the beneficiaries' primary providers, changing medical care plans, or mitigating deterioration in health status...Interviewed physicians felt that care management would be more effective and efficient if care managers were colocated with primary care physicians.[71] Later, they returned patient care coordinators to local practice sites after clinicians and patients expressed dissatisfaction with the centralized system. According to one respondent, locating at the practice enables patient care coordinators to have more inperson contact with clinicians and to build relationships with patients. This change promoted strong working relationships among teams of clinicians, medical assistants, and care coordinators. Those strong working relationships help to address patients' needs and avoid unnecessary readmissions and hospital and ED [emergency department] visits. Another practice changed where the physicians and other staff on the care team sat in the office. This practice clustered the care team together so they could discuss patients' concerns and care delivery more easily.[93]
CMO 3.19. Embedding care/case managers into primary care practices [C] makes it more efficient [M1] and convenient [M2] for physicians to use case managers services [O].	One improvement proposed was featuring a care management structure that pairs care managers and participants' primary care physicians in the same physical location.[71] CPC [Comprehensive Primary Care] practices greatly increased their use of dedicated care managers who were members of the primary care practice team over time. The number of practice survey respondents from CPC practices who reported that "care managers who were members of the practice team systematically provided care management services to high-risk patients" increased from 20 percent in 2012 to 88 percent in 2014 and 2015, and 89 percent in 2016. In comparison, fewer than half of comparison practices reported in 2016 that care managers who were practice care team members systematically provided these services to high-risk patients [91] Most physicians supported the general concept and potential benefits of the program but also expressed frustration with several aspects of the current demonstration design...care managers were not embedded in their physical practice locations.[71] At the time of the program launch, strong integration support from MGH leadership afforded the case managers physical entry into the primary care practice settings whereby the case managers were co-located with the primary care physicians ultimately becoming a part of the beneficiaries' primary health care teams.[77]

Key Question 3: Overall, what is the effectiveness and harms of interventions for HNHC patients in reducing potentially preventable or modifiable healthcare use and costs and improving health outcomes?

Appendix Table B-14. Summary of strength of evidence by outcome and study model type (by primary setting)

Outcomes	Population	System-level	Telephonic	Community-Based	ED-based	Ambulatory Intensive Caring Unit	Primary Care	Home-based
Number of samples in the model type		6	9	7	4	3	8	3
Utilization outcomes								
ED visits, all-cause[a]	HNHC patients	I	I	L-B	M-B	I1	L-B	I
ED visits at 270 days, all-cause	HNHC patients	-	-	I1	-	-	-	-
ED visits at 180 days, all-cause	HNHC patients	-	-	I1	-	-	-	-
ED visits, ACSC	HNHC patients	I1	I	-	-	-	I	I
ED visits, outpatient	HNHC patients	I1	-	-	-	-	-	-
ED visit resulted in inpatient admission	HNHC patients	I1	-	-	-	-	-	-
ED, any (%)	HNHC patients	-	-	-	-	-	I1	-
Psychiatric emergency visits	HNHC patients	-	-	-	I1	-	-	-
Inpatient admissions, all-cause[a]	HNHC patients	I	I	-	I1	I1	M-B	I
Inpatient admissions, any (%)	HNHC patients	-	I	I	-	-	M-B	I
Inpatient admissions at 270 days, all-cause	HNHC patients	-	-	I1	-	-	-	-
Inpatient admissions at 180 days, all-cause	HNHC patients	-	-	I1	-	-	-	-
Inpatient admissions, ACSC	HNHC patients	I1	I	I1	-	-	I	L-B
Inpatient admissions, any ACSC (%)	HNHC patients	-	I	-	-	-	I	M-B
Acute medical/surgery stays	HNHC patients	-	-	-	-	I1	-	-
Other inpatient stays	HNHC patients	-	-	-	-	I1	-	-
Inpatient days	HNHC patients	-	-	I	-	-	I1	-
Medical inpatient admissions	HNHC patients	-	-	-	I1	-	-	-
Medical inpatient days	HNHC patients	-	-	-	I1	-	-	-
Psychiatric inpatient admissions	HNHC patients	-	-	-	I1	-	-	-
Psychiatric inpatient days	HNHC patients	-	-	-	I1	-	-	-
Total hospital encounters	HNHC patients	-	-	I1	-	-	-	-
Hospital encounter resulted in discharge to hospital or observation stay	HNHC patients	-	-	I1	-	-	-	-
Hospital encounter resulted in discharge from ED	HNHC patients	-	-	I1	-	-	-	-
Outpatient visits	HNHC patients	-	-	-	-	-	I	-
Outpatient visits at 6 months	HNHC patients	-	I1	-	-	-	-	-
Outpatient visits at 12 months	HNHC patients	-	I1	-	-	-	-	-
Outpatient visits at 30 months	HNHC patients	-	I1	-	-	-	-	-
Medical outpatient visits	HNHC patients	-	-	-	I1	-	-	-
Primary care visits	HNHC patients	I[b]	-	-	L-B[c]	I1	I	-
Primary care visits at 360 days, all-cause	HNHC patients	-	-	I1	-	-	-	-
Primary care visits at 270 days, all-cause	HNHC patients	-	-	I1	-	-	-	-
Primary care visits at 180 days, all-cause	HNHC patients	-	-	I1	-	-	-	-
Total utilization (%)	HNHC patients	-	I1	-	-	-	-	-
180-day readmission, count	HNHC patients	-	-	I	-	-	-	-
180-day readmission, any (%)	HNHC patients	-	-	I1	-	-	-	-

Outcomes	Population	System-level	Telephonic	Community-Based	ED-based	Ambulatory Intensive Caring Unit	Primary Care	Home-based
180-day readmission, ≥2 (%)	HNHC patients	-	-	I1	-	-	-	-
Specialist visits	HNHC patients	I	-	-	-	I1	-	-
FQHC visits	HNHC patients	I	-	-	-	-	-	-
Filled ≥3 antidepressant prescriptions in first 6 months	HNHC patients	-	-	-	-	-	I1	-
Specialty mental health visit in first 6 months	HNHC patients	-	-	-	-	-	I1	-
Cancelled visits and/or no shows	HNHC patients	-	-	-	-	-	I1	-
Intensive care unit visits	HNHC patients	-	-	-	-	-	I1	-
Dental visits	HNHC patients	-	-	-	-	-	I1	-
Probability of hospice use	HNHC patients	I1	-	-	-	-	-	-
Probability of SNF use	HNHC patients	I1	-	-	-	-	-	-
Probability of home health use	HNHC patients	I1	-	-	-	-	-	-
Home health days	HNHC patients	I1	-	-	-	-	-	-
Home health visits	HNHC patients	I1	-	-	-	-	-	-
Visits in nonacute settings by primary care clinicians	HNHC patients	I1	-	-	-	-	-	-
Visits in nonacute settings by specialists	HNHC patients	I1	-	-	-	-	-	-
Care management visits	HNHC patients	-	-	-	-	I1	-	-
Mental health care visits	HNHC patients	-	-	-	-	I1	-	-
Homeless care visits	HNHC patients	-	-	-	-	I1	-	-
ED visits at 180 days, all-cause	HNHC patients with a mental health diagnosis	-	-	I1	-	-	-	-
Inpatient admissions at 180 days, all-cause	HNHC patients with a mental health diagnosis	-	-	I1	-	-	-	-
Primary care visits at 180 days, all-cause	HNHC patients with a mental health diagnosis	-	-	I1	-	-	-	-
Outpatient visits at 6 months	HNHC patients with arthritis	-	I1	-	-	-	-	-
Outpatient visits at 6 months	HNHC patients with high blood pressure	-	I1	-	-	-	-	-
Outpatient visits at 6 months	HNHC diabetes patients	-	I1	-	-	-	-	-
Outpatient visits at 12 months	HNHC patients with arthritis	-	I1	-	-	-	-	-
Outpatient visits at 12 months	HNHC patients with high blood pressure	-	I1	-	-	-	-	-
Outpatient visits at 12 months	HNHC diabetes patients	-	I1	-	-	-	-	-
Outpatient visits at 30 months	HNHC patients with arthritis	-	I1	-	-	-	-	-

Summary of SOE	Population	System-level	Telephonic	Community-Based	ED-based	Ambulatory Intensive Caring Unit	Primary Care	Home-based
Outpatient visits at 30 months	HNHC patients with high blood pressure	-	I1	-	-	-	-	-
Outpatient visits at 30 months	HNHC diabetes patients	-	I1	-	-	-	-	-
Total utilization (%)	HNHC patients living in a low income area	-	I1	-	-	-	-	-
Total utilization (%)	HNHC patients living in a low education area	-	I1	-	-	-	-	-
Total utilization (%)	HNHC patients with Medicaid	-	I1	-	-	-	-	-
Cost outcomes								
Total costs	HNHC patients	L-ND	L-ND	I	I1	I1	L-B	I
Inpatient costs	HNHC patients	-	-	I1	I[c]	I1	-	-
ED costs	HNHC patients	-	-	-	M-B	I1	-	-
Hospital charges	HNHC patients	-	-	I1	-	-	-	-
Hospital payments received	HNHC patients	-	-	I1	-	-	-	-
Direct ED costs	HNHC patients	-	-	I1	-	-	-	-
Indirect ED costs	HNHC patients	-	-	I1	-	-	-	-
Psychiatric emergency costs	HNHC patients	-	-	-	I1	-	-	-
Psychiatric hospital costs	HNHC patients	-	-	-	I1	-	-	-
All hospital costs (including ED case management)	HNHC patients	-	-	-	I1	-	-	-
All non-ED case management costs	HNHC patients	-	-	-	I1	-	-	-
Acute cost	HNHC patients	I1	-	-	-	-	-	-
Outpatient department cost	HNHC patients	I1	-	-	-	-	-	-
Outpatient costs	HNHC patients	I1	-	-	I[c]	I1	-	-
Prescription costs (PMPM)	HNHC patients	-	-		I1	-	-	-
Primary care physician cost	HNHC patients	I1	-	-	-	-	-	-
Total costs	High-cost, high-risk HNHC patients	-	-	-	-	-	-	I
Total costs	High-cost HNHC patients	-	-	-	-	-	-	I
Total costs	HNHC patients with dementia	I1	-	-	-	-	-	-
Total costs	HNHC patients without dementia	I1	-	-	-	-	-	-
Clinical and functional outcomes		-						
Mortality rate	HNHC patients	I1	I	I1	-	I	I	I
Influenza vaccine	HNHC patients	-	I	-	-	-	M-H	M-B
Progression to ESRD	HNHC patients	-	I	-	-	-	-	-
PHC score (physical health)	HNHC patients	-	I1	-	-	-	I1	I1
MHC score (mental health)	HNHC patients	-	I1	-	-	-	I1	I1
PQH-2 score (depression)	HNHC patients	-	I1	-	-	-	I1	I1
Number of ADLs difficult to do	HNHC patients	-	I1	-	-	-	I1	I1
Number ADLs receiving help	HNHC patients	-	I1	-	-	-	I1	I1

Summary of SOE	Population	System-level	Telephonic	Community-Based	ED-based	Ambulatory Intensive Caring Unit	Primary Care	Home-based
Helping to cope with a chronic condition	HNHC patients	-	I1	-	-	-	I1	I1
Number of helpful discussion topics	HNHC patients	-	I1	-	-	-	I1	I1
Discussing treatment choices	HNHC patients	-	I1	-	-	-	I1	I1
Communicating with providers	HNHC patients	-	I1	-	-	-	I1	I1
Getting answers to questions quickly	HNHC patients	-	I1	-	-	-	I1	I1
Multimorbidity Hassles score	HNHC patients	-	I1	-	-	-	I1	I1
Percent receiving help setting goals	HNHC patients	-	I1	-	-	-	I1	I1
Percent receiving help making a care plan	HNHC patients	-	I1	-	-	-	I1	I1
Self-efficacy: Take all medications	HNHC patients	-	I1	-	-	-	I1	I1
Self-efficacy: Plan meals and snacks	HNHC patients	-	I1	-	-	-	I1	I1
Self-efficacy: Exercise 2 or 3 times weekly	HNHC patients	-	I1	-	-	-	I1	I1
Self-care activities: Prescribed medications taken (mean # of days)	HNHC patients	-	I1	-	-	-	I1	I1
Self-care activities: Followed healthy eating plan (mean # of days)	HNHC patients	-	I1	-	-	-	I1	I1
Self-care activities: 30 minutes of continuous physical activity (mean # of days)	HNHC patients	-	I1	-	-	-	I1	I1
Patient satisfaction	HNHC patients	-	-	-	I1	I1	I1	-
Psychiatric symptoms (total BSI)	HNHC patients	-	-	-	I1	-	-	-
Access to care	HNHC patients	-	-	-	-	I1	-	-
SF-36 Summary Score	HNHC patients	-	-	-	-	-	I1	-
SF-36 Mental Health Function Score	HNHC patients	-	-	-	-	-	I1	-
SF-20 subscale: Social Functioning	HNHC patients		-	-	-	-	I1	-
SF-20 subscale: Mental Health	HNHC patients	-	-	-	-	-	I1	-
SF-20 subscale: General Health	HNHC patients	-	-	-	-	-	I1	-
SF-20 subscale: Physical Functioning	HNHC patients	-	-	-	-	-	I1	-
SF-20 subscale: Role Functioning	HNHC patients	-	-	-	-	-	I1	-
SF-20 subscale: Pain Perception	HNHC patients	-	-	-	-	-	I1	-
Change in Ham-D score	HNHC patients	-	-	-	-	-	I1	-
In remission (Ham-D < 7)	HNHC patients	-	-	-	-	-	I1	-
Patient-centered care coordination	HNHC patients	-	-	-	-	I1	-	-
Relationship with providers: trusted provider	HNHC patients	-	-	-	-	I1	-	-
Relationship with providers: feel respected by provider	HNHC patients	-	-	-	-	I1	-	-
Health care hassles summary score (challenges in getting care)	HNHC patients	-	-	-	-	I1	-	-
Patient assessment of chronic illness care (PACIC) Summary Score (receipt of care for chronic illness)	HNHC patients	-	-	-	-	I1	-	-
Progression to ESRD	HNHC CKD patients	-	I	-	-	-	-	-

Summary of SOE	Population	System-level	Telephonic	Community-Based	ED-based	Ambulatory Intensive Caring Unit	Primary Care	Home-based
Graft or fistula prior to hemodialysis	HNHC CKD patients	-	I	-	-	-	-	-
Graft or fistula prior to hemodialysis	HNHC ESRD patients	-	I	-	-	-	-	-
HbA1c test	HNHC patients, diabetes subgroup	I	I	-	-	-	I	I
LDL-C test	HNHC patients, diabetes subgroup	I	I	-	-	-	I	I
LDL-C test	HNHC IVD patients	-	I	-	-	-	I	I
Eye exam	HNHC patients, diabetes subgroup	I	I	-	-	-	-	-
Nephrology/nephropathy test	HNHC patients, diabetes subgroup	I	I	-	-	-	-	-
Lipid test	HNHC patients, IVD subgroup	I	I	-	-	-	-	-
Oxygen saturation test	HNHC COPD patients	-	-	-	-	-	-	I
Social risk outcomes								
Participation in Supplemental Nutrition Assistance Program (%)	HNHC patients	-	-	I1	-	-	-	-
Receipt of temporary assistance for needy families (%)	HNHC patients	-	-	I1	-	-	-	-
Receipt of general assistance (%)	HNHC patients	-	-	I1	-	-	-	-
Overall wellbeing	HNHC patients	-	-	-	-	-	I1	-
Problem alcohol use (%)	HNHC patients	-	-	-	I1	-	-	-
Homelessness (%)	HNHC patients	-	-	-	I1	-	-	-
No health insurance (%)	HNHC patients	-	-	-	I1	-	-	-
No social security income (%)	HNHC patients	-	-	-	I1	-	-	-
Basic financial needs unmet	HNHC patients	-	-	-	I1	-	-	-

I1: Insufficient, only one sample reporting on the outcome; I: Insufficient, 2+ samples reporting on the outcome within the model type; L-B: Low strength of evidence for benefit for the outcome; LND: Low strength of evidence for no difference for the outcome; -: No eligible evidence; M-B: Moderate strength of evidence for benefit for the outcome; M-H: Moderate strength of evidence for harm for the outcome

[a] Includes visits at 12 months.

[b] Defined as Evaluation and Management PCP visits by Kahn et al.[105]

[c] Shumway et al., 2008[99] specified the outpatient and inpatient costs as medical outpatient costs and medical hospital costs.

ACSC = ambulatory care sensitive conditions; ADL = activities of daily living; BSI = brief symptom inventory; CKD = chronic kidney disease; COPD = chronic obstructive pulmonary disease; ED = emergency department; ESRD = end-stage renal disease; FQHC = Federally Qualified Health Center; HAM-D = Hamilton Depression Rating Scale.; HbA1c = hemoglobin A1c; HNHC = high-need, high-cost; IVD = ischemic vascular disease; LDL-C = low-density lipoprotein cholesterol; MHC = mental health composite; PACIC = patient assessment of chronic illness care; PBPM = per-beneficiary per-month; PCP = primary care provider; PHC = physical health composite; PMPM = per-member per-month; PQH-2 = patient health questionnaire-2; SF = short form; SNF = skilled nursing facility; SOE = strength of evidence.

Appendix Table B-15. Study characteristics for system-level transformation models

First Author, Year, Site(s)	Brief Description (Sample Size)	Study Design (Risk of Bias Assessment)	Patient Selection: High Healthcare Use or Cost; Time Period	Patient Selection: Chronic Conditions	Patient Selection: Other	Additional Selected Patient Characteristics
Kahn et al., 2016[105] 503 FQHCs	Support for FQHCs obtaining PCMH status (HNHC high ED use patient sample N=NR out of 730,353 beneficiaries total) Intervention (N=NR out of 269,364 beneficiaries total) Comparison (N=NR out of 360,989 beneficiaries total)	Observational study (RoB: some concerns)	subgroups based on data from past 1 year and utilization at baseline ED visits: 90th percentile vs. <90th percentile	NA	NA	NA
Kahn et al., 2016[105] 503 FQHCs	Support for FQHCs obtaining PCMH status (HNHC FQHC high visit use patient sample N=NR out of 730,353 beneficiaries total) Intervention (N=NR out of 269,364 beneficiaries total) Comparison (N=NR out of 360,989 beneficiaries total)	Observational study (RoB: some concerns)	Subgroups based on data from past 1 year and utilization at baseline 90th percentile FQHC visits vs. <90th	NA	NA	NA
Kimmy et al., 2019[93] National: 14 practices	(Incentive payment N=42,132) Intervention (N=8,216) Comparison (N=33,916)	Observational study (RoB: some concerns)	Hospitalization and use of acute or subacute rehabilitation services	2+ chronic conditions 2+ ADLs that require human assistance	Medicare FFS beneficiaries; all IAH-eligible patients of the IAH practices, including those who received home-based care before the demonstration began; not in hospice or long-term care for the entire time they were eligible for the intervention in a given year	Number of chronic conditions in Year 4 Total <6: 9.8% 6-9: 43.7% >9: 46.6% HCC: 3.90 Depression: 54.3%

First Author, Year, Site(s)	Brief Description (Sample Size)	Study Design (Risk of Bias Assessment)	Patient Selection: High Healthcare Use or Cost; Time Period	Patient Selection: Chronic Conditions	Patient Selection: Other	Additional Selected Patient Characteristics
Peikes et al., 2018[91] AR, CO, NJ, OR, NY, OH, KY, OK: 502 practices and 40 payers	Primary care model Shared savings: APM (N=1,730,958) Intervention (N=565,674) Comparison (N=1,165,284) Subgroups (N=NR)	Observational study (RoB: some concerns)	2+ hospitalizations in previous 2 years	2+ of 13 eligible chronic conditions including congestive heart failure, COPD, acute myocardial infarction, ischemic heart disease, diabetes, any cancer other than skin cancer, stroke, depression, dementia, atrial fibrillation, osteoporosis, rheumatoid arthritis or osteoarthritis, chronic kidney disease	Received care in a CPC practice	NR
Peikes et al., 2019[106] AR, CO, HI, KC, MI, MT, NJ, NY, OH, KY, OK, OR, PA, RI, TN: 1,373 practices	Primary care model Shared Savings: APM Track 1 multiple chronic condition subgroup (N=269,046) Intervention (N=64,079) Comparison (N=204,967)	Observational study (RoB: some concerns)	1+ hospitalizations in past 1 year	2+ of 12 eligible chronic conditions including congestive heart failure, COPD, history of acute myocardial infarction, ischemic heart disease, diabetes, severe cancer, history of stroke, depression, dementia, atrial fibrillation, rheumatoid arthritis or osteoarthritis, chronic kidney disease	enrolled in Medicare Parts A and B; Medicare FFS as primary payer; do not have ESRD and not enrolled in hospice; are not institutionalized or incarcerated; and are not attributed to a PCP for a nonoverlap CMS service	NR

First Author, Year, Site(s)	Brief Description (Sample Size)	Study Design (Risk of Bias Assessment)	Patient Selection: High Healthcare Use or Cost; Time Period	Patient Selection: Chronic Conditions	Patient Selection: Other	Additional Selected Patient Characteristics
Peikes et al., 2019[106] AR, CO, HI, KC, MI, MT, NJ, NY, OH, KY, OK, OR, PA, RI, TN: 1,515 practices	Primary care model Shared savings: APM Track 2 multiple chronic condition subgroup (254,458) Intervention (N=79,237) Comparison (N=175,221)	Observational study (RoB: some concerns)	1+ hospitalizations in past 1 year	2+ of 12 eligible chronic conditions including congestive heart failure, COPD, history of acute myocardial infarction, ischemic heart disease, diabetes, severe cancer, history of stroke, depression, dementia, atrial fibrillation, rheumatoid arthritis or osteoarthritis, and chronic kidney disease	Enrolled in Medicare Parts A and B; Medicare FFS as primary payer; not ESRD and not in hospice; not institutionalized or incarcerated; and are not attributed to a PCP for a nonoverlap CMS service	NR

APM = advanced alternative payment model; AR = Arkansas; CMS = Centers for Medicare & Medicaid Services; CO = Colorado; CPC = comprehensive primary care; COPD = chronic obstructive pulmonary disease; ED = emergency department; ESRD = end-stage renal disease; FFS = fee-for-service; FQHC = Federally Qualified Health Center; HI = Hawaii; HNHC = high-need, high-cost; KC = Kansas City; KY = Kentucky; MI = Michigan; MT = Montana; N = number; NA = not applicable; NJ = New Jersey; NR = not reported; NY = New York; OH = Ohio; OK = Oklahoma; OR = Oregon; PA = Pennsylvania; PCMH = patient-centered medical home; PCP = primary care provider; RI = Rhode Island; RoB = risk of bias; TN = Tennessee; vs. = versus.

Appendix Table B-16. Intervention characteristics for system-level transformation models

First Author, Year, Site(s)	Intervention: Brief Description	Intervention Duration	Assessment, Education, Skills, Monitoring	Coordination and Continuity of Care	Referral to/Linkages to Community-Based Support Services	Providers	Mode of Delivery Setting(S)	Intensity	Impact on Clinician Workload/ Clinical Practice	Comparison
Kahn et al., 2016[105] 503 FQHCs	Three intervention components to support FQHC transformation into PCMHs: quarterly care management fee payments, technical assistance (TA), and data and performance feedback reports	3 years	Periodically received three types of feedback reports: the biannual NCQA RAS report, the quarterly cost and utilization data reports, and the quarterly claims-based beneficiary-level report summarizing cost, utilization, and health. FQHCs were offered TA to prepare documentation for NCQA PCMH recognition through extensive learning systems involving varying partners.	Intervention goals based on PCMH principles which are designed to encourage doctors, hospitals, and other healthcare providers to work together to better coordinate care for patients.	NR	PCMHs are physician-or nurse practitioner–directed medical practices	NR	NR	NR	Usual care at comparison FQHCs

First Author, Year, Site(s)	Intervention: Brief Description	Intervention Duration	Assessment, Education, Skills, Monitoring	Coordination and Continuity of Care	Referral to/Linkages to Community-Based Support Services	Providers	Mode of Delivery Setting(S)	Intensity	Impact on Clinician Workload/ Clinical Practice	Comparison
Kimmy et al., 2019[93] Effect of incentive payment National: 14 practices	Practices may earn an additional payment if their chronically ill, functionally limited patients' Medicare expenditures are below an estimated spending target and if the practice meets required standards for a set of quality measures	Up to 4 years	Clinicians are available at all hours of the day; carry out individualized care plans; and use electronic health information systems, remote monitoring, and mobile diagnostic technology	Report on other measures, including fall risk assessments and depression screenings, to promote the provision of such care	Some practices added social workers or other staff to coordinate care for their patients with other organizations	Physicians or nurse practitioners. Team may have also included physician assistants, clinical staff, and other health and social services staff	Face to face	Clinicians made 3-15 home visits per day, varied by site	<=1 home visit and no visit from a participating practice in study year	Usual care of Medicare-eligible beneficiaries living in IAH regions

First Author, Year, Site(s)	Intervention: Brief Description	Intervention Duration	Assessment, Education, Skills, Monitoring	Coordination and Continuity of Care	Referral to/Linkages to Community-Based Support Services	Providers	Mode of Delivery Setting(S)	Intensity	Impact on Clinician Workload/ Clinical Practice	Comparison
Peikes et al., 2018[91] AR, CO, NJ, OR, NY, OH, KY, OK: 502 practices and 40 payers	Comprehensive Primary Care (CPC) Initiative	51 months	CPC practices received financial support, data feedback, and learning support	Practices required to address: access and continuity, planned care for chronic conditions and preventive care, risk-stratified care management, patient and caregiver engagement	Practices required to address coordination of care across the medical neighborhood	CPC practices; multiple contractors and organizations provided different intervention elements to CPC practices Patients received intervention services from regular practice staff and from specialized staff (e.g., care coordinators, care managers, social workers)	CMS sent reports on practice and patient-level data; learning support was peer-to-peer, didactic, and one-on-one	Reports and financial support were sent quarterly; frequency of learning support varied	Practices perceived that a big benefit of CPC participation was increased capacity to provide care management services to high-risk patients; practices shared with CMS any net savings in healthcare costs beyond amount required to cover their care management fee payments; Within practices, care managers were increasingly integrated into clinicians' work	Usual care at non-CPC practices

First Author, Year, Site(s)	Intervention: Brief Description	Intervention Duration	Assessment, Education, Skills, Monitoring	Coordination and Continuity of Care	Referral to/Linkages to Community-Based Support Services	Providers	Mode of Delivery Setting(S)	Intensity	Impact on Clinician Workload/ Clinical Practice	Comparison
Peikes et al., 2019[106] AR, CO, HI, KC, MI, MT, NJ, NY, OH, KY, OK, OR, PA, RI, TN: 2,888 practices	Comprehensive Primary Care Plus (CPC+)	1 year	Practice focused intervention; CPC+ practices received financial support, data feedback, health IT support, and learning support; track 2 CPC+ practices received enhanced payments and replacement of some fee-for-service payments with prospective payments	Required to address: access and continuity, care management, comprehensive-ness and coordination, patient and caregiver engagement, and planned care and population health CMS specified care delivery requirements within each of these functions; they were considered a starting point and practices could choose which care delivery requirements or other changes to adopt first, which personnel would be involved and which tactics they would pursue.	Care management, comprehensiveness and coordination are 2 of the 5 key functions of a CPC+ practice	CPC+ practices; CMS partnered with 79 public and private payers across 18 CPC+ regions; various contractors and organizations provided intervention elements to CPC+ practices; Practices hired new staff to support CPC+ activities: care managers, behavioral health specialists, clinical pharmacists, social workers, data analysts, dietitians, diabetes educators, and QI staff	Practices received data reports; learning was delivered in groups and in-person practice coaching	Reports and financial support were sent quarterly; frequency of learning support NR	NR	Usual care at non-CPC+ practices

AR = Arkansas; CMS = Centers for Medicare & Medicaid Services; CO = Colorado; CPC = Comprehensive Primary Care; CPC+ = Comprehensive Primary Care Plus; FQHC = Federally Qualified Health Center; HI = Hawaii; IT = information technology; KC = Kansas City; KY = Kentucky; MI = Michigan; MT = Montana; NCQA = National Committee for Quality Assurance; NJ = New Jersey; NR = not reported; NY = New York; OH = Ohio; OK = Oklahoma; OR = Oregon; PA = Pennsylvania; PCMH = patient-centered medical home; QI = quality improvement; RAS = Readiness Assessment Survey; RI = Rhode Island; TA = technical assistance; TN = Tennessee.

Appendix Table B-17. Healthcare utilization outcomes for system-level transformation model studies

Utilization Measures	Study Design	Direction of Change in Intervention Group (G1)	Direction of Change in Comparison Group (G2)	Difference
Inpatient admissions	Observational	NR	NR	FQHC sample 1: adjusted year 3 difference in visits: -5.32 (SE: 28.60) (p>0.10)[105]
	Observational	NR	NR	FQHC sample 2: adjusted year 3 difference in visits: -47.75 (SE: 17.56) (p>0.10)[a105]
	Observational	NR	NR	IAH incentive payment DiD=-0.07 (SE: 0.05) (p>0.10)[93]
Inpatient admissions, ACSC	Observational	NR	NR	**Greater reduction in G1 than G2: IAH incentive payment DiD=-0.03 (SE: 0.02) (p<0.05)[93]**
ED visits	Observational	NR	NR	FQHC sample 1: adjusted year 3 difference in visits: -80.75 (SE: 87.65) (p>0.10)[105]
	Observational	NR	NR	FQHC sample 2: adjusted year 3 difference in visits: 24.48 (SE: 39.62) (p>0.10)[105]
	Observational	NR	NR	**Greater reduction in G1 than G2: IAH incentive payment DiD=-0.12 (SE: 0.05) (p<0.05)[93]**
ED visits, outpatient	Observational	NR	NR	IAH incentive payment DiD=-0.02 (SE: 0.05) (p>0.10)[93]
ED visits resulted in inpatient admission	Observational	NR	NR	**Greater reduction in G1 than G2: IAH incentive payment DiD=-0.10 (SE: 0.04) (p<0.05)[93]**
ED visits, ACSC	Observational	NR	NR	IAH incentive payment DiD=0.00 (SE: 0.01) (p>0.10)[93]
Primary care visits[b]	Observational	NR	NR	FQHC sample 1: adjusted year 3 difference in visits: -132.58 (SE: 84.18) (p>0.10)[105]
	Observational	NR	NR	FQHC sample 2: adjusted year 3 difference in visits: -148.04 (SE: 80.99) (p>0.10)[105]
Specialist visits	Observational	NR	NR	FQHC sample 1: adjusted year 3 difference in visits: -29.67 (SE: 78.82) (p>0.10)[105]
	Observational	NR	NR	FQHC sample 2: adjusted year 3 difference in visits: -121.52 (SE: 71.95) (p>0.10)[105]
FQHC visits	Observational	NR	NR	FQHC sample 1: adjusted year 3 difference in visits: -15.90 (SE: 54.65) (p>0.10)[105]
	Observational	NR	NR	FQHC sample 2: adjusted year 3 difference in visits: -298.57 (SE: 73.41) (p>0.10)[105]
Probability of hospice use	Observational	NR	NR	IAH incentive payment DiD=-0.83 (SE: 0.68) (p>0.10)[93]
Probability of SNF use	Observational	NR	NR	IAH incentive payment DiD=0.19 (SE: 0.82) (p>0.10)[93]
Probability of home health use	Observational	NR	NR	IAH incentive payment DiD=-0.45 (SE: 0.70) (p>0.10)[93]
Home health days	Observational	NR	NR	IAH incentive payment DiD=-0.58 (SE: 5.67) (p>0.10)[93]
Home health visits	Observational	NR	NR	IAH incentive payment DiD=0.14 (SE: 2.43) (p>0.10)[93]
Visits in nonacute settings by primary care clinicians	Observational	NR	NR	IAH incentive payment DiD=0.59 (SE: 0.57) (p>0.10)[93]

Utilization Measures	Study Design	Direction of Change in Intervention Group (G1)	Direction of Change in Comparison Group (G2)	Difference
Visits in nonacute settings by specialists	Observational	NR	NR	IAH incentive payment DiD=-0.39 (SE: 0.32) (p>0.10)[93]

[a] The reported p-value reflect the authors' adjustment for multiple comparisons.
[b] Defined as Evaluation and Management PCP visits by Kahn et al.[105]

ACSC = ambulatory care sensitive conditions; DiD = difference-in-difference; ED = emergency department; FQHC = Federally Qualified Health Center; G = group; IAH = Independence at HomeNR = not reported; PCP = primary care provider; SE = standard error; SNF = skilled nursing facility.
Note: FQHC sample 1: number of ED visits in the 90th percentile or better; FQHC sample 2: number of FQHC visits in the 90th percentile or better.

Appendix Table B18. Strength of evidence for system-level transformation model vs. usual care outcomes

Population	Outcome	Results	Study Design and Sample Size	Strength of Evidence Domains	Overall Evidence Strength (Direction of Effect)
HNHC patients	Total cost	FQHC sample 1: adj diff $387.23 (p>0.10);[105] FQHC sample 2: adj diff: -$539.46 (p>0.10);[105] CPC: DiD: -$45 (p = 0.23);[91] CPC+ sample 1: DiD: NR (p=NS);[106] CPC+ sample 2: DiD: NR (p=NS)[106] IAH incentive payment DiD=-161 (SE: 142) (p=NS)[93]	6 OBS, N=NR[b]	Moderate study limitations, inconsistent, direct, imprecise	Low for no difference
HNHC patients	Inpatient admissions	FQHC sample 1: adj diff: -5.32 (p>0.10);[105] FQHC sample 2: adj diff: -47.75 (p>0.10);[105] IAH incentive payment DiD=-0.07 (SE: 0.05) (p>0.10)[93]	3 OBS, N=NR[b]	Moderate study limitations, consistent, direct, imprecise	Insufficient
HNHC patients	ED visits	FQHC sample 1: adj diff: -80.75 (p>0.10);[105] FQHC sample 2: adj diff: 24.48 (p>0.10);[105] IAH incentive payment: lower use in G1 than G2: DiD=-0.12 (p<0.05)[93]	3 OBS, N=NR[b]	Moderate study limitations, inconsistent, direct, imprecise	Insufficient
HNHC patients	Primary care visits[a]	FQHC sample 1: adj diff: -132.58 (p>0.10);[105] FQHC sample 2: adj diff: -148.04 (p>0.10)[105]	2 OBS, N=NR[b]	Moderate study limitations, consistent, direct, imprecise	Insufficient
HNHC patients	Specialist visits	FQHC sample 1: adj diff: -29.67 (p>0.10);[105] FQHC sample 2: adj diff: -121.52 (p>0.10)[105]	2 OBS, N=NR[b]	Moderate study limitations, consistent, direct, imprecise	Insufficient
HNHC patients	FQHC visits	FQHC sample 1: adj diff: -15.90 (p>0.10);[105] FQHC sample 2: adj diff: -298.57 (p>0.10)[105]	2 OBS, N=NR[b]	Moderate study limitations, consistent, direct, imprecise	Insufficient
HNHC patients diabetes subgroup	HbA1C test	FQHC sample 1: adj diff: 0.35 (p>0.10);[105] FQHC sample 2; adj diff: -0.13 (p>0.10)[105]	2 OBS, N=NR[b]	Moderate study limitations, inconsistent, direct, imprecise	Insufficient
HNHC patients diabetes subgroup	LDL test	FQHC sample 1: adj diff: -1.17 (p>0.10);[105] FQHC sample 2: adj diff: 0.52 (p>0.10)[105]	2 OBS, N=NR[b]	Moderate study limitations, inconsistent, direct, imprecise	Insufficient
HNHC patients diabetes subgroup	Eye exam	FQHC sample 1: adj diff: 1.09 (p>0.10);[105] FQHC sample 2: adj diff: 1.60 (p>0.10)[105]	2 OBS, N=NR[b]	Moderate study limitations, consistent, direct, imprecise	Insufficient
HNHC patients diabetes subgroup	Nephropathy test	FQHC sample 1: adj diff: 2.88 (p>0.10);[105] FQHC sample 2: adj diff: -0.83 (p>0.10)[105]	2 OBS, N=NR[b]	Moderate study limitations, inconsistent, direct, imprecise	Insufficient

Population	Outcome	Results	Study Design and Sample Size	Strength of Evidence Domains	Overall Evidence Strength (Direction of Effect)
HNHC patients diabetes subgroup	All 4 recommended diabetes tests	FQHC sample 1: adj diff: -0.51 (p>0.10);[105] FQHC sample 2: adj diff: -0.07 (p>0.10)[105]	2 OBS, N=NR[b]	Moderate study limitations, consistent, direct, imprecise	Insufficient
HNHC patients IVD subgroup	Lipid test	FQHC sample 1: adj diff: -0.81 (p>0.10);[105] FQHC sample 2: adj diff: 2.75 (p>0.10)[105]	2 OBS, N=NR[b]	Moderate study limitations, inconsistent, direct, imprecise	Insufficient

[a] Defined as Evaluation and Management PCP visits by the study authors
[b] The Federally Qualified Health Center[105] and Comprehensive Primary Care[91] studies did not report sample sizes for their HNHC populations. The sample size was 42,132 for the Independence at Home study,[93] 269,0246 for Comprehensive Primary Care Plus Sample 1, and 254,458 for Comprehensive Primary Care Plus Sample 2.[106]

Note: FQHC sample 1: number of ED visits in the 90th percentile or better; FQHC sample 2: number of FQHC visits in the 90th percentile or better; CPC+ sample 1: HNHC patients in CPC+ practices making less advanced care delivery changes; CPC+ sample 2: HNHC patients in CPC+ practices making more advanced care delivery changes

adj = adjusted, DiD = difference-in-difference, diff = difference, ED = emergency department, FQHC = Federally Qualified Health Center, HbA1C = hemoglobin A1c, HNHC = high need, high cost, IVD = ischemic vascular disease, LDL = low-density lipoprotein, N = number, NR = not reported, NS = not statistically significant, OBS = observational study, PCP = primary care practice, RCT = randomized controlled trial, vs. = versus.

Appendix Table B-19. Cost outcomes for system-level transformation model studies

Cost Measures	Study Design	Direction of Change in Intervention Group (G1)	Direction of Change in Comparison Group (G2)	Difference
Total cost ($)	Observational	NR	NR	FQHC sample 1: adjusted differences in visits: 387.23 (SE: 494.62) (p>0.10)[105]
	Observational	NR	NR	FQHC sample 2: adjusted differences in visits: -539.46 (SE: 304.11) (p>0.10)[105]
	Observational	NR	NR	IAH incentive payment DiD=-161 (SE: 142) (p=NS)[93]
	Observational	NR	NR	CPC DiD: -45 (p = 0.23)[91]
	Observational	NR	NR	CPC+ Sample 1 DiD: NR (p=NS)[106]
	Observational	NR	NR	CPC+ Sample 2 DiD: NR (p=NS)[106]
Outpatient cost	Observational	NR	NR	FQHC sample 1: adjusted differences in visits: 290.07 (SE: 178.26) (p>0.10)[105]
Acute cost	Observational	NR	NR	FQHC sample 1: adjusted for differences in visits: 292.47 (SE: 315.40) (p>0.10)[105]
OPD cost	Observational	NR	NR	FQHC sample 1: adjusted for differences in visits: 218.92 (SE: 150.97) (p>0.10)[105]
Primary care physician cost	Observational	NR	NR	FQHC sample 1: adjusted differences in visits: 18.99 (SE: 26.65) (p>0.10)[105]

Note: FQHC sample 1: number of ED visits in the 90th percentile or better; FQHC sample 2: number of FQHC visits in the 90th percentile or better; CPC+ sample 1: HNHC patients in CPC+ practices making less advanced care delivery changes; CPC+ sample 2: HNHC patients in CPC+ practices making more advanced care delivery changes

DiD = difference-in-difference; ED = emergency department; FQHC = Federally Qualified Health Center; G = group; NR = not reported; NS = not statistically significant; OPD = outpatient department; SE = standard error.

Appendix Table B-20. Cost outcomes for system-level transformation model studies: Subgroup outcomes

Cost Measures	Study Design	Direction of Change in Intervention Group (G1)	Direction of Change in Comparison Group (G2)	Difference
Total cost (PBPM)	Observational	NR	NR	Beneficiaries with dementia subgroup: IAH incentive payment DiD=-222 (SE: 143)(p=NS)[93]
	Observational	NR	NR	Beneficiaries without dementia subgroup: IAH incentive payment DiD=-347 (SE: 279) (p=NS)[93]

DiD = difference-in-difference; IAH = Independence at Home; NS = not statistically significant; SE = standard error.

Appendix Table B-21. Clinical and functional outcomes for system-level transformation model studies

Clinical and Functional Outcomes	Study Design	Direction of Change in Intervention Group (G1)	Direction of Change in Comparison Group (G2)	Difference Between Intervention Group (G1) and Comparison Group (G2)
Mortality rate	**Observational**	**NR**	**NR**	**IAH incentive payment DiD: -0.2 (SE: 0.5) (p=NS)[93]**

DiD = difference-in-difference; IAH = Independence at Home; NR = not reported; NS = not statistically significant; SE = standard error.

Appendix Table B-22. Clinical and functional outcomes for system-level transformation model studies: Subgroup outcomes

Clinical and Functional Outcomes	Study Design	Direction of Change in Intervention Group (G1)	Direction of Change in Comparison Group (G2)	Difference Between Intervention Group (G1) and Comparison Group (G2)
Mortality rate	Observational	NR	NR	IAH incentive payment DiD: -0.2 (SE: 0.5) (p=NS)[93]
HbA1C test	Observational	NR	NR	FQHC sample 1 diabetes subgroup: adjusted year 3 difference in visits: 0.35 (SE: 1.16) (p>0.10)[105]
	Observational	NR	NR	FQHC sample 2 diabetes subgroup: adjusted year 3 difference in visits: -0.13 (SE: 0.63) (p>0.10)[105]
LDL test	Observational	NR	NR	FQHC sample 1 diabetes subgroup: adjusted year 3 difference in visits: -1.17 (SE: 1.37) (p>0.10)[105]
	Observational	NR	NR	FQHC sample 2 diabetes subgroup: adjusted year 3 difference in visits: 0.52 (SE: 1.05) (p>0.10)[105]
Eye exam	Observational	NR	NR	FQHC sample 1 diabetes subgroup: adjusted year 3 difference in visits: 1.09 (SE: 1.53) (p>0.10)[105]
	Observational	NR	NR	FQHC sample 2 diabetes subgroup: adjusted year 3 difference in visits: 1.60 (SE: 1.27) (p>0.10)[105]
Nephropathy test	Observational	NR	NR	FQHC sample 1 diabetes subgroup: adjusted year 3 difference in visits: 2.88 (SE: 1.60) (p>0.10)[105]
	Observational	NR	NR	FQHC sample 2 diabetes subgroup: adjusted year 3 difference in visits: -0.83 (SE: 1.20) (p>0.10)[105]
All 4 recommended diabetes tests	Observational	NR	NR	FQHC sample 1 diabetes subgroup: adjusted year 3 difference in visits: -0.51 (SE: 0.45) (p>0.10)[105]
	Observational	NR	NR	FQHC sample 2 diabetes subgroup: adjusted year 3 difference in visits: -0.07 (SE: 0.54) (p>0.10)[105]
Lipid test	Observational	NR	NR	FQHC sample 1 IVD subgroup: adjusted year 3 difference in visits: -0.81 (SE: 1.80) (p>0.10)[105]
	Observational	NR	NR	FQHC sample 2 IVD subgroup: adjusted year 3 difference in visits: 2.75 (SE: 1.72) (p>0.10)[105]

Note: FQHC sample 1: number of ED visits in the 90th percentile or better; FQHC sample 2: number of FQHC visits in the 90th percentile or better.

ED = emergency department; FQHC = Federally Qualified Health Center; G = group; HbA1C = hemoglobin A1c; IVD = ischemic vascular disease; LDL = low-density lipoprotein; NR = not reported; SE = standard error.

Appendix Table B-23. Study characteristics for telephonic/mail models

First Author, Year, Site(s)	Sample Size	Study Design (Risk of Bias Assessment)	Patient Selection: High Healthcare Use or Cost; Time Period	Patient Selection: Chronic Conditions	Patient Selection: Other	Additional Selected Patient Characteristics
Mccall et al., 2010[70] 48 counties in Western TX	HNHC only (N=2815) Intervention (N=1,986) Comparison (N=1,969)	RCT (RoB: some concerns)	Medicare costs of $6,000 or more in past 1 year	NA	Medicare FFS beneficiaries; majority of visits to TX Tech U Health Sciences Center or Physician Network Services (a PCP)	NR
McCall et al., 2010[72] Suffolk, Nassau, and Queens, NY: 6 nephrology practices	Original sample (N=6,996) Intervention (N=4,996) Comparison (N=2,000) Diabetes subgroup (N=2165) ESRD subgroup (N=331) IVD subgroup (N=2434)	RCT (RoB: some concerns)	Medicare costs of $5,000 or more in past 1 year	Chronic kidney disease diagnosis on at least one claim; Hierarchical Condition Code > 1.7 (high risk for future healthcare utilization); exclude ESRD patients	Medicare FFS beneficiaries with primary residence in the intervention county/region	NR
McCall et al., 2010[72] Suffolk, Nassau, and Queens, NY: 6 nephrology practices	Refresh sample (N=3,341) Intervention (N=2,385) Comparison (N=956) Diabetes subgroup (N=1280) ESRD subgroup (N=97) IVD subgroup (N=1,508)	RCT (RoB: some concerns)	Medicare costs of $5,000 or more in past 1 year	CKD diagnosis as evidence by at least one claim; Hierarchical Condition Code > 1.7 (high risk for future healthcare utilization); exclude ESRD patients	Medicare FFS beneficiary with primary residence in the intervention county/region; excluded patients institutionalized from March to May 2006 (part of the baseline period)	NR

First Author, Year, Site(s)	Sample Size	Study Design (Risk of Bias Assessment)	Patient Selection: High Healthcare Use or Cost; Time Period	Patient Selection: Chronic Conditions	Patient Selection: Other	Additional Selected Patient Characteristics
Urato et al., 2013[73] Sites in NY counties: Nassau, Suffolk, Queens, Kings, Westchester, Richmond, Rockland, and Bronx	Original sample (N=5,889) Intervention (N=2,945) Comparison (N=2,944) Diabetes subgroup (N=2,284) CKD subgroup (N=3,159) Intervention IVD subgroup (N=2,030)	RCT (RoB: some concerns)	Medicare costs of $5,000 or more for CKD beneficiaries and $12,000 or more for ESRD beneficiaries in past 1 year	Stage 3 CKD diagnosis, as evidence by at least one claim	Medicare FFS beneficiaries with primary residence in the intervention county/region	Mean HCC score: 2.65
Urato et al., 2013[73] Sites in NY counties: Nassau, Suffolk, Queens, Kings, Westchester, Richmond, Rockland, and Bronx	Refresh sample (N=4,467) Intervention (N=2,234) Comparison (N=2,233) Diabetes subgroup (N=2202) CKD subgroup (N=1663) IVD subgroup (N=2,061)	RCT (RoB: some concerns)	Medicare costs of $5,000 or more for CKD beneficiaries and $12,000 or more for ESRD beneficiaries in past 1 year	Stage 3 CKD diagnosis, as evidence by at least one claim	Medicare FFS beneficiaries with primary residence in the intervention county/region	NR
Dally et al., 2002[80] OH	(N=593) Intervention (N=297) Comparison (N=296)	RCT (RoB: some concerns)	11+ outpatient visits in 2 years	1+ visit with a diagnosis of at least 1 of 3 targeted conditions (arthritis, hypertension, diabetes)	Age: 18-64; Kaiser Permanente Ohio patient	
McCall et al., 2011[71] Central OR and Central WA: 2 large multi-specialty group practices	Original HNHC sample (N=125) Intervention (N=66) Comparison (N=59)	RCT (RoB: some concerns)	Medicare costs of $6,000 or more in 1 year	HF, diabetes, or COPD diagnosis on at least 1 claim	Medicare FFS beneficiaries; 2+ visits to the HBC medical practices	NR

First Author, Year, Site(s)	Sample Size	Study Design (Risk of Bias Assessment)	Patient Selection: High Healthcare Use or Cost; Time Period	Patient Selection: Chronic Conditions	Patient Selection: Other	Additional Selected Patient Characteristics
McCall et al., 2011[71] Central OR and Central WA: 2 large multi-specialty group practices	Refresh HNHC sample (N=227) Intervention (N=120) Comparison (N=107)	RCT (RoB: some concerns)	Medicare costs of $6,000 or more in 1 year	HF, diabetes, or COPD diagnosis on inpatient, outpatient hospital, or physician claims only	Medicare FFS beneficiaries; 2+ visits to the HBC medical practices	NR
Schickedanz et al., 2019[104] Southern CA: 1 health system including 13 medical centers	(N=34,225) Intervention (N=7,107) Comparison (N=27,118)	Observational (RoB: some concerns)	Predicted to be in top 1% of healthcare utilization in health system in the next 1 year	NA	Age: 18+; Kaiser Permanente Southern California patient	Nonwhite: 50% Cancer: 46% Diabetes: 13% CAD/CHF: 33% Asthma: 6% Charlson Comorbidity score: 7 (3) Depression: 6% Lives in low-income census tract: 14%; Medicare: 60%; Commercial insurance: 25%

CA = California; CAD = coronary artery disease; CHF = congestive heart failure; CKD = chronic kidney disease; COPD = chronic obstructive pulmonary disease; ED = emergency department; ESRD = end-stage renal disease; FFS = fee-for-service; HF = heart failure; HBC = Health Buddy Consortium; HCC = hierarchical condition category; IVD = ischemic vascular disease; N = number; NA = not applicable; NR = not reported; NY = New York; OH = Ohio; OR = Oregon; PCP = primary care practice; RCT = randomized controlled trial; RoB = risk of bias; TX = Texas; U = University; WA = Washington.

Appendix Table B-24. Intervention characteristics for telephonic/mail models

First Author, Year, Site(s)	Intervention: Brief Description	Intervention Duration	Assessment, Education, Skills, Monitoring	Coordination and Continuity of Care	Referral to/Linkages to Community-Based Support Services	Providers	Mode of Delivery Setting(s)	Intensity	Comparison
Mccall et al., 2010[70] 48 counties in western TX	TX Senior Trails Program: Care Management for High-Cost Beneficiaries Demonstration: TX Tech University Health Sciences Center Shared savings and care management	NR; up to 16 months	Patient education and coaching of chronic conditions and self-management skills	Facilitate communication with providers, care plan compliance, hospital discharge planning, medication adherence, access to clinics; sharing information with physicians	Care team drew on community resources to assist with social issues	Nurse care managers, nurses for telephone support, social workers	Telephone, face-to-face, written: in patient homes, physician offices, or in the hospital, as needed	Mean contacts per beneficiary: 6 (median: 4) 97% of participants had 1+ contacts with a care manager or physician, 50% had 2-4 contacts and 25% had 5-9 contacts. Written contact was most frequent, face-to-face was least frequent (20% had face-to-face contact with the care manager)	Usual care: comparison group was not contacted
McCall et al., 2010[72] Suffolk, Nassau, and Queens, NY: 6 nephrology practices	Care Management for High-Cost Beneficiaries Demonstration: VillageHealth I Shared savings and one-on-one nurse care manager support	Up to 36 months for original sample, up to 24 months for refresh sample	Initial and continuous risk evaluation, telemonitor health failure patients, 24 hour hotline for assistance requests, develop care plan, renal disease education	Coordinated care, referral to nephrologist when reach stage IV CKD, support from pharmacist, medication therapy management,	NR	Care managers (phone and field RNs), pharmacists, dieticians: telephone support and education materials, social workers: telephone psychosocial support (e.g., insurance, transportation), health service assistants provide admin support for patients and providers	Telephone, face-to-face: NR	On average, participants were contacted about every 1.4 months or had 13 contacts over 18 months. Nearly all had a telephone or in-person contact during the last 18 months, mostly by telephone	Usual care: comparison group was not contacted

First Author, Year, Site(s)	Intervention: Brief Description	Intervention Duration	Assessment, Education, Skills, Monitoring	Coordination and Continuity of Care	Referral to/Linkages to Community-Based Support Services	Providers	Mode of Delivery Setting(s)	Intensity	Comparison
Urato et al., 2013[73] Sites in NY counties: Nassau, Suffolk, Queens, Kings, Westchester, Richmond, Rockland, and Bronx	Extended Medicare Care Management for High Cost Beneficiaries (CMHCB) Demonstration: VillageHealth II Shared savings and disease management/ case management through a care management organization	Up to 21 months for original sample; up to 11 months for refresh sample	Provided Individualized assessment, including risk stratification, and tailored care plans; education related to self-management activities to decrease risk for acute exacerbations of chronic diseases	Facilitated patient relationships with physicians, helped patients to comply with physician care plans, hospital discharge planning support, medication management	Referrals or provision for ancillary services (drugs, community services)	Nurse care managers, nurses for telephone support, registered dietician, pharmacist, social worker	Face-to-face or telephone contact with nurse care manager, in-person educational classes: In patient home or over telephone • CKD patients provided telephone support only • ESRD patients provided phone or in person support	At least monthly contact with care manager - >50% of benes did not get a call or in person meeting with a care manager in the last 15 months Telephonic contact was the dominant form of contact (about 70%)	Usual care: comparison group was not contacted

First Author, Year, Site(s)	Intervention: Brief Description	Intervention Duration	Assessment, Education, Skills, Monitoring	Coordination and Continuity of Care	Referral to/Linkages to Community-Based Support Services	Providers	Mode of Delivery Setting(s)	Intensity	Comparison
Dally et al., 2002[80] OH	Mailed health promotion program	90% remained enrolled for 30 months	Health risk appraisal (HRA) questionnaire; personalized letter and report with feedback after each questionnaire with recommendations to reduce the health risks identified by the questionnaire, and condition-specific health education pamphlets and books	NR	NR	A vendor provided all intervention-related materials	All materials were mailed to participants' homes	After initial HRA questionnaire, 3 additional HRA questionnaires and individualized feedback letters/reports were delivered approximately every 3 months.	Controls also received and completed the baseline HRAs, education materials, and an incentive to complete the final questionnaire
McCall et al., 2011[71] Central OR and central WA: 2 large multi-specialty group practices	Care Management for High-Cost Beneficiaries Demonstration: Health Buddy Consortium Shared savings and Health Buddy® disease management (Health Buddy® device allowed for daily, routine communication with program staff)	Up to 38 months for original population, up to 26 months for refresh population	Daily Health Buddy questionnaire to assess health condition, followup from nurse CM as appropriate	13 disease-specific care management programs; triaged and coordinated medical, psychological, or social services	Coordinated social services, as needed	Nurse care managers, physicians	Telephone, over Health Buddy device	Nearly all intervention group members who used the device received at least one call from a care manager during the demo and nearly 60% received >20 contacts during this same period. Over 60% of participants never had a device and scheduled regular telephone calls with a nurse care manager	Usual care: comparison group was not contacted

First Author, Year, Site(s)	Intervention: Brief Description	Intervention Duration	Assessment, Education, Skills, Monitoring	Coordination and Continuity of Care	Referral to/Linkages to Community-Based Support Services	Providers	Mode of Delivery Setting(s)	Intensity	Comparison
Schickedanz et al., 2019[104] Southern CA: 1 health system including 13 medical centers	Health Leads Program: Social needs screening and navigation intervention	NR; up to 14 months (followup time)	Social needs screener, intake assessment	NR	Tailored referral to community-based services (i.e., food banks, housing programs, or other resources to address the identified social need) immediately or during followup calls	Program associates provided screening and navigation	Telephone	Followup calls at minimum every 2 weeks until call were no longer needed or loss to followup	Usual care

benes = beneficiaries; CA = California; CKD = chronic kidney disease; CM = case manager; CMHCB = Care Management for High Cost Beneficiaries; ESRD = end-stage renal disease; HRA = health risk appraisal; KTBH = Key To Better Health; NA = not applicable; NR = not reported; NY = New York; OH = Ohio; OR = Oregon; RN = registered nurse; TST = Texas Senior Trails; TX = Texas; WA = Washington.

Appendix Table B-25. Healthcare utilization outcomes for telephonic/mail model studies

Utilization Measures	Study Design	Direction of Change in Intervention Group (G1)	Direction of Change in Comparison Group (G2)	Difference
Inpatient admissions, all-cause	RCT	⇧	⇧	Original sample DiD: IRR=0.94 (95% CI, 0.82 to 1.07)[72]
	RCT	⇧	⇧	Refresh sample DiD: IRR=0.96 (95% CI, 0.80 to 1.15)[72]
	RCT	⇧	⇧	Original sample DiD: IRR=1.06 (95% CI, 0.95 to 1.19)[73]
	RCT	⇩	⇩	Refresh sample DiD: IRR=0.98 (95% CI, 0.86-1.11)[73]
Inpatient admissions, ACSC	RCT	⇧	⇧	Original sample DiD: IRR=1.05 (95% CI, 0.87 to 1.28)[73]
	RCT	⇧	⇩	Refresh sample DiD: IRR=0.98 (95% CI, 0.80 to 1.20)[73]
	RCT	⇧	⇧	Original sample DiD: IRR=0.83 (95% CI, 0.67 to 1.04)[72]
	RCT	⇧	⇧	Refresh sample DiD: IRR=1.02 (95% CI, 0.77 to 1.36)[72]
Inpatient admissions, any (%)	RCT	⇧	⇧	Original sample DiD: OR=0.98 (95% CI, 0.82 to 1.18)[72]
	RCT	⇩	--	Refresh sample DiD: OR=0.94 (95% CI, 0.74 to 1.18)[72]
Inpatient Admissions, ACSC (%)	RCT	⇧	⇧	Original sample DiD: OR=0.86 (95% CI, 0.69 to 1.08)[72]
	RCT	⇧	⇧	Refresh sample DiD: OR=0.93 (95% CI, 0.70 to 1.25)[72]
ED visits, all-cause	RCT	⇧	⇧	Original sample DiD: IRR=1.04 (95% CI, 0.91 to 1.19)[72]
	RCT	⇧	⇧	Refresh sample DiD: IRR=1.01 (95% CI, 0.82 to 1.24)[72]
	RCT	⇧	⇧	Original sample DiD: IRR=1.03 (95% CI, 0.90 to 1.17)[73]
	RCT	⇧	⇧	Refresh sample DiD: IRR=0.97 (95% CI, 0.85 to 1.10)[73]
ED visits, ACSC	RCT	⇧	⇧	Original sample DiD: IRR=1.09 (95% CI, 0.90 to 1.33)[73]
	RCT	⇩	⇩	Refresh sample DiD: IRR=1.00 (95% CI, 0.81 to 1.23)[73]
	RCT	⇧	⇧	Original sample DiD: IRR=0.87 (95% CI, 0.71 to 1.08)[72]
	RCT	⇧	⇧	Refresh sample DiD: IRR=1.07 (95% CI, 0.79 to 1.45)[72]
Outpatient visits at 6 months	RCT	NR	NR	Total sample: Poisson coefficient =-0.0328 (p=0.27)[80]
Outpatient visits at 12 months	RCT	⇧	⇩	Total sample: Poisson coefficient =-0.0341 (p=0.11)[80]
Outpatient visits at 30 months	RCT	NR	NR	**Total sample: Lower use in G1 than G2: Poisson coefficient =-0.0260 (p=0.04)[80]**

Utilization Measures	Study Design	Direction of Change in Intervention Group (G1)	Direction of Change in Comparison Group (G2)	Difference
Total Utilization (%)	Observational	NR	NR	Total sample DiD:[a] -2.2 (95% CI, -4.5 to 0.1)[104]

[a] Total utilization includes a count of all visits in emergency department, outpatient, and/or inpatient settings. The subgroups were based on the census tract estimates of patients' home address. The low-income subgroup included patients who lived in census tracts where a plurality of residents had income below $34,575. The low-education subgroup included patients who live in census tracts where a plurality of residents have less than a high school education.
ACSC = ambulatory care sensitive conditions; CI = confidence interval; DiD = difference-in-difference; ED = emergency department; G = group; IRR = incidence rate ratio; NR = not reported; OR = odds ratio; RCT = randomized controlled trial.

Appendix Table B-26. Healthcare utilization outcomes for telephonic/mail model studies: Subgroup outcomes

Utilization Measures	Study Design	Direction of Change in Intervention Group (G1)	Direction of Change in Comparison Group (G2)	Difference
Outpatient visits at 6 months	RCT	NR	NR	Arthritis subgroup: Poisson coefficient=-0.0710 (p=0.16)[80]
	RCT	NR	NR	Blood pressure subgroup: Poisson coefficient=0.0838 (p=0.15)[80]
	RCT	NR	NR	Diabetes subgroup: Poisson coefficient=-0.0879 (p=0.07)[80]
Outpatient visits at 12 months	RCT	⬇	⬆	**Arthritis subgroup: Lower use in G1 than G2: Poisson coefficient =-0.1130 (p<0.01)[80]**
	RCT	⬇	⬇	**Blood pressure subgroup: Higher use in G1 than G2: Poisson coefficient=0.0938 (p=0.02)[80]**
	RCT	⇩	⇧	Diabetes subgroup: Poisson coefficient=-0.0651 (p=0.06)[80]
Outpatient visits at 30 months	RCT	NR	NR	**Arthritis subgroup: Lower use in G1 than G2: Poisson coefficient =-0.1004 (p<0.01)[80]**
	RCT	NR	NR	Blood pressure subgroup: Poisson coefficient=0.0317 (p=0.21)[80]
	RCT	NR	NR	Diabetes subgroup: Poisson coefficient=-0.0146 (p=0.50)[80]
Total utilization (%)	Observational	NR	NR	**Low-income area subgroup DiD:[a] Greater reduction in G1: -7.0 (95% CI -11.9 to -1.9)[104]**
	Observational	NR	NR	**Low-education area subgroup DiD:[a] Greater reduction in G1: -11.5 (95% CI, -17.6 to -5.0)[104]**
	Observational	NR	NR	**Medicaid insurance subgroup DiD:[a] Greater reduction in G1: -12.1 (95% CI, -18.1 to -5.6)[104]**

CI = confidence interval; DiD = difference-in differences; G = group; NR = not reported; RCT = randomized controlled trial.

Appendix Table B-27. Strength of evidence for telephonic/mail models vs. usual care outcomes[a]

Population	Outcome	Results	Study Design and Sample Size	Strength of Evidence Domains	Overall Evidence Strength (Direction of Effect)
HNHC patients	Inpatient admissions, all cause	VH I: Original sample DiD: IRR=0.94 (95% CI, 0.82 to 1.07)[72] VH I: Refresh sample DiD: IRR=0.96 (95% CI, 0.80 to 1.15)[72] VH II: Original sample DiD: IRR=1.06 (95% CI, 0.95 to 1.19)[73] VH II: Refresh sample DiD: IRR=0.98 (95% CI, 0.86 to 1.11)[73]	4 RCTs, N=20,693	Moderate study limitations, inconsistent, imprecise, direct	Insufficient
HNHC patients	Inpatient admissions, ACSC	VH II: Original sample DiD: IRR=1.05 (95% CI, 0.87 to 1.28)[73] VH II: Refresh sample DiD: IRR=0.98 (95% CI, 0.80 to 1.20)[73] VH I: Original sample DiD: IRR=0.83 (95% CI, 0.67 to 1.04)[72] VH I: Refresh sample DiD: IRR=1.02 (95% CI, 0.77 to 1.36)[72]	4 RCTs, N=20,693	Moderate study limitations, inconsistent, imprecise, direct	Insufficient
HNHC patients	Inpatient admissions, any (%)	VH I:Original sample DiD: OR=0.98 (95% CI, 0.82 to 1.18)[72] VH I: Refresh sample DiD: OR=0.94 (95% CI, 0.74 to 1.18)[72]	2 RCTs, N=10,337	Moderate study limitations, consistent, imprecise, direct	Insufficient
HNHC patients	Inpatient admissions, ACSC (%)	VH I: Original sample DiD: OR=0.86 (95% CI, 0.69 to 1.08)[72] VH I: Refresh sample DiD: OR=0.93 (95% CI, 0.70 to 1.25)[72]	2 RCTs, N=10,337	Moderate study limitations, consistent, imprecise, direct	Insufficient
HNHC patients	ED visits, all cause	VH I: Original sample DiD: IRR=1.04 (95% CI, 0.91 to 1.19)[72] VH I: Refresh sample DiD: IRR=1.01 (95% CI, 0.82 to 1.24)[72] VH II: Original sample DiD: IRR=1.03 (95% CI, 0.90 to 1.17)[73] VH II: Refresh sample DiD: IRR=0.97 (95% CI, 0.85 to 1.10)[73]	4 RCTs, N=20,693	Moderate study limitations, inconsistent, imprecise, direct	Insufficient
HNHC patients	ED visits, ACSC	VH II: Original sample DiD: IRR=1.09 (95% CI, 0.90 to 1.33)[73] VH II: Refresh sample DiD: IRR=1.00 (95% CI, 0.81 to 1.23)[73] VH I: Original sample DiD: IRR=0.87 (95% CI, 0.71 to 1.08)[72] VH II: Refresh sample DiD: IRR=1.07 (95% CI, 0.79 to 1.45)[72]	4 RCTs, N=20,693	Moderate study limitations, inconsistent, imprecise, direct	Insufficient
HNHC patients	Total cost	TST: DiD=120 (p>0.05)[70] HB: Original sample DiD=-308 (p>0.05)[71] HB: Refresh sample DiD=178 (p>0.05)[71] VH I: Original sample DiD=-111 (p>0.05)[72] VH I: Refresh sample DiD=-142 (p>0.05)[72] VH II: Original sample DiD=206 (p>0.05)[73] VH II: Refresh sample DiD=-99 (p>0.05)[73]	7 RCTs, N=25,000	Moderate study limitations, inconsistent, imprecise, direct	Low for no difference
HNHC patients	Mortality rate	VH I: Original sample diff=0.8 (p=0.51)[72] VH I: Refresh sample diff= -1.1 (p=0.49)[72] VH II: Original sample diff=0.6 (p=0.61)[73] VH II: Refresh sample diff=0.3 (p=0.76)[73]	4 RCTs, N=20,693	Moderate study limitations, inconsistent, imprecise, direct	Insufficient
HNHC patients	Influenza vaccine	VH I: Original sample DiD: OR=1.12 (95% CI, 0.93 to 1.34);[72] VH I: Refresh sample DiD: OR=0.91 (95% CI, 0.72 to 1.15)[72]	2 RCTs, N=10,337	Moderate study limitations, inconsistent, imprecise, direct	Insufficient

Population	Outcome	Results	Study Design and Sample Size	Strength of Evidence Domains	Overall Evidence Strength (Direction of Effect)
HNHC patients	Progression to ESRD	VH I: Original sample diff: -0.75 (95% CI, -1.90 to 0.41)[72] VH I: Refresh sample diff: 0.91 (95% CI, -2.23 to 0.41)[72]	4 RCTs, N=20,693	Moderate study limitations, inconsistent, imprecise, direct	Insufficient
HNHC patients CKD subgroup	Progression to ESRD	VH II: Original sample diff: Greater in G1: 2.92 (95% CI, 0.30 to 5.54)[73] VH II: Refresh sample diff: 0.37 (95% CI, -2.53 to 3.28)[73]	2 RCTs, N=4,822	Moderate study limitations, imprecise, inconsistent, direct	Insufficient
HNHC patients CKD subgroup	Graft or fistula prior to hemodialysis	VH II: Original sample diff: Lower in G1: -3.09 (95% CI, -5.93 to -0.24)[73] VH II: Refresh sample diff: -2.05 (95% CI, -6.39 to 2.30)[73]	2 RCTs, N=4,822	Moderate study limitations, consistent, imprecise, direct	Insufficient
HNHC patients ESRD subgroup	Graft or fistula prior to hemodialysis	VH I: Original sample diff: -6.08 (95% CI, -15.75 to 3.59)[72] VH I: Refresh sample diff: 2.87 (95% CI, -16.72 to 22.46)[72]	2 RCTs, N=428	Moderate study limitations, inconsistent, imprecise, direct	Insufficient
HNHC patients Diabetes subgroup	HbA1c test	VH II: Original sample DiD: OR=1.22 (95% CI, 0.73 to 2.03)[73] VH II: Refresh sample DiD: OR=0.76 (95% CI, 0.47 to 1.23)[73] VH I: Original sample DiD: OR=1.02 (95% CI, 0.68 to 1.54)[72] VH I: Refresh sample DiD: OR=0.95 (95% CI, 0.56 to 1.61)[72]	4 RCTs, N=7,931	Moderate study limitations, inconsistent, imprecise, direct	Insufficient
HNHC patients Diabetes subgroup	LDL test	VH II: Original sample DiD: OR=1.05 (95% CI, 0.70 to 1.58)[73] VH II: Refresh sample DiD: OR=1.15 (95% CI, 0.80 to 1.67)[73] VH I: Original sample DiD: OR=1.19 (95% CI, 0.84 to 1.68)[72] VH I: Refresh sample DiD: OR=0.72 (95% CI, 0.42 to 1.24)[72]	4 RCTs, N=7,931	Moderate study limitations, inconsistent, imprecise, direct	Insufficient
HNHC patients IVD subgroup	LDL test	VH I: Original sample DiD: OR=0.98 (95% CI, 0.72 to 1.35)[72] VH II: Refresh sample DiD: OR=0.88 (95% CI, 0.54 to 1.43)[72]	2 RCTs, N=3,942	Moderate study limitations, consistent, imprecise, direct	Insufficient
HNHC patients Diabetes subgroup	Eye exam	VH II: Original sample DiD: OR=1.05 (95% CI, 0.81 to 1.137)[73] VH II: Refresh sample DiD: OR=1.25 (95% CI, 0.94 to 1.66)[73]	2 RCTs, N=4,486	Moderate study limitations, imprecise, consistent, direct	Insufficient
HNHC patients Diabetes subgroup	Nephrology	VH II: Original sample DiD: OR=0.92 (95% CI, 0.71 to 1.18)[73] VH II: Refresh sample DiD: OR=1.30 (95% CI, 1.01 to 1.67)[73]	2 RCTs, N=4,486	Moderate study limitations, inconsistent, imprecise, direct	Insufficient
HNHC patients IVD subgroup	Lipid panel	VH II: Original sample DiD: OR=1.10 (95% CI, 0.85 to 1.44)[73] VH II: Refresh sample DiD: OR=1.22 (95% CI, 0.17 to 0.92)[73]	2 RCTs, N=4,091	Moderate study limitations, consistent, imprecise, direct	Insufficient

[a] Comparison group participants for Dally et al. received baseline education materials and incentives.[80]

ACSC = ambulatory care sensitive conditions; CI = confidence interval; CKD= chronic kidney disease; DiD = difference-in-difference; diff = difference; ED = emergency department; ESRD = end-stage renal disease; G = group; HB = Health Buddy; HbA1C = hemoglobin A1c; HNHC= high-need, high-cost; IRR = incidence rate ratio; IVD = ischemic vascular disease; LDL = low-density lipoprotein; N = number; NR = not reported; OBS = observational study; OR = odds ratio; PBPM = per-beneficiary per-month; PC = primary care; RCT = randomized controlled trial; TST = Texas Senior Trails vs. = versus; VH = Village Health.

Appendix Table B-28. Costs outcomes for telephonic/mail model studies

Cost measures	Study Design	Direction of change in Intervention group (G1)	Direction of change in comparison group (G2)	Difference
Total cost	RCT	⇩	⇩	DiD=120 (SE:99.6) (p>0.05)[70]
	RCT	⇩	⇩	Original sample DiD=-308 (SE: 311.2) (p>0.05)[71]
	RCT	⇩	⇩	Refresh sample DiD=178 (SE: 257.5) (p>0.05)[71]
	RCT	⇧	⇧	Original sample DiD=-111 (SE: 83.2) (p>0.05)[72]
	RCT	⇧	⇧	Refresh sample DiD=-142.1 (SE: 138.7) (p>0.05)[72]
	RCT	⇧	⇧	Original sample DiD=206 (SE: 152.2) (p>0.05)[73]
	RCT	⇩	⇩	Refresh sample DiD=-99 (SE: 206.6) (p>0.05)[73]

DiD = difference-in-difference; ED = emergency department; G = group; PBPM = per-beneficiary per-month; RCT = randomized controlled trial.

Appendix Table B-29. Clinical and functional outcomes for telephonic/mail model studies

Clinical and Functional Outcomes	Study Design	Difference Between Intervention Group (G1) and Comparison Group (G2)
Mortality rate	RCT	Original sample difference=0.8 (p=0.51)[72]
	RCT	Refresh sample difference=-1.1 (p=0.49)[72]
	RCT	Original sample difference=0.6 (p=0.61)[73]
	RCT	Refresh sample difference=0.3 (p=0.76)[73]
Influenza vaccine	RCT	Original sample DiD: OR=1.12 (95% CI, 0.93 to 1.34)[72]
	RCT	Refresh sample DiD: OR=0.91 (95% CI, 0.72 to 1.15)[72]
Progression to ESRD	RCT	Original sample difference=-0.75 (95% CI, -1.90 to 0.41)[72]
	RCT	Refresh sample difference=-0.91 (95% CI, -2.23 to 0.41)[72]
PHC score (physical health)	RCT	ANCOVA-adjusted IE=-0.1 (p>0.05)[72]
MHC score (mental health)	RCT	ANCOVA-adjusted IE=0.0 (p>0.05)[72]
PHQ-2 (depression, 0 to 6)	RCT	**Lower score in G1 than G2:[a] ANCOVA-adjusted IE=-0.45 (p<0.05)[72]**
Number of ADLs difficult to do (0 to 6)	RCT	ANCOVA-adjusted intervention effect=-0.02 (p>0.05)[72]
Number of ADLs receiving help (0 to 6)	RCT	ANCOVA-adjusted IE=0.21 (p>0.05)[72]
Helping to cope with a chronic condition (1 to 5)	RCT	ANCOVA-adjusted IE=0.10, (p>0.05)[72]
Number of helpful discussion topics (0 to 5)	RCT	ANCOVA-adjusted IE=0.08 (p>0.05)[72]
Discussing treatment choices (1 to 4)	RCT	**Lower score in G1 than G2:[b] ANCOVA-adjusted IE=-0.19 (p<0.05)[72]**
Communicating with providers (0 to 100)	RCT	ANCOVA-adjusted IE=2.7 (p>0.05)[72]
Getting answers to questions quickly (0 to 100)	RCT	ANCOVA-adjusted IE=-0.8 (p>0.05)[72]
Multimorbidity Hassles score (0 to 24)	RCT	ANCOVA-adjusted IE=0.15 (p>0.05)[72]
Percent receiving help setting goals	RCT	ANCOVA-adjusted IE=9.5 (p>0.05)[72]
Percent receiving help making a care plan	RCT	ANCOVA-adjusted IE=4.0 (p>0.05)[72]
Self-efficacy: Take all medications (1 to 5)	RCT	ANCOVA-adjusted IE=0.03 (p>0.05)[72]
Self-efficacy: Plan meals and snacks (1 to 5)	RCT	ANCOVA-adjusted IE=-0.08 (p>0.05)[72]
Self-efficacy: Exercise 2 or 3 times weekly (1 to 5)	RCT	ANCOVA-adjusted IE=0.14 (p>0.05)[72]
Self-care activities: Prescribed medications taken (mean # of days)	RCT	ANCOVA-adjusted IE=-0.15 (p>0.05)[72]
Self-care activities: Followed healthy eating plan (mean # of days)	RCT	ANCOVA-adjusted IE=-0.03 (p>0.05)[72]
Self-care activities: 30 minutes of continuous physical activity (mean # of days)	RCT	ANCOVA-adjusted IE=-0.30 (p>0.05)[72]

[a] Lower scores in the PHQ-2 indicate fewer depressive symptoms.
[b] Lower scores indicate worse experience, satisfaction, or self-management.

ADL = activities of daily living; ANCOVA = analysis of covariance; CI = confidence interval; DiD = difference-in-difference; ESRD = end-stage renal disease; G = group; IE = intervention effect; MHC = mental health composite; OR = odds ratio; PHC = physical health composite; PHQ-2 = patient health questionnaire-2; RCT = randomized controlled trial.

Appendix Table B-30. Clinical and functional outcomes for telephonic/mail model studies: Subgroup outcomes

Clinical and Functional Outcomes	Study Design	Difference Between Intervention Group (G1) and Comparison Group (G2)
Progression to ESRD	RCT	**Chronic kidney disease patients subgroup: Original sample difference: Greater in G1: 2.92 (95% CI, 0.30 to 5.54)[73]**
	RCT	Chronic kidney disease patients subgroup: Refresh sample difference: 0.37 (95% CI, -2.53 to 3.28)[73]
Graft or fistula prior to hemodialysis	RCT	**Chronic kidney disease patients subgroup: Original sample difference: Lower in G1: -3.09 (95% CI, -5.93 to -0.24)[73]**
	RCT	Chronic kidney disease patients subgroup: Refresh sample difference: -2.05 (95% CI, -6.39 to 2.30)[73]
	RCT	End-stage renal disease patients subgroup: Original sample difference: -6.08 (95% CI, -15.75 to 3.59)[72]
	RCT	End-stage renal disease patients subgroup: Refresh sample difference: 2.87 (95% CI, -16.72 to 22.46)[72]
HbA1c test	RCT	Diabetes patients subgroup: Original sample DiD: OR=1.22 (95% CI, 0.73 to 2.03)[73]
	RCT	Diabetes patients subgroup: Refresh sample DiD: OR=0.76 (95% CI, 0.47 to 1.23)[73]
	RCT	Diabetes patients subgroup: Original sample DiD: OR=1.02 (95% CI, 0.68 to 1.54)[72]
	RCT	Diabetes patients subgroup: Refresh sample DiD: OR=0.95 (95% CI, 0.56 to 1.61)[72]
LDL-C test	RCT	Diabetes patients subgroup: Original sample DiD: OR=1.05 (95% CI, 0.70 to 1.58)[73]
	RCT	Diabetes patients subgroup: Refresh sample DiD: OR=1.15 (95% CI, 0.80 to 1.67)[73]
	RCT	Diabetes patients subgroup: Original sample DiD: OR=1.19 (95% CI, 0.84 to 1.68)[72]
	RCT	Diabetes patients subgroup: Refresh sample DiD: OR=0.72 (95% CI, 0.42 to 1.24)[72]
	RCT	IVD patient subgroup: Original sample DiD: OR=0.98 (95% CI, 0.72 to 1.35)[72]
	RCT	IVD patient subgroup: Refresh sample DiD: OR=0.88 (95% CI, 0.54 to 1.43)[72]
Eye exam	RCT	Diabetes patients subgroup: Original sample DiD: OR=1.05 (95% CI, 0.81 to 1.137)[73]
	RCT	Diabetes patients subgroup: Refresh sample DiD: OR=1.25 (95% CI, 0.94 to 1.66)[73]
Nephrology	RCT	Diabetes patients subgroup: Original sample DiD: OR=0.92 (95% CI, 0.71 to 1.18)[73]
	RCT	**Diabetes patients subgroup: Refresh sample DiD: Greater increase in G1 than G2: OR=1.30 (95% CI, 1.01 to 1.67)[73]**
All 4 measures[a]	RCT	Diabetes patients subgroup: Original sample DiD: OR=1.01 (95% CI, 0.80 to 1.29)[73]
	RCT	Diabetes patients subgroup: Refresh sample DiD: OR=1.18 (95% CI, 0.93 to 1.52)[73]
None of the measures[b]	RCT	Diabetes patients subgroup: Original sample DiD: OR=1.74 (95% CI, 0.35 to 8.70)[73]
	RCT	Diabetes patients subgroup: Refresh sample DiD: OR= 0.60 (95% CI, 0.16 to 2.33)[73]
Lipid panel	RCT	IVD patient subgroup: Original sample DiD: OR=1.10 (95% CI, 0.85 to 1.44)[73]
	RCT	**IVD patient subgroup: Refresh sample DiD: Greater increase in G1 than G2: OR=1.22 (95% CI, 0.17 to 0.92)[73]**

[a] The "All 4 measure" is the rate at which beneficiaries receive all of the following four diabetes measures: rate of annual HbA1c testing, low-density lipoprotein cholesterol (LDL-C) screening, receipt of a retinal eye exam, and medical attention for nephropathy.
[b] The "None of the measure" is the rate at which beneficiaries did not receive any of the four diabetes measures.

CI = confidence interval; DiD = difference-in-difference; ESRD = end-stage renal disease; G = group; HbA1c = hemoglobin A1c; IVD = ischemic vascular disease; LDL-C = low-density lipoprotein cholesterol; OR = odds ratio; RCT = randomized controlled trial.

Appendix Table B-31. Study characteristics for community-based models

First Author, Year, Site(s)	Sample Size	Study Design (Risk of Bias Assessment)	Patient Selection: High Healthcare Use or Cost; Time Period	Patient Selection: Chronic Conditions	Patient Selection: Other	Additional Selected Patient Characteristics
Finkelstein et al., 2020[86] Camden, NJ; 4 local area hospital systems	(N=800) Intervention (N=399) Comparison (N=401)	RCT (RoB: Low)	1 or more IP admissions in past 6 months	2 or more chronic conditions	At least 2 of the following traits or conditions constituting medically and socially complex needs: use of 5 or more active outpatient medications, difficulty accessing services, lack of social support, a coexisting MH condition, an active drug habit, and/or homelessness; 18-80 years of age Exclusion criteria: uninsured, cognitively impaired, oncology patient, admitted for a surgical procedure for an acute health problem, for mental healthcare (with no comorbid physical health conditions), or for complications of a progressive chronic disease that has limited treatments.	≥65 years: 28%; nonwhite: 85%; Medicare: 48%; Medicaid:45%; hypertension: 80.6%; CHF: 33.9%, diabetes: 53.1% Needs help with mobility: 62% Self-reported health: poor: 54% Depression: 30%. Substance abuse: 44%
Sevak et al., 2018[76, 107] Aurora, CO; San Diego, CA; Allentown, PA; Kansas City, MO: 1 site per location	(N=1279) Intervention (N=149) Comparison (N=1130)	Observational study (RoB: Some concerns)	Initial inclusion criteria: 2+ inpatient admissions in 6 months 2 of 4 sites amended criteria: 1 site expanded criteria to also include 3+ inpatient admissions in past 12 months 1 site expanded criteria to 3+ hospital events (admissions or ED visits) in past 6 months	NA	Medicare FFS beneficiaries Exclusion: patients whose conditions could not be managed with existing program resources	Mean age: 59 years; black: 48.4%; Hispanic: 8.5%; Zip code poverty rate: 25.6%; dual coverage at enrollment: 69% Alzheimer: 8.5%; cancer: 5.3%; CHF: 56.0%; CKD: 63.0%; COPD: 56.3%; diabetes: 71.1%

First Author, Year, Site(s)	Sample Size	Study Design (Risk of Bias Assessment)	Patient Selection: High Healthcare Use or Cost; Time Period	Patient Selection: Chronic Conditions	Patient Selection: Other	Additional Selected Patient Characteristics
Capp et al., 2017[79] Colorado: 1 site	(N=3802) Intervention (N=406) Comparison (N=3396)	Observational study (RoB: some concerns)	2+ ED visits or inpatient admissions in past 180 days	NA	Age: 18+ Exclusion criteria: pregnant, primary diagnosis of substance use disorder, active malignancy, or ESRD; have a caregiver or power of attorney who was making primary decisions; psychiatric hospitalization in the previous 180 days; undergone major surgery in the past month	Nonwhite: 54% ≥56 years: 15% Medicaid or Colorado Indigent Care Program: 69% Medicare: 15% Self-pay: 12% CKD: 3% Congestive heart failure: 5% COPD: 7% Diabetes: 19% Hypertension: 38% Mental health comorbidity: 43%
Weerahandi et al., 2015[102] NYC: 1 hospital	(N=1158) Intervention (N=579) Comparison (N=579)	Observational study (RoB: some concerns)	At time of index hospitalization: 1 admission in past 30 days or 2 in past 6 months	NA	≥18 years of age; exclude: determined to be too medically acute to benefit from behavioral intervention	Hypertension: 69% Diabetes without chronic complication: 25% Chronic pulmonary disease: 49% Congestive heart failure: 23% Diabetes w/chronic complication: 8% Depression: 10.5% Drug abuse: 6% Psychoses: 3% Alcohol abuse: 3% nonwhite: 77%
Shah et al., 2011[98] Kern County, CA: 3 sites	(N=258) Intervention (N=98) Comparison (N=160)	Observational study (RoB: High)	4+ ED visit or IP admissions OR 3+ IP admissions OR 2+ IP admissions and 1 ED visit in past 1 year	NA	Age: 18-64; below 200% FPL; uninsured; not eligible for any public insurance programs	Charlson comorbidity index: 1.14 nonwhite: 51%
DeHaven et al., 2012[109, 111] Dallas, TX: 1 study site	(N=574) Intervention (N=265) Comparison (N=309)	Observational study (RoB: High)	Exceeded average ED visit rate of 1.5 ED visits in past 12 months	NA	Below 200% FPL; uninsured; not eligible for health insurance through local hospital system; not receiving Medicaid or Medicare	Nonwhite: 89.5%

First Author, Year, Site(s)	Sample Size	Study Design (Risk of Bias Assessment)	Patient Selection: High Healthcare Use or Cost; Time Period	Patient Selection: Chronic Conditions	Patient Selection: Other	Additional Selected Patient Characteristics
Thompson et al., 2018[85] Memphis, TN: 1 site	(N=439) Intervention (N=159) Comparison (N=280)	Observational study (RoB: High)	11+ hospital encounters originating in the ED in past 1 year	NA	Resident of Memphis, TN, in 38109 zip code	Moderate or severe Charlson comorbidity index (>3): 13% Nonwhite: 97% None/missing PCP: 21%

CA = California; CHF = congestive heart failure; CKD = chronic kidney disease; CO = Colorado; COPD = chronic obstructive pulmonary disease; ED = emergency department; ESRD = end-stage renal disease; FFS = fee-for-service; FPL = federal poverty line; IP = inpatient; MH = mental health; MO = Missouri; N = number; NA = not applicable; NJ = New Jersey; NYC = New York City; PA = Pennsylvania; PCP = primary care provider; RCT = randomized controlled trial; RoB = risk of bias; TN = Tennessee; TX = Texas.

Appendix Table B-32. Intervention characteristics for community-based models

First Author, Year, Site(s)	Intervention: Brief Description	Intervention Duration	Assessment, Education, Skills, Monitoring	Coordination and Continuity of Care	Referral to/Linkages to Community-Based Support Services	Providers	Mode of Delivery Setting(s)	Intensity	Comparison
Finkelstein et al., 2020[86] Camden, NJ; 4 local area hospital systems	Camden Core Model: hotspotting;	Median: 92 days; tailored to patient needs and responsiveness	Disease-specific self-care coaching; patient education	Scheduled and accompanied patients to initial post-IP primary and specialty care visits and followup care; medication reconciliation; medication management	assistance applying for social services and BH programs	Multidisciplinary: RNs, social workers, LPNs, CHWs, and health coaches	Face-to-face Enrollment in the hospital; Subsequent service delivery through home visits, PCP and specialty care	Received both a home visit within 14 days and provider visit within 60 days: 75% of participants; further contract tailored to individual	Usual post-discharge care which could include home visits or other outreach
Sevak et al., 2018[76, 107] Aurora, CO; San Diego, CA; Allentown, PA; Kansas City, MO: 1 site per location	Health Care Innovation Award: Rutgers Center for State Health Policy (CSHP) Community-based care management/care coordination for high-risk patients Replication of Camden Coalition model	Mean: 4.2 months (site means ranged from 2.4 months to 6.3 months)	Sites received technical assistance to implement the intervention Pt education about the importance of using primary and specialty care instead of, or as a followup to, emergency and hospital care and about managing medical and social needs	Developed individualized care plans, integrated care management services through mobile care teams	Assisted in enrollment in social service and BH service programs	Differing combination of RNs, NPs, social workers, CHWs, peer health coaches, medical assistants, and BH providers	face-to-face, telephone calls to physicians or other service providers care teams met with participants in their homes or in other community locations (e.g., library)	Mean staff contacts = 10.3 per participant per month, almost 6 hours per participant per month	Usual care

First Author, Year, Site(s)	Intervention: Brief Description	Intervention Duration	Assessment, Education, Skills, Monitoring	Coordination and Continuity of Care	Referral to/Linkages to Community-Based Support Services	Providers	Mode of Delivery Setting(s)	Intensity	Comparison
Capp et al., 2017[79] Colorado: 1 site	Bridges to Care (B2C), an ED-initiated, multidisciplinary, Community-based program that provides intensive medical, behavioral health, and social care coordination services following an ED visit or hospital discharge	60 days	Depression screening, behavioral health screening, helping patient learn empowerment skills and using "teach back" opportunities to ensure the patient understands results and next steps	Patient services include coordinating primary and specialty care	Care plan and associated patient services can include assistance with obtaining housing resources, insurance or disability benefits, refugee services, and access to transportation, and filling prescriptions	Primary care provider, care coordinator, health coach, behavioral health evaluator, and community health worker	Face-to-face	First home visit occurs 24-72 hours post enrollment date; second visit is conducted by PCP within 1 week of ED visit/discharge; third and fourth visits are conducted within 30 days of enrollment. Fifth and sixth visits depend on patient specific needs. Final two visits help patient transition out of program.	Usual care
Weerahandi et al., 2015[102] NYC: 1 hospital	Preventable Admissions Care Team (PACT) program: social work transition of care.	35 days	Comprehensive psychosocial assessment during hospitalization	Facilitated communication with PCP and specialists; collaborated with caregivers; Scheduled PCP appointment within 10 days of discharge	NR	MSWs with experience and training working with at-risk, vulnerable populations	Phone; face-to-face: home visits and while attending appointments	NR	Usual care: social worker assistance only during IP

First Author, Year, Site(s)	Intervention: Brief Description	Intervention Duration	Assessment, Education, Skills, Monitoring	Coordination and Continuity of Care	Referral to/Linkages to Community-Based Support Services	Providers	Mode of Delivery Setting(s)	Intensity	Comparison
Shah et al., 2011[98] Kern County, CA: 3 sites	Care Management Program (CMP) for low-income high utilizers of hospital services	NR	Assisted in goal creation/reaching goals	Care navigation (schedule appts, referral follow up, refill meds); care transitions (assistance in IP and discharge); and communication with providers (accompany to appointments and followup).	Arranged for social services (connect with agency staff, referrals)	Care managers with experience as case workers or medical office assistants	Face-to-face: at appointments, patients' homes, or resource centers	Met at least monthly	Usual care

First Author, Year, Site(s)	Intervention: Brief Description	Intervention Duration	Assessment, Education, Skills, Monitoring	Coordination and Continuity of Care	Referral to/Linkages to Community-Based Support Services	Providers	Mode of Delivery Setting(s)	Intensity	Comparison
DeHaven et al., 2012[111] Dallas, TX: 1 study site	Project Access Dallas (PAD): community faith-health partnership to improve access to care and preventive services to the uninsured, care coordination Participants received $750 a year in pharmacy benefits and were eligible for laboratory tests, ancillary procedures and IP hospital care. CCC pts: more complex and chronic problems, assigned a CHW Self-care pts: less serious illnesses, access to a telephone help line for medical care questions and CHW services on-request	Up to 1 year	Intake interview and HRA to assign to CCC or self-care CCC pts: CHWs developed Care Coordination Plan, taught health education and self-sufficiency	CCC pts: identified and addressed social concerns, identified patients with or at risk of developing type 2 diabetes, identified patients with depression, provided ED and referrals for cancer screening, provided care coordination and other support services (e.g., transportation, translation)	CCW link patients to other service organizations	HRA: community-clinic or hospital-based coordinator Services: CHWs, volunteer PCPs and specialists	Face-to-face for CCC pts; phone for self-care pts: in primary care and specialty care offices Volunteer PCPs and specialists met with CHWs monthly to discuss patients	CCC pts: at least monthly self-care: as needed	Usual care

First Author, Year, Site(s)	Intervention: Brief Description	Intervention Duration	Assessment, Education, Skills, Monitoring	Coordination and Continuity of Care	Referral to/Linkages to Community-Based Support Services	Providers	Mode of Delivery Setting(s)	Intensity	Comparison
Thompson et al., 2018[85] Memphis, TN: 1 site	Familiar Faces Program Community navigators (blend of CHWs and patient navigators) to bridge gap between patients and the healthcare and social systems	Up to 1 year	Created a plan for patients' health behaviors, tailored health information to client needs, and motivated them to make healthy choices	Helped to identify and eliminate barriers to health, coordinated care	Connecting patients to health and social resources in their community	Community navigators employed in the hospital system and receive the training	Initial engagement was face-to-face at the ED/hospital. The mode of delivery of other services was not reported.	NR	Usual care

B2C = Bridges to Care; BH = behavioral health; CA = California; CCC = community care coordination; CCW = community care worker; CHW = community health worker; CMP = Care Management Program; CO = Colorado; CSHP = Rutgers Centers for State Health Policy; ED = emergency department; HRA = health risk appraisal; IP = inpatient; LPN = licensed practical nurse; MO = Missouri; MSW = master of social worker; NJ = New Jersey; NR = not reported; NP = nurse practitioner; NYC = New York City; PA = Pennsylvania; PACT = Preventable Admissions Care Team; PAD = Project Access Dallas; PCP = primary care provider; Pt = patient; RN = registered nurse; TN = Tennessee; TX = Texas.

Appendix Table B-33. Healthcare utilization outcomes for community-based model studies

Utilization Measures	Study Design	Direction of Change in Intervention Group (G1)	Direction of Change in Comparison Group (G2)	Difference
180-day readmissions, count	RCT	NR	NR	aBGD=0.01 (95% CI, -0.25 to 0.27)[86]
	Observational	NR	NR	G1 vs. G2: p=0.32[102]
180-day readmissions, any (%)	RCT	NR	NR	aBGD=0.82 (95% CI, -5.97 to 7.61)[86]
180-day readmissions, ≥2 (%)	RCT	NR	NR	aBGD=0.27 (95% CI, -6.22 to 6.77)[86]
ED visits at 12 months, all-cause[a]	Observational	NR	NR	DiD: 0.057 (90% CI, -0.194 to 0.309) (p=0.704)[76, 107]
	Observational	⬇	NR	**Greater reduction in G1: RR=0.6748 (p<0.0001)[98]**
	Observational	NR	NR	**Greater reduction in G1: NR (p<0.01)[109, 111]**
	Observational	NR	NR	**Greater reduction in G1 than G2: DiD=-1.623 (p<0.01)[79]**
ED visits at 270 days, all-cause	Observational	NR	NR	**Greater reduction in G1 than G2: DiD=-1.091 (p<0.01)[79]**
ED visits at 180 days, all-cause	Observational	⬇	⬇	**Greater reduction in G1 than G2: DiD=-1.005 (p<0.01)[79]**
Inpatient admissions at 12 months, all-cause[a]	Observational	NR	NR	DiD: -0.116 (90% CI, -0.252 to 0.020)[76, 107]
	Observational	⇩	NR	RR: 0.8070 (p=0.3771)[98]
	Observational	NR	NR	**Greater reduction in G1 than G2: DiD=-0.906 (p<0.01)[79]**
Inpatient admissions at 270 days, all-cause	Observational	NR	NR	**Greater reduction in G1 than G2: DiD=-0.438 (p<0.01)[79]**
Inpatient admissions at 180 days, all-cause	Observational	⇩	⇩	DiD=-0.159 (p<0.1)[79]
Inpatient admissions, ACSC	Observational	NR	NR	DiD=-0.027 (90% CI, -0.081 to 0.028)[76, 107]
Inpatient days	RCT	NR	NR	aBGD=-0.32 (95% CI, -2.17 to 1.53)[86]
	Observational	⇩	NR	RR: NR (p=NS)[98]
	Observational	NR	NR	**Greater reduction in G1: NR (p<0.05)[109, 111]**
	Observational	⬇	⬇	**DiD: greater reduction in G1 than G2: -8 (95% CI, -14 to -2) [85]**
Total hospital encounters	Observational	⬇	⬇	**DiD: greater reduction in G1 than G2: -13 (95% CI, -19 to -6)[85]**
Hospital encounter resulted in discharge to hospital or observation stay	Observational	⬇	⬇	**DiD: greater reduction in G1 than G2: -12 (95% CI, -19 to -5)[85]**
Hospital encounter resulted in discharge from ED	Observational	⬇	⬇	**DiD: greater reduction in G1 than G2: -12 (95% CI, -19 to -4)[85]**
Primary care visits at 360 days, all-cause	Observational	NR	NR	**Greater increase in G1 than G2: DiD=1.932 (p<0.01)[79]**
Primary care visits at 270 days, all-cause	Observational	NR	NR	**Greater increase in G1 than G2: DiD=1.517 (p<0.01)[79]**
Primary care visits at 180 days	Observational	⬆	⬇	**Greater increase in G1 than G2: DiD=1.218 (p<0.01)[79]**

[a] Followup time for the outcomes was 12 months for CHSP[76, 107], CMP[98], and PAD[109, 111] and 360 days for B2C.[79]

aBGD = adjusted between-group difference; ACSC = ambulatory care sensitive conditions; CI = confidence interval; DiD = difference-in-difference; ED = emergency department; G = group; NR = not reported; NS = not statistically significant; RCT = randomized controlled trial; RR = relative risk.

Appendix Table B-34. Healthcare utilization outcomes for community-based model studies: Subgroup outcomes

Utilization Measures	Study Design	Direction of Change in Intervention Group (G1)	Direction of Change in Comparison Group (G2)	Difference
ED visits at 180 days, all-cause	Observational	⬇	⬇	**Patients with a mental health diagnosis subgroup: Greater reduction in G1 than G2: DiD=-1.377 (p<0.01)[79]**
Inpatient admissions at 180 days, all-cause	Observational	⬇	⬆	**Patients with a mental health diagnosis subgroup: Greater reduction in G1 than G2: DiD=-0.417 (p<0.01)[79]**
Primary care visits at 180 days	Observational	⬆	⬇	**Patients with a mental health diagnosis subgroup: Greater increase in G1 than G2: DiD=1.404 (p<0.01)[79]**

DiD = difference-in-difference; ED = emergency department; G = group.

Appendix Table B-35. Strength of evidence for community-based models vs. usual care outcomes

Population	Outcome	Results	Study Design and Sample Size	Strength of Evidence Domains	Overall Evidence Strength (Direction of Effect)
HNHC patients	180-day readmissions	Camden RCT: aBGD =0.01 (95% CI, -0.25 to 0.27);[86] PACT: RR: NR (p=0.32)[102]	1 RCT, N=800 1 OBS, N=1,158	Moderate study limitations, inconsistent, imprecise, direct	Insufficient
HNHC patients	ED visits, all cause at 12 months	CSHP DiD: 0.057 (90% CI, -0.194 to 0.309) (p=0.704);[76, 107] B2C: Greater reduction in G1: DiD=-1.623 (p<0.01) [79] CMP: Greater reduction in G1: RR=0.6748 (p<0.0001);[98] PAD: Greater reduction in G1: NR (p<0.01);[109, 111]	4 OBS, N=5,913	High study limitations (two high RoB OBS studies),[98, 109, 111] consistent, precise, direct	Low for benefit
HNHC patients	Inpatient admissions, all cause at 12 months	CSHP DiD: -0.116 (90% CI, -0.252 to 0.020);[76, 107] CMP: RR: 0.8070 (p=0.38);[98] B2C: Greater reduction in G1: DiD=-0.906 (p<0.01) [79]	3 OBS, N=5,339	Moderate study limitations (one high RoB OBS studies),[98] consistent, imprecise, direct	Insufficient
HNHC patients	Inpatient days	Camden RCT: aBGD=-0.32 (95% CI, -2.17 to 1.53);[86] CMP: RR: NR (p=NS);[98] PAD: Greater reduction in G1: NR (p<0.05);[109, 111] Familiar Faces: DiD: -8% (95% CI, -14% to -2%)[85]	1 RCT, N=800 3 OBS, N=1,271	Moderate study limitations (three high RoB OBS studies),[85, 98, 109, 111] mostly consistent, imprecise, direct	Insufficient
HNHC patients	Total costs	CSHP DiD: -1405 (90% CI, -3509 to 700) (p=0.268);[76, 107] Familiar Faces: DiD: -4903 (95% CI, -$13,579 to $3774)[85]	2 OBS, N=1,718	High study limitations (one high RoB OBS studies),[85] consistent, imprecise, direct	Insufficient

aBGD = adjusted between-group difference; B2C: Bridges to Care; CI = confidence interval; CMP = Care Management Program; CSHP = Rutgers Center for State Health Policy; DiD = difference-in-difference; ED = emergency department; G = group; HNHC = high-need, high-cost; N = number; NR = not reported; NS = not statistically significant; OBS = observational study; PAD = Project Access Dallas; RCT = randomized controlled trial; RoB = risk of bias; RR = rate ratio; vs. = versus.

Appendix Table B-36. Cost outcomes for community-based model studies

Cost Measures	Study Design	Direction of Change in Intervention Group (G1)	Direction of Change in Comparison Group (G2)	Difference
Hospital charges	RCT	NR	NR	aBGD=3,722 (95% CI, -23,438 to 30,882)[86]
Hospital payments received	RCT	NR	NR	aBGD=680 (95% CI, -3,415 to 4,775)[86]
Total costs	Observational	NR	NR	DiD: -1405 (90% CI, -3509 to 700) (p=0.268)[76, 107]
	Observational	⇩	⇩	DiD: -4903 (95% CI, -$13,579 to $3774) [85]
Inpatient costs	Observational	NR	NR	DiD: -120 (90% CI, -1891 to 1652) (p=0.911)[76, 107]
Direct ED costs	Observational	NR	NR	**Lower costs in G1:[a] NR (p=0.01)[109, 111]**
Indirect ED costs	Observational	NR	NR	**Lower costs in G1:[b] NR (p=0.03)[109, 111]**

[a] Direct ED costs include to costs associated with the delivery of care during an ED visit or inpatient admission in the 12 months following enrollment.
[b] Indirect ED costs the fixed costs related to building, maintenance, staffing, and utilities in the 12 months following enrollment.

aBGD = adjusted between-group difference; CI = confidence interval; DiD = difference-in-difference; ED = emergency department; G = group; NR = not reported; RCT = randomized controlled trials.

Appendix Table B-37. Clinical and functional outcomes for community-based model studies

Clinical and Functional Outcomes	Study Design	Difference Between Intervention Group (G1) and Comparison Group (G2)
Mortality, 180-day (%)	RCT	Change with intervention=-1.17 (95% CI, -5.25 to 2.91)[86]

CI = confidence interval; G = group; RCT = randomized controlled trial.

Appendix Table B-38. Social risk outcomes for community-based model studies

High Impact Social Risk Outcomes	Study Design	Difference
Participation in supplemental nutrition assistance program (%)	RCT	**AD=4.59 (95% CI, 0.52 to 8.65)[86]**
Receipt of temporary assistance for needy families (%)	RCT	AD=0.69 (95% CI, -0.34 to 1.71)[86]
Receipt of general assistance (%)	RCT	AD=0.68 (95% CI, -1.82 to 3.18)[86]

AD = adjusted difference; CI = confidence interval; RCT = randomized controlled trial.

Appendix Table B-39. Study Characteristics of ED-Based Care Model Interventions

First Author, Year, Site(s)	Sample size	Study Design (Risk of bias assessment)	Patient selection: high healthcare use or cost; time period	Patient selection: Chronic conditions	Patient selection: Other	Additional selected patient characteristics
Shumway et al., 2008[99] San Francisco, CA: 1 hospital	(N=252) Intervention (N=167) Comparison (N=85)	RCT (RoB: some concerns)	5+ ED visits in past 1 year	NA	Age: 18+; psychosocial problems that could be addressed with case management	Nonwhite: 87%; Homeless: 81% Alcohol problems alcohol use: 57% Lack health insurance: 67% Charlson Comorbidity Index (Mean [SD]): 1.4 (2.2) Most common diagnosis in prior 1 yr: Mental disorders, 22%
Seaberg et al., 2017[100] Chattanooga, TN metro area: 5 sites	(N=304) Intervention (N=163) Comparison (N=141)	RCT (RoB: some concerns)	5+ ED visits in past 1 year	NA	NA	NA
Enard and Ganelin, 2013[110] Houston, TX: 1 site	(N=13,642) Intervention (N=1,905) Comparison (N=11,737)	Observational study (RoB: high)	Frequent use of the ED for primary care, data included visits to any of the 9 EDs in the healthcare system, receiving urgent or primary care in the ED (levels 3, 4, and 5-medical decisions of minimal to moderate complexity but may be considered PCP patients) in past 1 year	NA	Age: 18-64; on Medicaid, uninsured/self-pay, or covered by TX public health benefit	Nonwhite: 82% Age 18-34: 58.6% Uninsured: 62.7%
Navratil-Strawn et al., 2014[103] National	(N=14,140) Intervention (N=7,070) Comparison (N=7,070)	Observational study (RoB: some concerns)	3+ ED visits in past 1 year	NA	Age: 65+; UnitedHealth-Care's AARP Medigap insurance	Live in area with medium/high Minority status: 38%

CA = California; ED = emergency department; N = number; NA = not applicable; PCP = primary care provider; RCT = randomized controlled trial; RoB = risk of bias; SD = standard deviation; TN = Tennessee; TX = Texas; yr = year.

Appendix Table B-40. Intervention characteristics of ED-based care model interventions

First Author, Year, Site(s)	Intervention: Brief Description	Intervention Duration	Assessment, Education, Skills, Monitoring	Coordination and Continuity of Care	Referral to/Linkages to Community-Based Support Services	Providers	Mode of Delivery Setting(s)	Intensity	Comparison
Shumway et al., 2008[99] San Francisco, CA: 1 hospital	Case Management	24 months	Psychosocial problems and functioning were assessed at study entry and at 6, 12, 18, and 24-months. Psychosocial assessment included homelessness, problem alcohol use, lack of health insurance, lack of social security income, unmet basic financial needs, and psychiatric symptoms.	Provided linkage to medical care providers and ongoing assertive community outreach to maintain continuity of care.	Assistance in obtaining stable housing, income entitlements, and referral to substance abuse services when needed.	Master's-level psychiatric social workers provided most case management services in collaboration with a nurse practitioner, a primary care physician, and a psychiatrist.	Face-to-face individually and group sessions	NR	Usual care
Seaberg et al., 2017[100] Chattanooga, TN metro area: 5 sites	Patient navigation for ED patients	12 months	Reviewed diagnoses and prescriptions	NR	Arranged followup appointments and identified relevant community resources	Patient navigator with hospital case management training	In person and via telephone	Initial ED visit, subsequent ED visits, followup calls within 2 weeks and 12 months of initial ED visit	Usual care
Enard and Ganelin, 2013[110] Houston, TX: 1 site	ED-based Patient Navigation Program	≤10 days	Initial assessment to determine barriers to appropriate primary care use. Educate patients on importance of making and keeping appointments and receiving preventive health care. Help patients identify barriers to primary care and identify local, state, and federal resources appropriate for their needs.	Patient navigators maintain relationships with community-based providers to bolster referral relationships ensure that contact information is current.	Connect patients with neighborhood providers or clinics and assess their needs for specific types of referrals based on access issues and health conditions.	Community health workers as patient navigators	In person and via telephone	Initial ED visit and a followup call 3 to 10 days later	Usual care

First Author, Year, Site(s)	Intervention: Brief Description	Intervention Duration	Assessment, Education, Skills, Monitoring	Coordination and Continuity of Care	Referral to/Linkages to Community-Based Support Services	Providers	Mode of Delivery Setting(s)	Intensity	Comparison
Navratil-Strawn et al., 2014[103] National	Emergency Room Decision-Support (ERDS) program	NR; up to 12 months (followup time)	Assessment of health needs and treatment options	Make appointments with providers, refer to care coordination programs	Provide connections with health resources	Nurse	Telephone	NR	Usual care

CA = California; ED = emergency department; NR = not reported; TN = Tennessee; TX = Texas.

Appendix Table B-41. Healthcare utilization outcomes for ED-based care model studies

Utilization Measures	Study Design	Direction of Change in Intervention Group (G1)	Direction of Change in Comparison Group (G2)	Difference
ED visits	RCT	⬇	⬇	**Lower use in G1 than G2[a] (p<0.01)[99]**
	RCT	⬇	⬇	**Greater reduction in G1 than G2 (p<0.0001)[100]**
	Observational	⬇	⬇	**Greater reduction in G1 than G2: DiD=-178 (p=0.033)[103]**
ED visits, any	Observational	⬇	⬇	**Lower use in G1 than G2 among patients with PCR-ED visits in prior 24 months ≥1: OR=0.55 (95% CI, 0.47 to 0.63); ≥2: OR=0.46 (95% CI, 0.37 to 0.57); ≥3: OR=0.32 (95% CI, 0.24 to 0.44); ≥4: OR=0.29 (95% CI, 0.19 to 0.44); or ≥5: OR=0.31 (95% CI, 0.17 to 0.54)[110]**
	Observational	⬇	⬇	G1 vs. G2 among patients with PCR-ED visits in prior 12 months **≥1: OR=0.83 (95% CI, 0.71 to 0.98); ≥2: OR=0.72 (95% CI, 0.57 to 0.93);** ≥3: OR=0.90 (95% CI, 0.60 to 1.3); ≥4: OR=0.98 (95% CI, 0.52 to 1.8); or ≥5: OR=0.96 (95% CI, 0.39 to 2.3)[110]
Inpatient admissions, all-cause	Observational	⬇	⬇	**Greater reduction in G1 than G2: DiD=-53 (p=0.002)[103]**
Medical inpatient admissions	RCT	⇩	⇩	G1 vs. G2[a] (p=NS)[99]
Medical inpatient days	RCT	⇩	⇩	G1 vs. G2[a] (p=NS)[99]
Psychiatric emergency visits	RCT	⇩	--	G1 vs. G2[a] (p=NS)[99]
Psychiatric inpatient admissions	RCT	⇩	⇩	G1 vs. G2[a] (p=NS)[99]
Psychiatric inpatient days	RCT	⇩	⇩	G1 vs. G2[a] (p=NS)[99]
Medical outpatient visits	RCT	⇩	⇩	G1 vs. G2[a] (p=NS)[99]
Primary care visits	RCT	⬆	⬇	**Greater use in G1 than G2 (p=0.001)[100]**
	Observational	⬇	⬇	**Smaller reduction in G1 than G2: DiD=897 (p<0.001)[103]**

[a]Interaction between level of prior ED use (5 to 11 or ≥12 visits in prior 12 months) and group: p=NS

CI = confidence interval; DiD = difference-in differences; ED = emergency department; G = group; OR = odds ratio; NS = not statistically significant; PCR = primary care related; RCT = randomized controlled trial; vs. = versus.

Appendix Table B-42. Strength of evidence for ED-based care models vs. usual care outcomes

Population	Outcome	Results	Study Design and Sample Size	Strength of Evidence Domains	Overall Evidence Strength (Direction of Effect)
HNHC patients	ED visits	Case management RCT: Lower use in G1 than G2 (p<0.01);[99] Navigation RCT: Greater reduction in G1 than G2 (p<0.0001);[100] ERDS: Greater reduction in G1 than G2: DiD=-178 (p=0.033)[103]	2 RCTs, N=556 1 OBS, N=14,140	Moderate study limitations, consistent, precise, direct	Moderate for benefit
HNHC patients	Primary care visits	Navigation RCT: Greater use in G1 than G2 (p=0.001)[100] ERDS: Smaller reduction in G1 than G2: DiD=897 (p<0.001)[103]	1 RCT, N=304 1 OBS, N=14,140	Moderate study limitations, consistent, precise, direct	Low for benefit
HNHC patients	ED costs	Case management RCT: Lower in G1 than G2[a] (p<0.01)[99] Navigation RCT: Greater reduction in G1 than G2 (p<0.0001)[100] ERDS: DiD=-21 (p=0.140)[103]	2 RCTs, N=556 1 OBS, N=14,140	Moderate study limitations; consistent, precise, direct	Moderate for benefit
HNHC patients	Inpatient costs	Case management RCT: G1 vs. G2 (p=NS)[99] ERDS: DiD=-59 (p=0.080)[103]	1 RCT, N=252 1 OBS, N=14,140	Moderate study limitations, inconsistent, imprecise, direct	Insufficient
HNHC patients	Outpatient costs	Case management RCT: G1 vs. G2 (p=NS)[99] ERDS: DiD=10 (p=0.828)[103]	1 RCT, N=252 1 OBS, N=14,140	Moderate study limitations, inconsistent, imprecise, direct	Insufficient

DiD = difference-in differences; ED = emergency department; ERDS = Emergency Room Decision-Support; G = group; HNHC= high-need, high-cost; N = number; OBS = observational study; PCR = primary care related; RCT = randomized controlled trial; RoB = risk of bias; vs. = versus.

Appendix Table B-43. Cost outcomes for ED-based care model studies

Cost Measures	Study Design	Direction of Change in Intervention Group (G1)	Direction of Change in Comparison Group (G2)	Difference
ED costs	RCT	⬇	⬇	**Lower in G1 than G2[a] (p<0.01)[99]**
	RCT	⬇	⬇	**Greater reduction in G1 than G2 (p<0.0001)[100]**
	Observational	⇩	⇩	DiD=-21 (p=0.140)[103]
Inpatient costs	RCT	⇩	⇩	G1 vs. G2[a,b] (p=NS)[99]
	Observational	⇩	⇩	DiD=-59 (p=0.080)[103]
Psychiatric emergency costs	RCT	⇩	⇩	G1 vs. G2[a] (p=NS)[99]
Psychiatric hospital costs	RCT	⇩	⇧	G1 vs. G2[a] (p=NS)[99]
All hospital costs (including ED case management)	RCT	⇩	⇩	G1 vs. G2[a] (p=NS)[99]
All non-ED case management costs	RCT	⇩	⇩	G1 vs. G2[a] (p=NS)[99]
Total costs ($)	Observational	⇩	⇩	DiD=-40 (p=0.502)[103]
Outpatient costs	RCT	⇩	--	G1 vs. G2[a,b] (p=NS)[99]
	Observational	⇩	⇩	DiD=10 (p=0.828)[103]
Prescription costs ($)	Observational	⇧	⇧	DiD=9 (p=0.201)[103]

[a]Interaction between level of prior ED use (5 to 11 or ≥12 visits in prior 12 months) and group: p=NS
[b]Shumway et al., 2008[99] specified the outpatient and inpatient costs as medical outpatient costs and medical hospital costs.

DiD = difference-in differences; ED = emergency department; G = group; NS = not statistically significant; RCT = randomized controlled trial; vs. = versus.

Appendix Table B-44. Clinical and functional outcomes for ED-based care model studies

Clinical and Functional Outcomes	Study Design	Difference Between Intervention Group (G1) and Comparison Group (G2)
Satisfaction (4-point Likert scale)	RCT	G1 vs. G2: (p=NS)[100]
Psychiatric symptoms (total BSI)	RCT	G1 vs. G2[a] (p=NS)[99]

[a]Interaction between level of prior ED use (5 to 11 or ≥12 visits in prior 12 months) and group: p=NS.

BSI = brief symptom inventory; ED = emergency department; G = group; NS = not statistically significant; RCT = randomized controlled trial; vs. = versus.

Appendix Table B-45. Social risk outcomes for ED-based care model studies

Quality Measures	Study Design	Difference Between Intervention Group (G1) and Comparison Group (G2)
Problem alcohol use (%)	RCT	**Lower in G1 than G2[a] (p=0.04)[99]**
Homelessness (%)	RCT	**Lower in G1 than G2[a] (p<0.01)[99]**
No health insurance (%)	RCT	**Lower in G1 than G2[a] (p=0.02)[99]**
No social security income (%)	RCT	**Lower in G1 than G2[a] (p<0.01)[99]**
Basic financial needs unmet	RCT	**Lower in G1 than G2[a] (p=0.04)[99]**

ED = emergency department; G = group; NS = not statistically significant; RCT = randomized controlled trial; vs. = versus.

Appendix Table B-46. Study characteristics of aICU (ambulatory intensive caring unit) interventions

First Author, Year, Site(s)	Sample Size	Study Design (Risk of Bias Assessment)	Patient Selection: High Healthcare Use or Cost; Time Period	Patient Selection: Chronic Conditions	Patient Selection: Other
Yoon et al., 2019[78]; Zalman, 2019[87] GA, OH, WI, NC, CA: 5 sites	(N=2,210) Intervention (N=1105) Comparison (N=1105) (N=1,527) Intervention (N=759) Comparison (N=768)	RCT (RoB: some concerns)	Veterans whose risk of 90-day hospitalization was ≥ 90th percentile based on the VA's Care Assessment Need (CAN) score and who had experienced a hospitalization or ED visit in past 6 months	NA	Intensive management teams at each site reviewed patient charts to determine whether participants would benefit from intensive services
Durfee et al., 2018[74] CO: 1 site	(N=3636) Intervention (N=1749) Comparison (N=1887)	Observational study (RoB: some concerns)	IP admission (analysis index admission) and at least 2 other admissions OR at least one other admission with a serious mental health diagnosis in past 1 year	NA	Age: 19+
Horn et al., 2016[82] Albuquerque, NM: 1 academic medical center	(N=1547) Intervention (N=753) Comparison (N=794)	Observational study (RoB: some concerns)	High cost (top 1%) in past 1 year	Medically complex patients with a chronic medical condition and at high risk for future hospitalization	Participant selection guided by the likelihood of recurrent illness and response to care management, and patient willingness to participate in the program and be monitored and contacted

aICU = ambulatory intensive caring unit; CA = California; CAN = care assessment need; CO = Colorado; ED = emergency department; GA = Georgia; IP = inpatient; N = number; NA = not applicable; NC = North Carolina; NM = New Mexico; OH = Ohio; RCT = randomized controlled trial; RoB = risk of bias; VA = Veterans Administration; WI = Wisconsin.

Appendix Table B-47. Intervention characteristics of aICU (ambulatory intensive caring unit) interventions

First Author, Year, Site(s)	Intervention: Brief Description	Intervention Duration	Assessment, Education, Skills, Monitoring	Coordination and Continuity of Care	Referral to/Linkages to Community-Based Support Services	Providers	Mode of Delivery Setting(s)	Intensity	Comparison
Yoon et al., 2019[78, 87] GA, OH, WI, NC, CA: 5 sites	Augmenting the VA's PCMH PACT with a PACT-PIM intervention for highest cost patients; locally tailored by site	Up to 15 months	Initial assessment: record review, followed by comprehensive in-person assessment for medical, MH, and social needs; goals assessment; health coaching for patient and caregivers, pharmacist medication reconciliation and adherence monitoring	Care coordination; transitional care management post IP discharge; feedback to PCP, assistance with navigating healthcare services	NR: VA provides many support services in-house	Interdisciplinary team: physician or nurse practitioner, a nurse, pharmacist, rehabilitation therapists, MH and addiction support	Outpatient, home, and phone	Limited: 1-2 encounters or referral to PCP; Full: goal was 3+ encounters in person or by phone from PIM team; received by 44% of participants. Tailored to individual needs. Full intervention participants received mean of 14 encounters (range: 3-116)	Patient Aligned Care Team (PACT) only

First Author, Year, Site(s)	Intervention: Brief Description	Intervention Duration	Assessment, Education, Skills, Monitoring	Coordination and Continuity of Care	Referral to/Linkages to Community-Based Support Services	Providers	Mode of Delivery Setting(s)	Intensity	Comparison
Durfee et al., 2018[74] CO: 1 sites	IOC in integrated delivery system	NR	In-depth intake assessment included determining medical barriers to improving health, taking into account BH needs, social determinants of health and patient-identified priorities	Sought to develop comprehensive care plans. More nursing support allowed for medical interventions to be done within the clinic instead of the ED or hospital.	NR	Eight existing family practice and internal medicine teams composed of a PCP, medical assistant, and shared nursing and social work resources. Supported by clinical pharmacists, patient navigators, BH clinicians.	Additional staffing to existing PCPs and developed IOCs (new, specialized primary care clinics). Face-to-face with care team; navigators and pharmacists primarily by phone	IOC had higher staff-patient ratio than regular PCP clinic, longer visits, walk-in availability. Mean number of encounters per patient: NR	Usual care - historic comparison group who received care prior to implementing the IOC.
Horn et al., 2016[82] Albuquerque, NM: 1 academic medical center	Care One, an intensive chronic care, primary care-oriented program designed to target HNHC patients.	NR	Assessment of whether amenable to care management based on interview and medical record review.	Provided access to specialty care consultations, assistance from nurse coordinators and social workers, and assistance with unanticipated problems related to access or quality	Assistance with social services: such as transportation to clinical appointments, food stamp applications, etc.	A physician, social worker/case manager, a patient care coordinator, and MH therapist. A pharmacist assists with medication management for patients with complex comorbidities.	Primary care	NR	Usual care

aICU = ambulatory intensive caring unit; BH = behavioral health; CA = California; CO = Colorado; ED = emergency department; GA = Georgia; HNHC = high-need, high-cost; IOC = intensive outpatient clinic; MH = mental health; NC = North Carolina; NM = New Mexico; NR = not reported; OH = Ohio; PACT = patient aligned care team; PCMH = Patient-Centered Medical Homes; PCP = primary care provider; PIM = PACT-intensive management; VA = Veterans Administration; WI = Wisconsin.

Appendix Table B-48. Healthcare utilization outcomes for ambulatory intensive care model studies

Utilization Measures	Study Design	Direction of Change in Intervention Group (G1)	Direction of Change in Comparison Group (G2)	Difference
Acute medical/ surgery inpatient stays	RCT	NR	NR	DiD: 1.13 (95% CI, 0.92 to 1.38)[78]
Other inpatient stays[a]	RCT	NR	NR	DiD: 1.04 (95% CI, 0.66 to 1.65)[78]
Inpatient admissions	Observational	⬇	⬇	**DiD: lower reduction in G1 than G2 (negative finding) (p<0.01)[74]**
ED visits	RCT	NR	NR	DiD: 1.02 (95% CI, 0.93 to 1.13)[78]
Primary care visits	RCT	NR	NR	**Greater use in G1: DiD: 1.40 (95% CI, 1.30 to 1.50)[78]**
Care management visits	RCT	NR	NR	**Greater use in G1: DiD: 2.70 (95% CI, 1.77 to 4.12)[78]**
Specialty care visits	RCT	NR	NR	DiD: 1.03 (95% CI, 0.96 to 1.10)[78]
Mental healthcare visits	RCT	NR	NR	**Greater use in G1: DiD: 1.33 (95% CI, 1.17 to 1.52)[78]**
Homeless care visits	RCT	NR	NR	DiD: 1.11 (95% CI, 0.86 to 1.44)[78]

[a] Other inpatient stays included psychiatric, substance use disorders, and rehabilitation stays.

aICU = ambulatory Intensive Care Unit; CI = confidence interval; DiD = difference-in-difference; G = group; NR = not reported; RCT = randomized controlled trial.

Appendix Table B-49. Cost outcomes for ambulatory intensive care model studies

Cost Measures	Study Design	Direction of Change in Intervention Group (G1)	Direction of Change in Comparison Group (G2)	Difference
Outpatient costs	RCT	⬆	⬇	**DiD: greater increase in G1 than G2: 2636 (95% CI, 524 to 4748)[78]**
Inpatient costs	RCT	⇩	⇧	DiD: −2164 (95% CI, −7916 to 3587)[78]
ED costs	RCT	⇩	⇩	DiD:−20 (95% CI,−277 to 237)[78]
Total costs/ charges	RCT	⇩	⇩	DiD: 471 (95% CI,−6347 to 7290)[78]
	Observational	⬇	⬇	**DiD: greater reduction in G1 than G2 (p<0.04)[74]**
	Observational	⬇	⬇	**DiD: greater reduction in G1 than G2: -$Good (p<0.01)[82]**

CI = confidence interval; DiD = difference-in-difference; ED = emergency department; G = group; N = number; NR = not reported; RCT = randomized controlled trial.

Appendix Table B-50. Strength of evidence for aICU models vs usual care outcomes

Population	Outcome	Results	Study Design and Sample Size	Strength of Evidence Domains	Overall Evidence Strength (Direction of Effect)
HNHC patients	Total costs	PIM: DiD: 471 (95% CI,−6347 to 7290);[78] IOC: DiD: greater reduction in G1 than G2 (p<0.04);[74] Care One DiD: -$44,504 (p<0.01)[82]	1 RCT, N=2,210 2 OBS, N=5,183	Moderate study limitations, consistent, precise, direct	Low for benefit
HNHC patients	Mortality one-year post randomization	PIM: (p = 0.93);[78] IOC: Lower in G1 than G2: (p<0.01)[74]	1 RCT, N=2,210 1 OBS, N=3,636	Moderate study limitations, inconsistent, imprecise, direct	Insufficient

aICU = ambulatory intensive caring unit; CI = confidence interval; DiD = difference-in- difference; G = group; HNHC = high need, high cost; IOC: Intensive Outpatient Clinic; N = number; NR = not reported; OBS = observational study; PIM: Patient Aligned Care Team (PACT)-Intensive Management; RCT = randomized controlled trial; RoB = risk of bias; vs. = versus.

Appendix Table B-51. Clinical and functional outcomes for ambulatory intensive care model studies

Clinical and Functional Outcomes	Study Design	Difference Between Intervention Group (G1) and Comparison Group (G2)
Mortality, One-Year post randomization	RCT	(p=0.93)[78]
	Observational	**Lower in G1 than G2: (p<0.01)[74]**
Patient-Centered Care Coordination	RCT	AOR for all 6 measured dimensions past 6 months[a] (p=NS)[87]
Access to care	RCT	AOR for all 3 measured dimensions[b] (p=NS)[87]
Patient satisfaction with care	RCT	AOR for all 4 measured dimensions[c] (p=NS)[87]
Relationships with Providers: trusted provider	RCT	**Greater in G1 than G2: AOR=1.30 (95% CI, 1.04 to 1.62)[87]**
Relationships with Providers: feel respected by provider	RCT	(p=NS)[87]
Healthcare hassles summary Score (challenges in getting care)	RCT	(p=0.61)[87]
Patient assessment of chronic illness care (PACIC) Summary Score (receipt of care for chronic illness)	RCT	**Greater in G1 than G2: (p=0.022)[87]**

[a] Goals assessed: barriers; medications reviewed; between-visit reminders; primary care informed about specialty care; VA healthcare provider helps coordinate care from different doctors and services, someone talked to them about their health goals, report 10 out of 10 satisfaction with primary care, patient assessment of chronic illness care based on PACIC scale; not significant for medications reviewed in past 6 months, between visit reminders in past 6 months, primary care informed about specialty care in past 6 months, VA healthcare provider who helps coordinate care from different doctors and services
[b]Dimensions include access to needed services, access to provider when questions about care arise; received needed services.
[c]Dimensions include satisfaction with overall care at VA facility, social services, mental healthcare services, primary care services.

AOR = adjusted odds ratio; CI = confidence interval; G = group; NS = not statistically significant; PACIC = patient assessment of chronic illness care; RCT = randomized controlled trial.

Appendix Table B-52. Study characteristics of primary care-based interventions

First Author, Year, Site(s)	Type of Intervention; Sample size	Study Design (Risk of Bias Assessment)	Patient Selection: High Healthcare Use or Cost; Time Period	Patient Selection: Chronic Conditions	Patient Selection: Other	Additional Selected Patient Characteristics
McCall et al., 2010[77] 5 MA counties (Norfolk, Suffolk, Middlesex, Essex, and Plymouth)	Primary Care Model includes Home visits Pay-for-Performance APM (Original N=5374) Intervention (N=2619) Comparison (N=2755)	RCT (RoB: some concerns)	Beneficiaries with HCC risk scores >=2.0 and annual costs of >=$2,000 or HCC risk scores >=3.0 and >=$1,000 annual medical costs in past 1 year	HCC risk scores >=2.0	Medicare FFS beneficiaries; at least 2 visits to MA General Hospital physicians for a selected group of outpatient and ED procedures	Nonwhite: 13.4% Medicaid: 5.3%
McCall et al., 2010[77] 5 MA counties (Norfolk, Suffolk, Middlesex, Essex, and Plymouth)	Primary Care Model includes Home visits Pay-for-Performance APM (Refresh N=1569) Intervention (N=785) Comparison (N=784)	RCT (RoB: some concerns)	Beneficiaries with HCC risk scores >=2.0 and annual costs of >=$2,000 or HCC risk scores >=3.0 and >=$1,000 annual medical costs in past 1 year	HCC risk scores >=2.0	Medicare FFS beneficiaries; at least 2 visits to MA General Hospital physicians for a selected group of outpatient and ED procedures	Nonwhite: 12.8% Medicaid: 5.4%
Sledge et al., 2006[114] Northeastern US: 1 site	Primary care model (N=96) Intervention (N=47) Comparison (N=49)	RCT (RoB: low)	2+ medical or surgical hospital admissions per year, excluded highest cost outliers in 12-18 month period	NA	age: 18+	Nonwhite: 62.5% Medicare/Medicaid: 93% Major depression: 34% 6th grade or lower reading level: 32% of those who spoke English (n=91)
Coleman et al., 2001[101] Denver, CO: 19 physician-nurse teams in 8 PCP practices	Primary Care Model: (Group Visits) (N=295) Intervention (N=146) Comparison (N=149)	RCT (RoB: some concerns)	11+ outpatient visits in past 18 months	1+ self-reported chronic condition	Age: 60+	NA

First Author, Year, Site(s)	Type of Intervention; Sample size	Study Design (Risk of Bias Assessment)	Patient Selection: High Healthcare Use or Cost; Time Period	Patient Selection: Chronic Conditions	Patient Selection: Other	Additional Selected Patient Characteristics
Katzelnick et al., 2000[89] WI, WA, MA: 163 physician practices affiliated with 1 of 3 included HMOs	Primary care model (N=407) Intervention (N=218) Comparison (N=189)	RCT (RoB: some concerns)	Ambulatory visit counts above the 85th percentile (including PCP, medical specialty and walk-in clinic visits-not MH provider visits) in previous 2 years	Screened positive for current major depression or major depression in partial remission (Ham-D score of 15 or more)	Age: 25-63	Female: 77%
Crane et al., 2012[88] Hendersonville, NC: 1 site	Primary Care Model: Group Visits (N=72) Intervention (N=36) Comparison (N=36)	Observational study (RoB: high)	6+ ED visits in past 1 year	NA	Below 200% FPL; uninsured	Median age: 32 The following were only reported in intervention group Chronic pain: 75% Uninsured: 100% Substance abuse: 47% Depression: 36%
Adam et al., 2010[92] MN: 1 residency clinic	Primary Care Model (N=21) Intervention (N=13) Comparison (N=8)	Observational study (RoB: high)	8+ clinic visits in past 1 year	NA	Age: 18+	Psychiatric diagnosis: 85% Nonwhite: 28% Female: 65% Median age: 49.5
Vickery et al., 2018[90, 108] MN: 1 site	Primary care model (N=92,891) Intervention (N=19,433) Comparison (N=73,458) Subgroups (N=NR)	Observational study (RoB: some concerns)	HNHC subgroup: More than 4 ED visits or 2 inpatient hospital visits in past 1 year.	NA	Whole study population: Adults with 1+ months of enrollment under early Medicaid expansion	NR

APM = advanced alternative payment model; AR = Arizona; CMS = Centers for Medicare & Medicaid Services; CO = Colorado; CPC = Comprehensive primary care; ED = emergency department; ESRD = end-stage renal disease; FFS = fee-for-service; FPL = federal poverty line; HCC = Hierarchical condition category; HMO = health maintenance organization; HNHC = high-need, high-cost; KY = Kentucky; MA = Massachusetts; MH = mental health; MN = Minnesota; N = number; NA = not applicable; NC = North Carolina; NJ = New Jersey; NR = not reported; NY = New York; OH = Ohio; OK = Oklahoma; OR = Oregon; PCP = primary care provider; RCT = randomized controlled trial; RoB = risk of bias; WA = Washington; WI = Wisconsin.

Appendix Table B-53. Intervention characteristics of primary care-based interventions

First Author, Year, Site(s)	Intervention: Brief Description	Intervention Duration	Assessment, Education, Skills, Monitoring	Coordination and Continuity of Care	Referral to/Linkages to Community-Based Support Services	Providers	Mode of Delivery Setting(s)	Intensity	Comparison
McCall et al., 2010[77] 5 MA counties (Norfolk, Suffolk, Middlesex, Essex, and Plymouth)	Provider-based care management program	Up to 36 months for original population, up to 24 months for refresh population	Conducted comprehensive assessment to evaluate the unique needs of each patient; educated patients about resources available and lifestyle changes that could help to prevent exacerbations of disease, to prevent or delay hospitalization and about the purpose of their medications and other treatment interventions; reviewed self-management activities	The role of the case manager is to provide support across patients' continuum of care	Connect patients to resources to meet medical and psychosocial needs	Nurse case managers supported by case management program project manager, an administrative assistant, a community resource specialist, and a patient financial counselor as well as social workers to help with mental health program and pharmacists	In-person at primary care offices, hospitals, and home visits as needed and via telephone	Among the original population, 97% of the intervention group received at least 1 contact. The mean number of contacts per patient was 8. A higher proportion of patients in the HCC risk score group received 10 or more calls during the 36-month period compared to the low HCC risk score group (27% compared to 17%), with 10% of patients in the high HCC risk score group receiving 20+ phone calls compared with 4% in the low HHC risk score group. In the refresh group, 87% received at least 1 contact, and the mean number of contacts was 4.	Usual care

First Author, Year, Site(s)	Intervention: Brief Description	Intervention Duration	Assessment, Education, Skills, Monitoring	Coordination and Continuity of Care	Referral to/Linkages to Community-Based Support Services	Providers	Mode of Delivery Setting(s)	Intensity	Comparison
Sledge et al., 2006[114] Northeastern US: 1 site	Primary Intensive Care (PIC)	1 year	Comprehensive interdisciplinary medical and psychosocial assessment; used a patient-centered approach to improve self-care patterns and coping skills; aimed to track and facilitate completion of recommendations made to the PCP based on the assessment	A report and recommendations for care were presented to PCP and subspecialty providers; the recommendations were intended to optimize chronic illness management; case manager used patient-centered approach to improve coordination of care	Offered assistance with referrals and appointments	Psychiatric nurse and team including social worker, psychiatrist, and general internist	In person and via telephone; home visits when necessary	Varied based on patient needs; at minimum included a monthly telephone call; patients were defined by 3 levels of contact: minimum contact, biweekly contact, and weekly or greater contact	Usual care (psychiatric consultation provided only if requested by PCP)

First Author, Year, Site(s)	Intervention: Brief Description	Intervention Duration	Assessment, Education, Skills, Monitoring	Coordination and Continuity of Care	Referral to/Linkages to Community-Based Support Services	Providers	Mode of Delivery Setting(s)	Intensity	Comparison
Coleman et al., 2001[101] Denver, CO: 19 physician-nurse teams in 8 PCP practices	Patient group visits model of care	2 years	Education on general as well as specific health topics, medication management, exercise, and nutrition; assessments included health promotion activities such as blood pressure measurement and need for and delivery of immunizations and medication refills and ongoing chronic disease management and evaluation of acute conditions in 1:1 sessions	Provided active care coordination within the primary care team and between other providers and care settings; promoted continuity of care with the health team	NR	Primary care physician, nurse, pharmacist. Periodic ancillary providers: Dietician, Social worker, Physical therapist	In person	Group visits were held monthly for 24 months, 120 minutes per session, with an average attendance of 8 to 12 participants per group	Usual care

First Author, Year, Site(s)	Intervention: Brief Description	Intervention Duration	Assessment, Education, Skills, Monitoring	Coordination and Continuity of Care	Referral to/Linkages to Community-Based Support Services	Providers	Mode of Delivery Setting(s)	Intensity	Comparison
Katzelnick et al., 2000[89] WI, WA, MA: 163 physician practices affiliated with 1 of 3 included HMOs	Depression Management Program (DMP)	1 year	Assessed patients to confirm diagnosis and appropriateness for medication; patients and PCPs received education about depression; periodic followup with PCP to monitor patient status and telephone monitoring by coordinators	PC was supported by coordinators who reviewed patient prescription refills and office visits and monitored treatment adherence, response, and adverse effects	Study psychiatrists had ongoing contact with PCPs via periodic case reviews and as needed telephone consultation; psychiatric consultations were encouraged for patients not responding to treatment by 10 weeks and those with more complicated depression	PCPs, psychiatrists, and treatment coordinators with some clinical mental health experience	In person and via telephone	Coordinators made telephone contact at 2 weeks, 10 weeks, 18 weeks, and 30 weeks and have an average of 2.7 contacts per patient; followup visits with the PCP were prescheduled at 1, 3, 6, and 10 weeks, subsequent visits occurred approximately every 10 weeks	Usual care

First Author, Year, Site(s)	Intervention: Brief Description	Intervention Duration	Assessment, Education, Skills, Monitoring	Coordination and Continuity of Care	Referral to/Linkages to Community-Based Support Services	Providers	Mode of Delivery Setting(s)	Intensity	Comparison
Crane et al., 2012[88] Hendersonville, NC: 1 site	Care management and drop-in group medical appointments (DIGMAs)	1 year	Small group sessions emphasized life skills; group and individual sessions addressed health and behavioral issues identified by the patient	For patients with a PCP, care other than emotional or group support provided in the program was reported to or coordinated with the PCP. All care was documented in an electronic medical record, including all phone calls. These records could be accessed by physicians in the ED as needed.	Program was based at a county free clinic which provided office space for case manager, room for DIGMA, and variety of wrap-around services to intervention group including free prescriptions at onsite pharmacy	The care team consisted of a family physician, 2 behavioral health providers, and a nurse care manager.	In person in clinic or via telephone	DIGMA visits were scheduled twice a week for 1 hour; small group sessions with care manager, scheduled twice a week for 1 hour; direct telephone access to RN care manager available Monday-Friday, 8AM to 5PM; median number of visits per month per patient was 2 and median number of patient contacts per month was 3.5	Usual care
Adam et al., 2010[92] MN: 1 residency clinic	Family Medicine Care Team	6 months	Care team met to review the healthcare status of a case patient and develop a care plan based on discussions with the patient's primary physician. A member of the team called the patient to schedule a free visit to review the care plan.	The team was interdisciplinary; providing joint care with consultants was encouraged when indicated, as was engaging family members or other stakeholders in the patient's care	Care plans included referrals as needed to care such as mental health treatment or medications	Faculty physician, 4 resident physicians, the clinic psychologist, pharmacist, triage nurse, certified medical assistant, and front desk manager	In person at family medicine residency clinic	Care team met 1 time per week to discuss the care and status of a patient	

First Author, Year, Site(s)	Intervention: Brief Description	Intervention Duration	Assessment, Education, Skills, Monitoring	Coordination and Continuity of Care	Referral to/Linkages to Community-Based Support Services	Providers	Mode of Delivery Setting(s)	Intensity	Comparison
Vickery et al., 2018[90] MN: 1 site	Hennepin Health Accountable Care Organization (ACO)	24 months	Developing patient-specific plans based on need; patient education and goal setting	Connected patients to primary care and other necessary services; increased access to care for mental illness and substance use (behavioral health) including integration within primary care; care coordination and disease management service intensity based on risk	Integrated county services for social and behavioral needs (housing, vocational, social services)with health care; increased access to services to meet social needs; improved access to dental services; high risk patient referred to a Coordinated Care Center	Care coordination team: RN care coordinators embedded in primary care clinics, clinical social workers, CHW Coordinated care center team: physician, NP or PA, care coordinator, social worker, psychologist, pharmacists, licensed chemical dependency counselors, and a part-time addiction psychiatrist support	Patients received care at various care settings; program managed by county	NR; based on patient risk	Usual care: enrolled in non-Hennepin Health managed care in Hennepin or Ramsey County

ACO = Accountable Care Organization; AR = Arizona; CO = Colorado; CPC = Comprehensive primary care; DIGMA = drop-in group medical appointments; DMP = depression management program; ED = emergency department; HCC = hierarchical condition category; KY = Kentucky; MA = Massachusetts; NA = not applicable; NJ = New Jersey; NR = not reported; NY = New York; OH = Ohio; OK = Oklahoma; OR = Oregon; PC = primary care; PCP = primary care provider; PIC = primary intensive care; QI = quality improvement; RN = registered nurse; WA = Washington; WI = Wisconsin.

Appendix Table B-54. Healthcare utilization outcomes for primary care–based model studies

Utilization Measures	Study Design	Direction of Change in Intervention Group (G1)	Direction of Change in Comparison Group (G2)	Difference
ED visits, all-cause	RCT	⇩	⇩	Difference in change over time, G1 vs. G2: (p=0.9)[114]
	RCT	⇧	⇧	Original sample: IRR= 0.94 (95% CI, 0.81 to 1.09)[77]
	RCT	⬆	⬆	**Refresh sample: Lower increase in G1 than G2: IRR=0.75 (95% CI, 0.57 to 0.99)[77]**
	RCT	NR	NR	**Lower use in G1 than G2: aMD=-0.42 (95% CI, -0.13 to -0.72)[101]**
	Observational	NR	NR	G1 vs. G2: Difference = 34.22 (95% CI, -10.9 to 79.3)[90, 108]
	Observational	⬇	⬇	**Greater reduction in G1 than G2: (p=0.005)[88]**
	Observational	⇧	⇩	Difference=0.5 (p=NR)[92]
ED, any (%)	RCT	NR	NR	**Lower use in G1 than G2: aRR=0.64 (95% CI, 0.44 to 0.86)[101]**
ED visits, ACSC	RCT	⇧	⇧	Original sample: IRR= 0.90 (95% CI, 0.70 to 1.16)[77]
	RCT	⇧	⇧	Refresh sample: IRR=0.80 (95% CI, 0.51 to 1.25)[77]
Inpatient admissions, all-cause	RCT	⇩	⇩	Difference in change over time, G1 vs. G2: (p=0.55)[114]
	RCT	⬆	⬆	**Original sample: Lower increase in G1 than G2: IRR=0.81 (95% CI, 0.70 to 0.94)[77]**
	RCT	⬆	⬆	**Refresh sample: Lower increase in G1 than G2: IRR: 0.76 (95% CI, 0.58 to 0.99)[77]**
	RCT	NR	NR	**Lower use in G1 than G2 (mean # of admissions): 0.44 vs. 0.81 (p=0.04)[101]**
	RCT	⇧	⇩	G1 vs. G2: (p=0.09)[89]
	Observational	NR	NR	**Lower use in G1 vs. G2: Difference=-26.11 (95% CI, -35.9 to -16.3)[90, 108]**
	Observational	--	--	Difference=0 (p=NR)[92]
Inpatient admissions, any (%)	RCT	⬆	⬆	**Original sample: Lower increase in G1 than G2, OR=0.65 (95% CI, 0.55 to 0.78}[77]**
	RCT	⬇	⬆	**Refresh sample: Greater reduction in G1 than G2, OR=0.66 (95% CI, 0.48 to 0.90)[77]**
Inpatient admissions, ACSC	RCT	⇧	⇧	Original sample: IRR=0.87 (95% CI, 0.66 to 1.14)[77]
	RCT	⇧	⇧	Refresh sample: IRR=0.78 (95% CI, 0.49 to 1.24)[77]
Inpatient admissions, any ACSC (%)	RCT	⬆	⬆	**Original sample: Lower increase in G1 than G2, OR=0.73 (95 %CI, 0.57 to 0.95)[77]**
	RCT	⇧	⇧	Refresh sample: OR=0.79 (95% CI, 0.51 to 1.21)[77]
Inpatient days	Observational	NR	NR	G1 vs. G2: Difference = -219.7 (95% CI, -826 to 386.6)[90, 108]
Primary care visits	RCT	⇧	⇩	Difference in change over time, G1 vs. G2: (p=0.055) [114]
	RCT	NR	NR	G1 vs. G2: (p=0.20)[101]
	Observational	NR	NR	G1 vs. G2: Difference=6.0 (95% CI: -39.3 to 51.4)[90, 108]

Utilization Measures	Study Design	Direction of Change in Intervention Group (G1)	Direction of Change in Comparison Group (G2)	Difference
Outpatient visits	RCT	⬆	⬇	**Greater increase in G1 than G2: (p=0.02)[89]**
	Observational	⇩	⇧	Difference=4.5 (p=NR)[92]
Filled ≥3 antidepressant prescriptions in first 6 months	RCT	NR	NR	**Greater use in G1 than G2: (p<0.001)[89]**
Specialty mental health visit in first 6 months	RCT	NR	NR	**Greater use in G1 than G2: (p=0.03)[89]**
Cancelled visits and/or no shows	Observational	⇧	⇩	Difference=3.5 (p=NR)[92]
Intensive care unit visits	Observational	NR	NR	G1 vs. G2: Difference=0.1 (95% CI: -0.7 to 0.9)[90, 108]
Dental visits	Observational	NR	NR	**Greater reduction in G1 vs. G2: Difference=-30.7 (95% CI, -41.0 to -20.3)[90, 108]**

[a] Outpatient visits were defined as primary care visits and group intervention visits for the intervention group, and as primary care visits only for the comparison group.

ACSC = ambulatory care sensitive conditions; aMD = adjusted mean difference; aRR = adjusted risk ratio; CI = confidence interval; DiD = difference-in-difference; ED = emergency department; G = group; IRR = incidence rate ratio; NR = not reported; NS = not statistically significant; PC = primary care; PCR = primary care related; RCT = randomized controlled trial; vs. = versus.

Appendix Table B-55. Strength of evidence for primary care–based models vs. usual care outcomes

Population	Outcome	Results	Study Design and Sample Size	Strength of Evidence Domains	Overall Evidence Strength (Direction of Effect)
HNHC patients	ED visits, all cause	PIC: Diff in change over time (p = 0.9)[114] MGH CMP original sample: IRR= 0.94 (95% CI, 0.81 to 1.09)[77] MGH CMP refresh sample: IRR=0.75 (95% CI, 0.57 to 0.99)[77] Group visit RCT: aMD=-0.42 (95% CI, -0.13 to -0.72)[101] HH ACO: diff = 34.22 (95% CI, -10.9 to 79.3)[90, 108] Bridges to Health: Greater reduction in G1 than G2: (p=0.005)[88]; Interdisciplinary Pilot: Diff=0.5 (p=NR)[92]	4 RCTs, N=7,334 3 OBS, N=92,984	Moderate study limitations (two high RoB OBS studies),[88, 92] consistent, imprecise, direct	Low for benefit
HNHC patients	ED visits, ACSC	MGH CMP original sample: IRR= 0.90 (95% CI, 0.70 to 1.16)[77] MGH CMP refresh sample: IRR=0.80 (95% CI, 0.51 to 1.25)[77]	2 RCTs, N=6,943	Moderate study limitations, consistent imprecise, direct	Insufficient
HNHC patients	Inpatient admissions, all cause	PIC: diff in change over time: (p=0.55)[114] MGH CMP original sample: IRR=0.81 (95% CI, 0.70 to 0.94)[77] MGH CMP refresh sample: IRR: 0.76 (95% CI, 0.58 to 0.99)[77] Group visit RCT: less use in G1 than G2: 0.44 vs. 0.81, (p=0.04)[101] DMP: G1 vs. G2: (p=0.09)[89] HH ACO: G1 vs. G2: Diff= -26.11 (95% CI, -35.9 to -16.3)[90, 108] Interdisciplinary Pilot: diff=0 (p=NR)[92]	5 RCTs, N=7,741 2 OBS, N=92,912	Moderate study limitations (one high RoB OBS studies),[88] consistent, precise, direct	Moderate for benefit
HNHC patients	Inpatient admissions, any (%)	MGH CMP: original sample: OR=0.65 (95% CI, 0.55 to 0.78)[77] MGH CMP refresh sample: OR=0.66 (95% CI, 0.48 to 0.90)[77]	2 RCTs, N=6,943	Moderate study limitations, consistent, precise, direct	Moderate for benefit
HNHC patients	Inpatient admissions, ACSC	MGH CMP original sample: IRR=0.87 (95% CI, 0.66 to 1.14);[77] MGH CMP refresh sample: IRR=0.78 (95% CI, 0.49 to 1.24)[77]	2 RCTs, N=6,943	Moderate study limitations, consistent, imprecise, direct	Insufficient
HNHC patients	Inpatient admissions, any ACSC (%)	MGH CMP original sample: OR=0.73 (95% CI, 0.57 to 0.95);[77] MGH CMP refresh sample: OR=0.79 (95% CI, 0.51 to 1.21)[77]	2 RCTs, N=6,943	Moderate study limitations, consistent, imprecise, direct	Insufficient
HNHC patients	PCP visits	PIC: diff in change over time: (p=0.055);[114] RCT group visits: G1 vs. G2: (p=0.20);[101] HH ACO: G1 vs. G2: Diff=6.0 (95% CI: -39.3 to 51.4)[90, 108]	2 RCTs, N=391 1 OBS, N=92,891	Moderate study limitations, inconsistent imprecise, direct	Insufficient
HNHC patients	Outpatient visits	DMP: greater use in G1 than G2: (p=0.02)[89] Interdisciplinary Pilot: diff=4.5 (p=NR)[92]	1 RCT, N=407 1 OBS, N=21	High study limitations (one high RoB OBS studies)[92] imprecise, inconsistent, direct	Insufficient

Population	Outcome	Results	Study Design and Sample Size	Strength of Evidence Domains	Overall Evidence Strength (Direction of Effect)
HNHC patients	Total cost	PIC: Diff in change over time, G1 vs. G2: (p=0.82)[114] MGH CMP: original sample DiD: -288 (p<0.01)[77] MGH CMP: refresh sample DiD: -355 (p<0.05)[77]	3 RCTs, N=7,039	Moderate study limitations, consistent, imprecise, direct	Low for benefit
HNHC patients	Mortality rate	MGH CMP: original sample diff: G1 vs. G2, -1.63 (p=0.19);[77] MGH CMP: refresh sample diff: G1 vs. G2: -3.97 (p=0.04)[77]	2 RCTs, N=6,943	Moderate study limitations, imprecise, inconsistent, direct	Insufficient
HNHC patients	Influenza vaccine	MGH CMP: original sample DiD OR=0.79 (95% CI, 0.66 to 0.95)[77] MGH CMP refresh sample DiD: OR=0.64 (95% CI, 0.46 to 0.87)[77]	2 RCTs, N=6,943	Moderate study limitations, consistent, precise, direct	Moderate for harms
HNHC patients Diabetes subgroup	HbA1c test	MGH CMP, original sample: DiD OR=0.99 (95% CI, 0.56 to 1.76)[77] MGH CMP refresh sample: DiD OR=0.70 (95% CI, 0.27 to 1.84)[77]	2 RCTs, N=1,959	Moderate study limitations, consistent, imprecise, direct	Insufficient
HNHC patients Diabetes subgroup	LDL-C test	MGH CMP original sample: DiD OR=0.85 (95% CI, 0.58 to 1.24)[77] MGH CMP refresh sample: DiD OR=1.72 (95% CI, 0.86 to 3.42)[77]	2 RCTs, N=1,959	Moderate study limitations, inconsistent, imprecise, direct	Insufficient
HNHC patients IVD subgroup	LDL-C test	MGH CMP original sample: DiD OR=0.92 (95% CI, 0.63 to 1.33)[77] MGH refresh sample: DiD OR=1.40 (95% CI, 0.76 to 2.58)[77]	2 RCTs, N=1,923	Moderate study limitations, inconsistent, imprecise, direct	Insufficient

ACSC = ambulatory care sensitive conditions; aMD = adjusted mean difference; CI = confidence interval; DiD = difference-in-difference; G = group; HbA1c = hemoglobin A1c; HH ACO = Hennepin Health Accountable Care Organization; HNHC= high-need, high-cost; IRR = incidence rate ratio; IVD = ischemic vascular disease; LDL-C = low-density lipoprotein cholesterol; MGH CMP = Massachusetts General Hospital, Care Management Program, N = number; NR = not reported; OBS = observational study; OR = odds ratio; PIC = Primary Intensive Care; PC = primary care; RCT = randomized controlled trial; RoB = risk of bias; SOE = strength of evidence; vs. = versus.

Appendix Table B-56. Cost outcomes for primary care–based model studies

Cost Measures	Study Design	Direction of Change in Intervention Group (G1)	Direction of Change in Comparison Group (G2)	Difference
Total cost	RCT	⇩	⇩	Difference in change over time, G1 vs. G2: (p=0.82)[114]
	RCT	⬆	⬆	**Original sample DiD: Lower increase in G1 than G2: -288 (82.1), (p<0.01)[77]**
	RCT	⬆	⬆	**Refresh sample DiD: Lower increase in G1 than G2: -355 (157.6), p<0.05[77]**

DiD = difference-in-difference; G = group; PBPM = per-beneficiary per-month; RCT = randomized controlled trial; vs. = versus.

Appendix Table B-57. Clinical and functional outcomes for primary care–based model studies

Clinical and Functional Outcomes	Study Design	Difference Between Intervention Group (G1) and Comparison Group (G2)
Mortality rate	RCT	Original sample difference: G1 vs. G2, -1.63 (p=0.19)[77]
	RCT	**Refresh sample difference: Lower in G1 than G2: -3.97 (p=0.04)[77]**
Influenza vaccine	RCT	**Original sample DiD: Increased less in G1 than G2: OR=0.79 (95% CI, 0.66 to 0.95)[77]**
	RCT	**Refresh sample DiD: Increased less in G1 than G2: OR=0.64 (95% CI, 0.46 to 0.87)[77]**
PHC score	RCT	Better in G1 than G2: ANCOVA-adjusted intervention effect = 2.3, p<0.01[77]
MHC score	RCT	ANCOVA-adjusted intervention effect = 1.1, p>0.05[77]
PQH-2 score (depression 0 to 6)	RCT	ANCOVA-adjusted intervention effect = -0.03, p>0.05[77]
Number of ADLs difficult to do (0 to 6)	RCT	ANCOVA-adjusted intervention effect = -0.28, p>0.05[77]
Number ADLs receiving help (0 to 6)	RCT	ANCOVA-adjusted intervention effect = -0.21, p>0.05[77]
Patient satisfaction	RCT	Difference in change over time, G1 vs. G2: p = 0.30[114]
SF-36 Summary Score	RCT	Difference in change over time, G1 vs. G2: p = 0.32[114]
SF-36 Mental Health Function Score	RCT	Difference in change over time, G1 vs. G2: p = 0.6[114]
Change in Ham-D score	RCT	Greater decrease in G1 than G2: p<0.001[89]
In remission (Ham-D <7)	RCT	Higher proportion in G1 than G2: p<0.001[89]
SF-20 subscale: Social Functioning	RCT	Better in G1 than G2: p<0.05 (data NR)[89]
SF-20 subscale: Mental Health	RCT	Better in G1 than G2: p<0.05 (data NR)[89]
SF-20 subscale: General Health	RCT	Better in G1 than G2: p<0.05 (data NR)[89]
SF-20 subscale: Physical Functioning	RCT	G1 vs. G2: p=NS (data NR)[89]
SF-20 subscale: Role Functioning	RCT	G1 vs. G2: p=NS (data NR)[89]
SF-20 subscale: Pain Perception	RCT	G1 vs. G2: p=NS (data NR)[89]
Helping to cope with a chronic condition (1 to 5)	RCT	G1 vs. G2 (N=590): ANCOVA-adjusted intervention effect = 0.16, p>0.05[77]
Number of helpful discussion topics (0 to 5)	RCT	G1 vs. G2 (N=590): ANCOVA-adjusted intervention effect = -0.02, p>0.05[77]
Discussing treatment choices (1 to 4)	RCT	**Better score in G1 than G2: ANCOVA-adjusted intervention effect = 0.26, p<0.01[77]**
Communicating with providers (0 to 100)	RCT	**Better score in G1 than G2: ANCOVA-adjusted intervention effect = 4.5, p<0.05[77]**

Clinical and Functional Outcomes	Study Design	Difference Between Intervention Group (G1) and Comparison Group (G2)
Getting answers to questions quickly (0 to 100)	RCT	G1 vs. G2 (N=590): ANCOVA-adjusted intervention effect = 5.0, p>0.05[77]
Multimorbidity Hassles score (0 to 24)	RCT	G1 vs. G2 (N=590): ANCOVA-adjusted intervention effect = -0.27, p>0.05[77]
Percent receiving help setting goals	RCT	G1 vs. G2 (N=590): ANCOVA-adjusted intervention effect = -5.6, p>0.05[77]
Percent receiving help making a care plan	RCT	G1 vs. G2 (N=590): ANCOVA-adjusted intervention effect = 2.3, p>0.05[77]
Self-efficacy: Take all medications (1 to 5)	RCT	G1 vs. G2 (N=590): ANCOVA-adjusted intervention effect = 0.05, p>0.05[77]
Self-efficacy: Plan meals and snacks (1 to 5)	RCT	G1 vs. G2 (N=590): ANCOVA-adjusted intervention effect = 0.01, p>0.05[77]
Self-efficacy: Exercise 2 or 3 times weekly (1 to 5)	RCT	G1 vs. G2 (N=590): ANCOVA-adjusted intervention effect = 0.11, p>0.05[77]
Self-care activities: Prescribed medications taken (mean # of days)	RCT	G1 vs. G2 (N=590): ANCOVA-adjusted intervention effect = -0.10, p>0.05[77]
Self-care activities: Followed healthy eating plan (mean # of days)	RCT	G1 vs. G2 (N=590), ANCOVA-adjusted intervention effect = -0.16, p>0.05
Self-care activities: 30 minutes of continuous physical activity (mean # of days)	RCT	G1 vs. G2 (N=590): ANCOVA-adjusted intervention effect = -0.05, p>0.05[77]

ADL = activities of daily living; ANCOVA = analysis of covariance; CI = confidence interval; DiD = difference-in-difference; Ham-D = Hamilton Depression Rating Scale; HbA1c = hemoglobin A1c; G = group; LDL-C = low density lipoprotein cholesterol; MHC = mental health composite; NR = not reported; NS = not statistically significant; PHC = physical health composite; PHQ-2 = Patient Health Questionnaire-2; RCT = randomized controlled trial; SF = short form; vs. = versus.

Appendix Table B-58. Clinical and functional outcomes for primary care–based model studies: Subgroup outcomes

Clinical and Functional Outcomes	Study Design	Difference Between Intervention Group (G1) and Comparison Group (G2)
HbA1c test	RCT	Original sample diabetes subgroup: DiD OR=0.99 (95% CI, 0.56 to 1.76)[77]
	RCT	Refresh sample diabetes subgroup: DiD OR=0.70 (95% CI, 0.27 to 1.84)[77]
LDL-C test	RCT	Original sample diabetes subgroup: DiD OR=0.85 (95% CI, 0.58 to 1.24)[77]
	RCT	Refresh sample diabetes subgroup: DiD OR=1.72 (95% CI, 0.86 to 3.42)[77]
	RCT	Original sample IVD subgroup: DiD OR=0.92 (95% CI, 0.63 to 1.33)[77]
	RCT	Refresh sample IVD subgroup: DiD OR=1.40 (95% CI, 0.76 to 2.58)[77]

CI = confidence interval; DiD = difference-in-difference; HbA1c = hemoglobin A1c; IVD = ischemic vascular disease LDL-C = low density lipoprotein cholesterol; OR = odds ratio; RCT = randomized controlled trial.

Appendix Table B-59. Social risk outcomes for primary care–based model studies

Patient-Reported Quality Measures	Study Design	Difference Between Intervention Group (G1) and Comparison Group (G2)
Overall wellbeing	Observational	G1 vs. G2: p=NR[92]

G = group; NR = not reported; vs. = versus.

Appendix Table B-60. Study characteristics for home-based care interventions

First Author, Year, Site(s)	Sample Size	Study Design (Risk of Bias Assessment)	Patient Selection: High Healthcare Use or Cost; Time Period	Patient Selection: Chronic Conditions	Patient Selection: Other	Additional Selected Patient Characteristics
McCall et al., 2010[75] CA, FL, TX	(original N=16,077) Intervention (N=11,516) Comparison (N=4,561) (COPD subgroup N=3344) Intervention (N=2384) Comparison (N=960) (Diabetes subgroup N=4502) Intervention (N=3223) Comparison (N=1279) (IVD subgroup N=7356) Intervention (N=5223) Comparison (N=2133) (High cost only PBPM subgroup N=4344) Intervention (N=3105) Comparison (N=1239) (High cost and high risk PBPM subgroup N=6802) Intervention (N=4845) Comparison (N=1957)	RCT (RoB: some concerns)	High costs with top 5% of costs and 2+ hospitalizations in past 1 year	1+ diagnosis from a list, such as heart failure; HCC score was ≥2.75 OR if had an HCC score <2.75, had a diagnosis of selected clinical conditions including peripheral vascular disease, ischemic heart disease, hypertensive heart and/or kidney disease, heart failure, chronic obstructive pulmonary disease (COPD), and asthma	Medicare FFS beneficiaries	Nonwhite: 27% Mean HCC: 2.8

First Author, Year, Site(s)	Sample Size	Study Design (Risk of Bias Assessment)	Patient Selection: High Healthcare Use or Cost; Time Period	Patient Selection: Chronic Conditions	Patient Selection: Other	Additional Selected Patient Characteristics
McCall et al., 2010[75] CA, FL, TX	(refresh N=18,344) Intervention (N=13,104) Comparison (N=5,240) (COPD subgroup N=4735) Intervention (N=3393) Comparison (N=1342) (Diabetes subgroup N=5950) Intervention (N=4199) Comparison (N=1751) (IVD subgroup N=7554) Intervention (N=5384) Comparison (N=2170) (High cost only PBPM subgroup N=1414) Intervention (N=1027) Comparison (N=387) (High cost and high risk PBPM subgroup N=8598) Intervention (N=6142) Comparison (N=2456)	RCT (RoB: some concerns)	2+ hospitalizations in past 1 year	HCC score was >2.749	Medicare FFS beneficiaries; excluded benes with drug/alcohol psychosis or dependence, major depressive, bipolar, and paranoid disorders; institutionalized in last 3 months of previous year; had a hospital claims where discharge date was equal to admission date	Nonwhite: 40% Mean HCC: 3.8

First Author, Year, Site(s)	Sample Size	Study Design (Risk of Bias Assessment)	Patient Selection: High Healthcare Use or Cost; Time Period	Patient Selection: Chronic Conditions	Patient Selection: Other	Additional Selected Patient Characteristics
Kimmy et al., 2019[93] National: 14 practices	(Home-based care N=181,001) Intervention (N=30,324) Comparison (N=150,677)	Observational study (RoB: some concerns)	Hospitalization and use of acute or subacute rehabilitation services; and 1+ home visit from the Independence at Home practice in past 1 year	2+ chronic conditions 2+ ADLs that require human assistance New to home-based primary care (2+ E&M visits from a primary care clinician in the home or an assisted living facility during the 6-month period starting with the first home visit Majority of E&M visits from a primary care clinician during the same period must have taken place in the home or assisted living facility.	Medicare FFS beneficiaries; new patients receiving home-based primary care who were IAH eligible and lived in an area served by an IAH practice	CC (risk score): 3.686 Chronically critically ill/medically complex: 29.1% Depression: 31.9%

ADL = activities of daily living; APM = advanced alternative payment model; CA = California; CC = chronic conditions; COPD = chronic obstructive pulmonary disease; E&M = evaluation and management; FFS = fee-for-service; FL = Florida; HCC = Hierarchical condition category; IAH = independence at home; N = number; OR = odds ratio; PBPM = per beneficiary per month; RoB = risk of bias; TX = Texas.

Appendix Table B-61. Intervention characteristics for home-based models

First Author, Year, Site(s)	Intervention: Brief Description	Intervention Duration	Assessment, Education, Skills, Monitoring	Coordination and Continuity of Care	Referral to/Linkages to Community-Based Support Services	Providers	Mode of Delivery Setting(S)	Intensity	Comparison
McCall et al., 2010[75] CA, FL, TX	Evaluation of Medicare Care Management for High Cost Beneficiaries (CMHCB) Demonstration: Care Level Management (CLM) home-based primary care for patients with multiple chronic conditions	Up to 29 months for original population, up to 18 months for refresh population	Assessment tool on patient acuity: number of admissions and emergency room visits within the last 6 months, presence of unmet social and emotional needs, expected number of PVP visits needed in the next 30 days, and presence of compliance, psychiatric or ongoing home health issues	Provided home-based care and 24/7 access to a PVP to patients; care management addressed adherence to treatment regimens, coordination of care services, end-of-life planning, home safety, socioeconomic issues, psychosocial issues, and medication management	helped selected beneficiaries receive services from community-based ancillary services as needed	PVPs, NPs to support PVPs, nurse care managers as patient advocates and care coordinators (PVPs were adjuncts to patients' PCP)	Face to face and by phone	12% had no contact 75% of beneficiaries had one or more physician visits, 22% had 10 or more visits, and 14% had 20 or more visits. 88% of beneficiaries received a telephone call from a nurse or physician, while 24% received 10 or more calls, and 39% of beneficiaries received 20 or more calls	Usual care

First Author, Year, Site(s)	Intervention: Brief Description	Intervention Duration	Assessment, Education, Skills, Monitoring	Coordination and Continuity of Care	Referral to/Linkages to Community-Based Support Services	Providers	Mode of Delivery Setting(S)	Intensity	Comparison
Kimmy et al., 2019[93] Effect of home-based primary care National: 14 practices	Practices may earn an additional payment if their chronically ill, functionally limited patients' Medicare expenditures are below an estimated spending target and if the practice meets required standards for a set of quality measures	Up to 4 years	Clinicians are available at all hours of the day; carry out individualized care plans; and use electronic health information systems, remote monitoring, and mobile diagnostic technology	Report on other measures, including fall risk assessments and depression screenings, to promote the provision of such care	Some practices added social workers or other staff to coordinate care for their patients with other organizations	Physicians or nurse practitioners. Team may have also included physician assistants, clinical staff, and other health and social services staff	Face to face	Clinicians made 3-15 home visits per day, varied by site	Usual care - Patients who did not receive primary care in the home during the six months after their index date

CA = California; CLM = care level management; CMHCB = Care Management for High Cost Beneficiaries; EMR = electronic medical record; FL = Florida; IAH = Independence at home; NP = nurse practitioner; NR = not reported; PCP = primary care provider; PVP = personal visiting physician; TX = Texas.

Appendix Table B-62. Healthcare utilization outcomes for home-based care model studies

Utilization Measures	Study Design	Direction of Change in Intervention Group (G1)	Direction of change in Comparison Group (G2)	Difference
Inpatient admissions, all-cause	RCT	⇩	⇩	Original sample DiD: IRR=0.94 (95% CI, 0.87 to 1.01)[75]
	RCT	⇩	⇩	Refresh sample DiD: IRR=0.94 (95% CI, 0.88 to 1.00)[75]
	Observational	NR	NR	**Lower reduction in G1 than G2: Home-based care DiD=0.05 (90% CI, 0.01 to 0.09)[93]**
Inpatient admissions, any all cause (%)	RCT	⇩	⇩	Original sample DiD: OR=1.05 (95% CI, 0.93 to 1.18)[75]
	RCT	⇩	⇩	Refresh sample DiD: OR=.93 (95% CI, 0.85 to 1.03)[75]
Inpatient admissions, ACSC	RCT	⬇	⬆	**Greater reduction in G1 than G2: Original sample DiD: IRR=0.86 (95% CI, 0.76 to 0.97)[75]**
	RCT	⬇	⬆	**Greater reduction in G1 than G2: Refresh sample DiD: IRR=0.89 (95% CI, 0.81 to 0.99)[75]**
	Observational	NR	NR	Home-based care sample DiD=0.00 (90% CI, -0.02 to 0.02)[93]
Inpatient admissions, any ACSC (%)	RCT	⬇	⬇	**Greater reduction in G1 than G2: Original sample DiD: OR=0.87 (95% CI, 0.77 to 0.99)[75]**
	RCT	⬇	⬇	**Greater reduction in G1 than G2: Refresh sample DiD: OR=.90 (95% CI, 0.81 to 1.00)[75]**
ED visits, all-cause	RCT	⇩	⇩	Original sample DiD: IRR=0.88 (95% CI, 0.69 to 1.12)[75]
	RCT	⇧	⇧	Refresh sample DiD: IRR=0.95 (95% CI, 0.85 to 1.07)[75]
	Observational	NR	NR	Home-based care DiD=0.00 (90% CI, -0.04 to 0.05) (p>0.10)[93]
ED visits, ACSC	RCT	⇩	⇩	Original sample DiD: IRR=.89 (95% CI, 0.66 to 1.18)[75]
	RCT	⇧	⇧	Refresh sample DiD: IRR=1.06 (95% CI, 0.87 to 1.30)[75]
	Observational	NR	NR	Home-based care DiD=0.00 (90% CI, -0.02 to 0.01) (p>0.10)[93]

ACSC = ambulatory care sensitive conditions; CI = confidence interval; DiD = difference-in-difference; ED = emergency department; G = group; IRR = incidence rate ratio; NR = not reported; RCT = randomized controlled trial; SE = standard error; SNF = skilled nursing facility.

Appendix Table B-63. Strength of evidence for home-based care models vs. usual care outcomes

Population	Outcome	Results	Study Design and Sample Size	Strength of Evidence Domains	Overall Evidence Strength (Direction of Effect)
HNHC patients	Inpatient admissions, all-cause	CLM original sample: IRR=0.94 (95% CI, 0.87 to 1.01);[75] CLM refresh sample: IRR=0.94 (95% CI, 0.88 to 1.00);[75] IAH home-based care: lower reduction in G1 than G2: DiD=0.05 (90% CI, 0.01 to 0.09)[93]	2 RCTs, N=34,421 1 OBS, N=181,246	Moderate study limitations, imprecise, inconsistent, direct	Insufficient
HNHC patients	Inpatient admissions, ACSC	CLM original sample: DiD: IRR=0.86 (95% CI, 0.76 to .97)[75] CLM refresh sample: DiD: IRR=0.89 (95% CI, 0.81 to .99)[75] IAH home-based care sample: DiD=0.00 (90% CI, -0.02 to 0.02)[93]	2 RCTs, N=34,421 1 OBS, N=181,246	Moderate study limitations, imprecise, consistent, direct	Low for benefit
HNHC patients	Inpatient admissions, any all cause (%)	CLM original sample: DiD: OR=1.05 (95% CI, 0.93 to 1.18)[75] CLM refresh sample: DiD: OR=.93 (95% CI, 0.85 to 1.03)[75]	2 RCTs, N=34,421	Moderate study limitations, imprecise, inconsistent, direct	Insufficient
HNHC patients	Inpatient admissions, any ACSC (%)	CLM original sample: DiD: OR=0.87 (95% CI, 0.77 to 0.99);[75] CLM refresh sample: DiD: OR=0.90 (95% CI, 0.81 to 1.00)[75]	2 RCTs, N=34,421	Moderate study limitations; precise, consistent, direct	Moderate for benefit
HNHC patients	ED visits, all-cause	CLM original sample DiD: IRR=0.88 (95% CI, 0.69 to 1.12)[75] CLM refresh sample DiD: IRR=0.95 (95% CI, 0.85 to 1.07)[75] IAH home-based care: higher use in G1 than G2: DiD=0.00 (90% CI, -0.04 to 0.05), (p>0.10)[93]	2 RCTs, N=34,421 1 OBS, N=181,246	Moderate study limitations, imprecise, inconsistent, direct	Insufficient
HNHC patients	ED visits, ACSC	CLM original sample DiD: IRR=0.89 (95% CI, 0.66 to 1.18)[75] CLM refresh sample DiD: IRR=1.06 (95% CI, 0.87 to 1.30)[75] IAH home-based care sample DiD=0.00 (90% CI, -0.02 to 0.01, p>0.10)[93]	2 RCTs, N=34,421 1 OBS, N= 181,246	Moderate study limitations, inconsistent, imprecise, direct	Insufficient

Population	Outcome	Results	Study Design and Sample Size	Strength of Evidence Domains	Overall Evidence Strength (Direction of Effect)
HNHC patients	Total cost	CLM original sample DiD=41 (p>0.05);[75] CLM refresh sample DiD=-29 (p>0.05)[75] IAH home-based care sample DiD=451 (90% CI, 342.4 to 559.6, p<0.10)[93]	2 RCTs, N=34,421 1 OBS, N= 181,246	Moderate study limitations, inconsistent, imprecise, direct	Insufficient
High cost, high risk patient subgroup	Total cost	CLM original sample: DiD=107 (p>0.05);[75] CLM refresh sample DiD= -21 (p>0.05)[75]	2 RCTs, N=15,400	Moderate study limitations, inconsistent, imprecise, direct	Insufficient
High cost only patient subgroup	Total cost	CLM original sample DiD=-170 (p>0.05);[75] CLM refresh sample: DiD=-236 (p>0.05)[75]	2 RCTs, N=5,758	Moderate study limitations, consistent, imprecise, direct	Insufficient
HNHC patients	Mortality rate	CLM original sample: diff in mean rate=0.4, (p=0.63);[75] CLM refresh sample: Diff in mean rate=0.1 (p=0.88)[75]	2 RCTs, N=34,421	Moderate study limitations, consistent, imprecise, direct	Insufficient
HNHC patients	Influenza vaccine	CLM original sample: DiD OR=1.15 (95% CI, 1.02 to 1.30)[75] CLM refresh sample: DiD OR=1.15 (95% CI, 1.03 to 1.27)[75]	2 RCTs, N=34,421	Moderate study limitations, consistent, precise, direct	Moderate for benefit
HNHC patients COPD subgroup	Oxygen saturation test	CLM original sample: DiD OR=1.02 (95% CI, 0.77 to 1.34);[75] CLM refresh sample: DiD OR=0.97 (95% CI, 0.77 to 1.22)[75]	2 RCTs, N=8,079	Moderate study limitations, inconsistent, imprecise, direct	Insufficient
HNHC patients Diabetes subgroup	HbA1c test	CLM original sample: DiD OR=0.91 (95% CI, 0.74 to 1.13)[75] CLM refresh: DiD OR=0.98 (95% CI, 0.82 to 1.18)[75]	2 RCTs, N=10,452	Moderate study limitations, consistent, imprecise, direct	Insufficient
HNHC patients Diabetes subgroup	LDL-C test	CLM original sample: DiD OR=0.92 (95% CI, 0.75 to 1.12)[75] CLM refresh sample: DiD OR=0.97 (95% CI, 0.77 to 1.22)[75]	2 RCTs, N=10,452	Moderate study limitations, consistent, imprecise, direct	Insufficient
IVD patient Subgroup	LDL-C test	CLM original sample: DiD OR=0.89 (95% CI, 0.76 to 1.05);[75] CLM refresh sample: DiD OR=0.95 (95% CI, 0.81 to 1.11)[75]	2 RCTs, N=14,910	Moderate study limitations, consistent, imprecise, direct	Insufficient

ACSC = ambulatory care sensitive conditions; CI = confidence interval; COPD = chronic obstructive pulmonary disease; DiD = difference-in-difference; ED = emergency department; G = group; HbA1C = hemoglobin A1c; HNHC= high-need, high-cost; IRR = incidence rate ratio; IVD = ischemic vascular disease; LDL-C = low-density lipoprotein cholesterol; N = number; NS = not statistically significant; OBS = observational study; OR = odds ratio; PBPM = per-beneficiary per-month; RCT = randomized controlled trial; SE = standard error; SOE = strength of evidence; vs. = versus.

Appendix Table B-64. Cost outcomes for home-based care model studies

Cost Measures	Study Design	Direction of Change in Intervention Group (G1)	Direction of Change in Comparison Group (G2)	Difference
Total cost	RCT	⇩	⇩	Original sample DiD=41 (SE: 67.9) (p>0.05)[75]
	RCT	⇧	⇧	Refresh sample DiD=-29 (SE: 73.1) (p>0.05)[75]
	Observational	NR	NR	**Greater increase in G1 than G2: Home-based care DiD=$451 (SE: 66) (90% CI, 342.4 to 559.6)[93]**

CI = confidence interval; DiD = difference in difference; G = group; NR = not reported; NS = not statistically significant; PBPM = per-beneficiary per-month; RCT = randomized controlled trial; SE = standard error.

Appendix Table B-65. Cost outcomes for home-based care model studies: Subgroup outcomes

Cost Measures	Study Design	Direction of Change in Intervention Group (G1)	Direction of Change in Comparison Group (G2)	Difference
Total cost	RCT	⇩	⇩	Original sample high cost, high risk subgroup DiD=107 (SE: 127.6) (p>0.05)[75]
	RCT	⇩	⇩	Refresh sample high cost, high risk subgroup DiD= -21 (SE: 121.3) (p>0.05)[75]
	RCT	⇩	⇩	Original sample high cost only subgroup DiD=-170 (SE: 104.0) (p>0.05)[75]
	RCT	⇩	⇩	Refresh sample high cost only subgroup DiD=-236 (SE: 197.5) (p>0.05)[75]

CI = confidence interval; DiD = difference-in-difference; G = group; NR = not reported; NS = not statistically significant; PBPM = per-beneficiary per-month; RCT = randomized controlled trial; SE = standard error.

Appendix Table B-66. Clinical and functional outcomes for home-based care model studies

Clinical and Functional Outcomes	Study Design	Difference Between Intervention Group (G1) and Comparison Group (G2)
Mortality rate	RCT	Original sample: Difference in mean rates=0.4, (p=0.63)[75]
	RCT	Refresh sample: Difference in mean rates=0.1 (p=0.88)[75]
Influenza vaccine	RCT	**DiD greater in G1 than G2: Original sample: DiD OR=1.15 (95% CI, 1.02 to 1.30)[75]**
	RCT	**DiD greater in G1 than G2: Refresh sample: DiD OR=1.15 (95% CI, 1.03 to 1.27)[75]**
PHC score (physical health)	RCT	**Greater in G1 than G2: ANCOVA-adjusted IE=2.1 (p<0.05[75])**
MHC score (mental health)	RCT	ANCOVA-adjusted IE=1.7 (p>0.05[75])
PHQ-2 score (depression)	RCT	ANCOVA-adjusted IE=0.26 (p>0.05[75])
Number of activities of daily living (ADLs) difficult to do	RCT	ANCOVA-adjusted IE=0.03 (p>0.05[75])
Number ADLs receiving help	RCT	ANCOVA-adjusted IE=0.00 (p>0.05[75])
Helping to cope with a chronic condition	RCT	ANCOVA-adjusted IE=0.19 (p>0.05[75])
Number of helpful discussion topics	RCT	ANCOVA-adjusted IE=0.20 (p>0.05[75])
Discussing treatment choices	RCT	**Greater in G1 than G2: ANCOVA-adjusted IE=0.23 (p<0.05[75])**
Communicating with providers	RCT	**Greater in G1 than G2: ANCOVA-adjusted IE=6.55 (p<0.01[75])**
Getting answers to questions quickly	RCT	ANCOVA-adjusted IE=4.90 (p>0.05[75])
Multimorbidity Hassles score	RCT	ANCOVA-adjusted IE=-0.44 (p>0.05[75])
Percent receiving help setting goals	RCT	ANCOVA-adjusted IE=6.1 (p>0.05[75])
Percent receiving help making a care plan	RCT	ANCOVA-adjusted IE=3.9 (p>0.05[75])
Self-efficacy: Take all medications	RCT	ANCOVA-adjusted IE=0.20 (p>0.05[75])
Self-efficacy: Plan meals and snacks	RCT	ANCOVA-adjusted IE=0.15 (p>0.05[75])
Self-efficacy: Exercise 2 or 3 times weekly	RCT	ANCOVA-adjusted IE=0.20 (p>0.05[75])
Self-care activities: Prescribed medications taken	RCT	ANCOVA-adjusted IE=0.06 (p>0.05[75])
Self-care activities: Followed healthy eating plan	RCT	ANCOVA-adjusted IE=-0.03 (p>0.05[75])
Self-care activities: 30 minutes of continuous physical activity	RCT	**Greater in G1 than G2: ANCOVA-adjusted IE=0.63 (p<0.05[75])**

ADL = activities of daily living; ANCOVA = analysis of covariance; CI = confidence interval; DiD = difference-in-difference; G = group; IE = intervention effect; ; MHC = mental health composite; OR = odds ratio; PHC = physical health composite; PHQ-2 = patient health questionnaire-2; RCT = randomized controlled trial.

Appendix Table B-67. Clinical and functional outcomes for home-based care model studies: Subgroup outcomes

Clinical and Functional Outcomes	Study Design	Difference Between Intervention Group (G1) and Comparison Group (G2)
Oxygen saturation test	RCT	Original sample COPD subgroup: DiD OR=1.02 (95% CI, 0.77 to 1.34)[75]
	RCT	Refresh sample COPD subgroup: DiD OR=0.97 (95% CI, 0.77 to 1.22)[75]
HbA1c test	RCT	Original sample diabetes subgroup: DiD OR=0.91 (95% CI, 0.74 to 1.13)[75]
	RCT	Refresh sample diabetes subgroup: DiD OR=0.98 (95% CI, 0.82 to 1.18)[75]
LDL-C test	RCT	Original sample diabetes subgroup: DiD OR=0.92 (95% CI, 0.75 to 1.12)[75]
	RCT	Refresh sample diabetes subgroup: DiD OR=0.97 (95% CI, 0.77 to 1.22)[75]
	RCT	Original sample IVD subgroup: DiD OR=0.89 (95% CI, 0.76 to 1.05)[75]
	RCT	Refresh sample IVD subgroup: DiD OR=0.95 (95% CI, 0.81 to 1.11)[75]

CI = confidence interval; COPD = chronic obstructive pulmonary disease; DiD = difference-in-difference; HbA1C = hemoglobin A1c; IVD = ischemic vascular disease; LDL-C = low-density lipoprotein-cholesterol; OR = odds ratio; RCT = randomized controlled trial.

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